CHARLOTTE
PIPE AND FOUNDRY COMPANY

You can't beat the system.®

ChemDrain®

TECHNICAL AND INSTALLATION MANUAL

CPVC Chemical Waste Drain System

(Updated January 4, 2023)

TECHNICAL MANUAL

TM-CD

INTRODUCTION

Monroe, North Carolina

Charlotte Pipe and Foundry is a privately held company committed to providing the highest quality products and service to the plumbing industry. We offer a full line of pipe and fittings in a wide range of materials. Our ChemDrain® Chemical Waste Drain System uses CPVC pipe and fittings specifically designed for management of chemical waste. The ChemDrain® System is designed and manufactured to provide easier installation, fewer callbacks and virtually trouble-free service for as long as the system is in use.

Muncy, Pennsylvania

Charlotte Pipe and Foundry's investment in state-of-the-art production equipment and outstanding customer service have created an excellent source of supply for our customers. We are constantly focusing on process improvement to find better ways to further enhance customer service. We've invested millions in increasing manufacturing efficiency, productivity and capacity. Because we manufacture for inventory, we are able to ship orders complete and in a timely manner.

Cameron, Texas

Huntsville, Alabama

Cedar City, Utah

Wildwood, Florida

CHARLOTTE
PIPE AND FOUNDRY COMPANY®

Manufacturing Facilities

- Monroe, North Carolina
- Muncy, Pennsylvania
- Cameron, Texas
- Wildwood, Florida
- Huntsville, Alabama
- Cedar City, Utah

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MEMBER IAPD INTERNATIONAL ASSOCIATION OF PLASTICS DISTRIBUTORS

NSF®

MEMBER OF ASTM

Understanding Safety Alert Messages

It is important to read and understand this manual. It contains information to help protect your safety and prevent problems.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid personal injury or death.

WARNING

"**WARNING**" Indicates a hazardous situation which, if not avoided, could result in severe injury or death.

CAUTION

"**CAUTION**" Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE

"**NOTICE**" Indicates a hazardous situation which, if not avoided, may result in system failure and property damage.

READ & SAVE THESE INSTRUCTIONS

Major Advantages of CPVC

Charlotte Pipe's ChemDrain® CPVC chemical waste system, manufactured with CPVC, provides a durable and economical disposal solution for many chemical waste applications. For more than 50 years, CPVC has been used in a variety of chemical processing applications. Now, Charlotte Pipe is offering ChemDrain CPVC pipe and fittings specifically engineered for laboratory chemical waste disposal systems.

Commercial and academic laboratories generate liquid waste that must be treated or neutralized before reaching the sewer system. One of the major benefits of CPVC is its resistance to a broad range of acids and corrosive chemicals. This range makes it an ideal system for labs, which use an unusually wide variety of chemicals. Additionally, a chemical waste drainage system must be able to handle the routine disposal of both hot and cold chemicals.

CPVC is an attractive alternative to glass, stainless steel, lined steel, high silicon cast iron, PP (polypropylene) and PVDF (polyvinylidene fluoride) for chemical waste and an excellent choice for long-term value.

Chemical waste piping systems must be designed to convey the mixtures of corrosive liquids generated by commercial and institutional laboratories to a point where it is either sufficiently diluted or neutralized before being discharged into the sanitary sewer system. CPVC is particularly well-suited to the task because it exhibits excellent chemical resistance to a broad range of chemicals including strong and dilute acids, bases, caustics, salts, aliphatic solutions and other common reagents. In addition, ChemDrain CPVC can convey liquids in gravity drainage applications at temperatures up to 220° F.

CPVC also overcomes many common problems that have been inherent in chemical waste piping systems up until now. Glass and high silicon iron systems are cumbersome, fragile, and have a high initial cost. Polypropylene lacks the ability to withstand the elevated temperatures that are common in some systems and isn't as good as CPVC in some highly concentrated acids. PVDF is excellent in strong acids but not recommended for many common alkaline solutions. And both polypropylene and PVDF are usually installed using time-consuming, complicated and at times unreliable fusion joining methods. It's easy to make consistent reliable joints in the ChemDrain system using simple hand tools, a specially formulated one-step solvent cement and easily trained labor. Bottom line, the ChemDrain CPVC system is often the best single choice for chemical waste drainage.

The ChemDrain CPVC pipe and fitting system is much easier to join than the mechanical or heat fusion PP or PVDF systems. CPVC pipe is lightweight, approximately one-sixth the weight of iron and requires no special tools for cutting. Each piece is manufactured by Charlotte Pipe to exacting standards to avoid time-consuming trouble or delays during installation. And there's no expensive heat fusion equipment to buy or rent.

⚠ 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.

CPVC is joined by solvent cement – the most commonly used technique for thermoplastic pipe and fittings in the chemical processing industry – which results in a permanent weld. Solvent cementing has been employed for decades to join thermoplastic pipe and fitting systems for a variety of applications including corrosive fluids at elevated temperatures.

ChemDrain one-step solvent cement is designed to create a intermolecular bond between pipe and fitting surfaces. Once properly applied and cured, the joint is permanent. Melted joints, corrosion of exposed internal heating wires and burn-through, all problems in the joining systems of heat-fused plastic products, are not possible with CPVC.

Our ChemDrain CPVC Solvent Cement has been specially formulated for chemical resistance to caustics including hypochlorites, mineral acids and other corrosive chemicals. Charlotte Pipe manufactures both ChemDrain pipe and fittings to our exacting tolerances, meaning everything is designed to fit together properly.

Benefits of CPVC Include:

Cost Effective

- CPVC is easy to install, reliable and durable, lowering your total costs of ownership over the life of the system. CPVC piping is extremely lightweight, convenient to handle and competitively priced against alternative materials. When properly installed and used, its durability and resistance to chemical corrosion make it a long-term, cost-effective option.

Easy Installation

- CPVC pipe is lightweight, approximately one-half the weight of aluminum and one-sixth the weight of steel, and requires no special tools for cutting. Each piece is manufactured by Charlotte Pipe to exacting standards to avoid time-consuming trouble or delays during installation. Also, CPVC has smooth, seamless walls and can be installed with fast and reliable solvent welded joints.

⚠ 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.

⚠ 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.

Corrosion Resistance

- CPVC is inert to most acids, bases, salts and a variety of organic media, within certain limits of concentration and temperature. A chemical waste management system of CPVC piping provides the chemical resistance for a wide variety of dedicated and mixed chemical applications when properly diluted by flushing with water. CPVC also eliminates the disadvantages found in alternative piping materials, such as borosilicate glass, high-silicon cast iron or double-containment piping, which can be heavy, fragile and expensive to purchase, install and maintain.

Recommended Product Application

A ChemDrain® CPVC chemical waste management system offers a wide-ranging solution to the dilution and disposal needs of institutional and academic laboratories. When properly designed, installed and utilized, the system will deliver years of reliable, problem-free service.

Best Uses of CPVC

One of the key advantages of a ChemDrain CPVC system is its resistance to a broad range of acidic and caustic chemicals. The inherent wide-ranging chemical resistance has led to the Charlotte ChemDrain system being tested and certified for chemical waste drainage by NSF International and bears the mark NSF-cw.

CPVC compares favorably to other commonly used non-metallic chemical waste piping materials and has a "recommended" rating for widely-used concentrations of many corrosive chemicals and common laboratory reagents. Please refer to the comprehensive chemical resistance chart on pages 17 through 23 for information on both CPVC as well as the fluoroelastomer which is used in ChemDrain Transition fittings as well as important notes concerning the use of CPVC in chemical waste applications.

NOTICE

The Chemical Resistance data located in this manual is for CPVC in a typical laboratory drainage environment. To reduce the risk of system failure, always evaluate the chemical resistance information and project specific factors.

- Laboratory Drainage is defined as: The routine non-continuous disposal of a wide variety of hot and cold chemicals in relatively small quantities in a gravity drainage system accompanied by water sufficient for the purpose of dilution and flushing.
- Refer to the Plastics Technical and Installation Manual available at www.charlottepipe.com for chemical resistance information for industrial or continuous chemical drainage applications.
- Chemical resistance of plastics is dependent on concentration, possible interactions with other chemicals, temperature, stress and other factors.

Product Certification

ChemDrain® CPVC chemical waste system is a complete system of pipe, fittings, solvent cement and accessories. Charlotte Pipe and Foundry CPVC pipe and fittings are listed for chemical waste systems by NSF International and bear the mark NSF-cw. For additional information log on to www.nsf.org.

Physical Properties of CPVC Material

PROPERTY	CPVC 4120	UNITS	STANDARD
Mechanical Properties			
Specific Gravity	1.55		ASTM D 792
Tensile Strength (73°F)	7,000	psi	ASTM D 638
Modulus of Elasticity in Tension (73°F)	360,000	psi	ASTM D 638
Flexural Strength (73°F)	15,100	psi	ASTM D 790
Izod Impact Cell Class 23447 (notched at 73°F) Min.	1.5 Fittings	ft lb/ in.	ASTM D 256
Hardness (Durometer D)	–		ASTM D 2240
Hardness (Rockwell R)	119		ASTM D 785
Compressive Strength (73°F)	10,100	psi	ASTM D 695
Hydrostatic Design Stress	2,000	psi	
Thermal Properties			
Heat Distortion Temperature at 264 psi Minimum	212°F (Cell Class 23447)	degrees F	ASTM D 648
Coefficient of Thermal Conductivity	.95	BTU/ hr/sq ft/ °F/ in.	ASTM C 177
Coefficient of Linear Expansion	3.4×10^{-5}	in./ in./ °F	ASTM D 696
Specific Heat	0.34	BTU/lb°F	ASTM D 2766
Water Absorption (24 hrs at 73°F)	.03	% weight gain	ASTM D 570
Cell Classification	23447-Pipe and Fittings		ASTM D 1784
Flammability			
Limiting Oxygen Index	60%		ASTM D2883
Burning Rate	Self Extinguishing		ASTM D 635
Burning Class	V-0		UL 94
Flame & Smoke Rating[1]			
	Flame Spread	0	CAN/ULC S 102.2
	Smoke Developed[2]	8-22	
Solvent Cement	Heavy Body,		ASTM F 493
	Mustard Yellow Color		

Above data is based upon information provided by the raw material manufacturers. It should be used only as a recommendation and not as a guarantee of performance.

[1] Based on test of physical product, as opposed to test of material only. Test was conducted on 1½″ - 6″ pipe.

[2] Results vary based on pipe diameter.

SUBMITTAL FOR CHARLOTTE PIPE® CHEMDRAIN® CPVC CHEMICAL WASTE SCHEDULE 40 PIPE AND FITTINGS

Date: ________________

Job Name: ______________________________ Location: ______________________________

Engineer: ______________________________ Contractor: ______________________________

Scope:
This specification covers CPVC Schedule 40 pipe and fittings for chemical waste drain applications. ChemDrain is intended for use in non-pressure drain applications where the temperature will not exceed 220°F.

Specification:
Pipe and fittings shall be manufactured as a system, be the product of one manufacturer and be manufactured in the United States. All pipe, fittings, and solvent cement shall be supplied together as a system, as Charlotte Pipe ChemDrain chemical waste system manufactured by Charlotte Pipe and Foundry. Pipe and fittings shall conform to the National Sanitation Foundation Standard (NSF) 14.

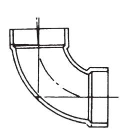
Special drainage systems for corrosive chemical or acid waste shall be manufactured by CPVC Type IV, Grade I, ASTM Cell Class 23447. All system components shall be certified by NSF International for use in chemical waste drainage systems and bear the mark NSF-cw. All system piping shall be Schedule 40 CPVC produced to the dimensional requirements of ASTM F 2618 and the manufacturer's specifications. All pipe and fittings shall be CPVC drainage patterns meeting the requirements of ASTM F 2618 and the manufacturer's specifications, as applicable.

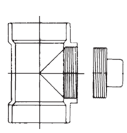
Installation:
Installation shall comply with the latest installation instructions published by Charlotte Pipe and Foundry and shall conform to all applicable plumbing, fire, and building code requirements. Buried pipe shall be installed in accordance with ASTM D 2321 and ASTM F 1668. Solvent welded joints shall be made with ChemDrain One-Step solvent cement conforming to ASTM F 493. The system shall be protected from items that are not compatible with CPVC compounds; materials like thread sealants, plasticized vinyl products, fire stopping devices, or other aggressive chemical agents. System shall be hydrostatically tested after installation. **WARNING!** Use of compressed air or gas in CPVC pipe or fittings can result in explosive failures and cause severe injury or death.

Referenced Standards:

ASTM C 1460	Standard Specification for Shielded Transition Couplings for use with Dissimilar DWV Pipe and Fittings Above Ground
ASTM D 1784	Rigid CPVC Vinyl Compounds
ASTM D 2321	Underground Installation of Thermoplastic Pipe (non-pressure applications)
ASTM F 493	Solvent Cements for CPVC Pipe and Fittings
ASTM F 1668	Procedures for Buried Plastic Pipe
ASTM F 2618	Standard for Chlorinated Poly (Vinyl Chloride) Chemical Waste Drainage Systems
NSF Standard 14	Plastic Piping Components and Related Materials

MADE IN USA


Quarter Bend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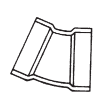
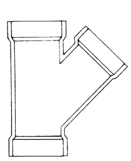

Sixteenth Bend


Transitional Coupling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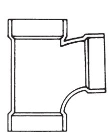
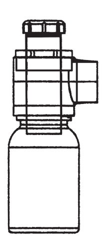

Sanitary Tee


Jar Trap with Tail Piece Adapter

One-Step CPVC Solvent Cement

Not all patterns shown

ChemDrain® CPVC Pipe

ChemDrain® CPVC Schedule 40 Pipe
Type IV, Grade 1

NSF

ASTM F 2618

CPVC SCHEDULE 40 (LIGHT GRAY)			PLAIN END		CPVC 4120	
PART NO.	NOM. SIZE	UPC # 611942-	QTY. PER SKID	AVG. OD (IN.)	MIN. WALL (IN.)	WT. PER 100 FT. (LBS.)
AW 14015	1½″ x 10′	10732	1650′	1.900	.145	55.3
AW 14002	2″ x 10′	10733	1110′	2.375	.154	74.3
AW 14003	3″ x 10′	10734	1130′	3.500	.216	154.2
AW 14004	4″ x 10′	10735	670′	4.500	.237	219.6
AW 14006	6″ x 10′	10736	330′	6.625	.280	386.1
AW 14008	8″ x 10′	11363	140′	8.625	.322	581.1

Charlotte Pipe and Foundry Company • P.O. Box 35430 Charlotte, NC 28235 • (800) 438-6091 • www.charlottepipe.com

Handling and Storage of CPVC Pipe

Receiving Pipe

When receiving CPVC pipe, thoroughly inspect pipe before unloading. For pipe transported on an open truck bed, examine for shipping damage from over-tightened tie-down straps, improper treatment or a shift in load. If pipe is delivered in a closed trailer, the inspection should happen when the trailer is first opened. Make sure the pipe has not been damaged by a load shift, rough handling or having other materials stacked on top of it.

To inspect CPVC pipe:

- Examine visually for cracks, splits, gouges or other forms of damage.
- Check for severe deformation of pipe as this may cause joining problems during assembly.
- Inspect interior for internal splits or cracks in all pipes measuring 4 inches in diameter or more. A flashlight may be necessary to perform this part of the inspection satisfactorily.

If damage is found, all parties involved, including the driver, must be made aware of the damage. Also note damage on the bill of lading and/or delivery ticket. Notify Charlotte Pipe and the carrier within 24 hours of any damage, as well as delivery errors or shortages.

Handling Pipe

CPVC piping is incredibly sturdy. As a result, workers sometimes have a tendency to treat it as if it is indestructible. However, reasonable care should be used during handling to reduce the risk of damaging the pipe. Refrain from unnecessary abuse when unloading, storing and handling. Do not drop pipe from trucks, drag pipe over the ground or step on pipes. When unloading, do not drag or push pipe from truck bed. Remove and handle pallets of pipe with a forklift.

NOTE: Avoid contact with sharp objects such as rocks, angle irons or the forks of a forklift. Pipe should never be lifted or moved by inserting forks of a forklift into the pipe ends.

NOTE: In addition to following these guidelines, extra care should be used when handling CPVC pipes measuring 4 inches in diameter or more. Because of the additional pipe weight, even a minor impact can cause cracking. Plastic pipe also becomes more brittle as the temperature decreases. Use extra precautions when handling pipe at temperatures of 50°F and lower.

Storing Pipe

Store CPVC pipe in a heated, ventilated area, preferably indoors. If CPVC pipe is stored outdoors for long periods, cover it with a non-transparent material to avoid UV exposure. When storing outside, place pipe on level ground that is dry and free of sharp objects. CPVC pipe with the thickest walls should be placed on the bottom of the pile if different schedules of pipes are stacked together.

Pipe that is in pallets should be stacked with the pallet boards touching. Pallet boards should not be placed directly on CPVC pipe, as they can damage the pipe or cause it to bow. If pipe is stored in racks, the pipe should be supported continuously along its length. If this is not possible, the spacing supports should be determined based on the pipe diameter. In general, supports and spacing that would provide for no more than 1/2″ in deflection of the pipe should be acceptable.

WEATHERING

UV Exposure

Ultraviolet (UV) radiation from sunlight can cause surface discoloration in CPVC pipe. The reaction occurs when energy from the sun excites the molecular bonds in the plastic, but affects only the exposed surface of the pipe to a shallow depth of 0.001 to 0.003 inches. The reaction ends when exposure to sunlight ends.

Placing an opaque shield between the sun and the pipe prevents UV degradation. CPVC pipe should be covered with an opaque material when stored outdoors for long periods of time. Burying CPVC pipe provides protection against UV attack.

Painting pipe with latex (water-based) paint also will help protect CPVC pipe installed above ground. However, proper surface preparation is crucial for painted pipe. First, clean the CPVC pipe to remove moisture, dirt and oil, and then wipe dry with a clean cloth. **NOTICE:** Do not use petroleum-based paints as the petroleum will prevent the paint from properly bonding to the pipe.

Cold Weather Considerations

CPVC is a ductile material that expands and contracts more than metallic plumbing pipe does. However, like all plumbing materials, CPVC must be protected from freezing with proper insulation in accordance with all plumbing codes.

⚠ WARNING

Like other piping materials, CPVC may split when liquids freeze in it, causing potential system failure and severe personal injury.

If a CPVC line should freeze, it is crucial to thaw the line if possible. If the frozen section of pipe is accessible, blow heated air directly onto the pipe using a low wattage heater/blower. When thawing a frozen CPVC line, the heat source should not exceed 180°F. Electrical heat tapes also can be applied to the area.

Also, eliminate the source of cold air that caused the pipe to freeze. Until this can be done, drain the system if overnight temperatures are likely to drop below 32°F.

Charlotte Pipe's ChemDrain® System offers a complete solution for creating a state-of-the-art CPVC chemical waste drain system that can deliver years of reliable, trouble-free service. From proper installation techniques to chemical resistance to fluid flow calculations, the pages that follow lay out everything needed to design and install a ChemDrain system for optimum performance.

Charlotte Pipe urges users to carefully study this information and to follow it precisely. ChemDrain has been created as a total system, and all warranties and guarantees depend on designing and implementing the system as recommended.

Fluid Flow Properties

Gravity Flow

CPVC is an extremely smooth material. Its low surface friction properties make CPVC as smooth as glass, but without its disadvantages (weight, high breakability). To determine the fluid velocity, pipe size and hydraulic slopes for a gravity drain, it is best to use the Manning's equation shown below. In the equation:

V = Velocity of flow in feet/second

N = Manning's value (see "Manning Roughness Factor", below)

R = The hydraulic radius, in feet. This is obtained by dividing the cross-sectional area of flow by the wetted perimeter of the pipe in contact with the flow. (R is a special case for V with pipes that are either 1/2 full or full; in those cases, R = inside diameter / 4, in feet)

$$S = \frac{\text{Upstream elevation} - \text{Downstream elevation}}{\text{pipe length}} \text{ (ft./ft.)}$$

$$V = \frac{1.486}{N} R^{2/3} S^{1/2}$$

Example 1:

Calculate the gravity flow for a 2″-diameter, Schedule 40 CPVC pipe, flowing full over a 30-foot pipe run with a 7.5-inch drop.

$$S = \frac{17.5''-10.0'' / 12''}{30 \text{ ft.}} = 0.0208 \text{ ft./ft.}$$

$$R = \frac{2.067'' / 12''}{4} = 0.043 \text{ ft.}$$

$$V = \frac{1.486}{N} R^{2/3} S^{1/2}$$

Manning's "N" value can range from 0.008 to 0.012. However, for gravity sewer systems, we generally use 0.009.

$$V = \frac{1.486}{0.009} (0.043)^{2/3} (0.0208)^{1/2}$$

V = 2.9 ft./second

Example 2:

Calculate the gravity flow for a 4″-diameter Schedule 40 CPVC pipe, flowing half full over a 10-foot pipe run with a 1.5-inch drop.

$$S = \frac{20''-18.5'' / 12''}{10 \text{ ft.}} = 0.0125 \text{ ft./ft.}$$

$$R = \frac{4.026'' / 12''}{4} = 0.0839 \text{ ft.}$$

Assume "N" to be 0.010. Then:

$$V = \frac{1.486}{0.010} (0.0839)^{2/3} (0.0125)^{1/2}$$

V = 3.2 ft./second

Charlotte Pipe generally recommends a flow velocity of at least 2.0 feet per second for self-cleaning drain lines. In both examples shown, the design being evaluated exceeds this recommendation.

Manning Roughness Factor ("N" Value)

The Manning "N" value is a commonly used flow coefficient. This coefficient expresses the "smoothness" of the interior walls of various types of piping material. The Manning value is used when making calculations for liquids with a steady flow, at a constant depth, in a prismatic open channel.

The "N" value for CPVC pipe ranges from 0.008 to 0.012, making it comparable in smoothness to glass, polypropylene and PVDF and somewhat smoother on average than competitive high-silicon iron systems.

Fluid Flow Rate

Use the following calculation to determine the volumetric flow rate. In the equation:

Q = aV
V = Flow velocity in feet/second
a = A cross-sectional area of flow in feet squared ($ft.^2$)
Q = Volume flow rate in cubic feet ($ft.^3$) per second

Example 1 (Same scenario as Gravity Flow Example 1 on previous page):

$$a = \frac{\pi Di^2}{4} = \frac{\pi (2.067/12)^2}{4} = 0.0233\ ft^2$$

$$V = 2.9\ ft/sec$$

$$Q = 0.0233 \times 2.9 = 0.0676\ ft^3/sec$$

$$Q = \frac{0.0676\ ft^3}{sec} \times \frac{7.48\ gal}{ft^3} \times \frac{60\ sec}{min} = \frac{30.3\ gals}{min}$$

Example 2 (Same scenario as Gravity Flow Example 2 on previous page):

$$a = 1/2 \left(\frac{\pi Di^2}{4} \right) = \frac{\pi (4.026/12)^2}{2 \times 4} = 0.0442\ ft^2$$

$$V = 3.2\ ft/sec$$

$$Q = 0.0442 \times 3.2 = 0.141\ ft^3/sec$$

$$Q = \frac{0.141\ ft^3}{sec} \times \frac{7.48\ gal}{ft^3} \times \frac{60\ sec}{min} = \frac{63.5\ gals}{min}$$

Expansion and Contraction of CPVC

As the temperature varies, CPVC pipe lengths expand and contract. Typically, CPVC expands five times as much as steel or iron pipe. When designing a plumbing system to compensate for thermal expansion and contraction, installation temperature versus the maximum working temperature must be considered. Thermal variations in CPVC lengths depend on three factors:

- The coefficient of linear expansion;
- The length of pipe between directional changes; and
- The temperature differential.

NOTICE

Failure to compensate for expansion and contraction caused by temperature change may result in system failure and property damage.

- Do not restrict expansion or contraction. Restraining movement in piping systems is not recommended and may result in joint or fitting failure.
- Use straps or clamps that allow for piping system movement.
- Align all piping system components properly without strain. Do not bend or pull pipe into position after being solvent welded.
- Do not terminate a pipe run against a stationary object (example: wall or floor joist).
- Do not install fittings under stress.

The coefficient of linear expansion (Y) is expressed in inches of expansion for every 10° F change in temperature over 100 feet of pipe. For CPVC, the value of Y is 0.408.

The amount of expansion or contraction can be calculated using the following formula:

$$\Delta L = \frac{Y\ (T1\text{-}T2)}{10} \times \frac{L}{100}$$

Where:

ΔL = The dimensional change due to thermal expansion or contraction in inches.
Y = The expansion coefficient for CPVC (0.408)
T1-T2 = The difference between the temperature at the time of installation and the maximum or minimum system temperature, (choose the one that provides the greatest differential), in °F.
L = The length of pipe run between changes in direction, in feet.

Example:

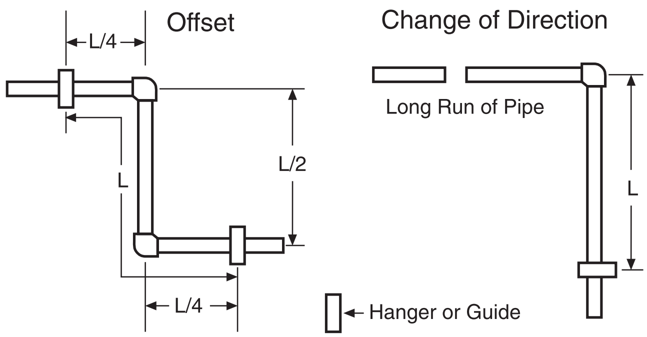
How much expansion can be expected in a 60-foot straight run of ChemDrain® CPVC pipe installed at 70° F and operating at 140°F?

Solution:

$$\Delta L = 0.408\ \frac{(140-70)}{10} \times \frac{60}{100} = 0.408 \times 7 \times 0.6 = 1.71\ in.$$

Temperature °F	(°C)	Correction FactorA	Allowable Stress (S) (psi)	Correction Factor	Modulus of Elasticity (psi)
73	(23)	1	2000	1	423,000
80	(27)	0.96	1920	0.98	415,000
90	(32)	0.91	1820	0.94	398,000
100	(38)	0.82	1640	0.91	385,000
110	(43)	0.74	1480	0.87	368,000
120	(49)	0.65	1300	0.84	355,000
130	(54)	0.57	1140	0.81	343,000
140	(60)	0.5	1000	0.78	330,000
150	(67)	0.45	900	0.74	313,000
160	(71)	0.4	800	0.71	300,000
170	(77)	0.32	640	0.67	283,000
180	(82)	0.25	500	0.64	271,000
190	(88)	0.22	440	0.61	258,000
200	(94)	0.2	400	0.57	241,000
210			347		228,000
220			297		214,000

For vertical stacks in above-grade applications, compensation for thermal expansion is recommended. This can be accomplished by installing a horizontal offset in the piping system at every other floor. For example, in a three-story installation, an offset in the piping system at the second floor would be recommended. Compensation for thermal expansion is not required for the vent system.



In underground applications, it is easy to compensate for expansion and contraction by snaking the pipe in the trench. Solvent-welded joints must be used. See the "Underground Installation" section for more details.

NOTICE: Due to exothermic reactions which can be caused by the mixing of chemicals, temperatures within the system may become elevated. It is important to consider this when designing for expansion and contraction.

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.

Support Spacing for CPVC Pipe

Any piping system requires adequate support, and this is particularly true of flexible piping material such as CPVC. The size of the pipe, the location of heavy fittings and the mechanical properties of the piping material all influence the amount of support needed and the types of hangers that will work best.

⚠ 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.

The design of a CPVC piping system should follow the same general principles used to design steel piping systems. However, there are several notable exceptions:

1. With CPVC, give direct support to concentrated loads such as flanges to eliminate high-stress concentrations. If direct support is impossible, support the pipe as close to the load as possible.
2. If large temperature fluctuations are possible, allow for expansion and contraction in the length of the pipe in the design. In most cases, changes in pipe direction will provide sufficient leeway. However, hangers must not be allowed to restrict this movement.
3. Where changes in direction occur, provide support as close as possible to the fitting. This will prevent excessive stresses that can twist or wrench the system (torsional stresses).
4. Since CPVC pipe expands approximately 5 times more than steel, select and install hangers to allow for this movement. When using a clamp-type hanger, for example, do not allow the hanger to force the pipe and fittings into position.
5. Hangers should provide as much load-bearing surface as possible. To prevent damage to the pipe, file any sharp edges or burrs on hangers or supports before installation.
6. Do not place CPVC lines alongside steam or other high-temperature pipe lines or objects.

NOTICE: The above information provides general guidelines. It should be used only as a reference and not as a guarantee or performance. Specific installation instructions and techniques may be required as a result of local plumbing and building codes, engineering specifications and instructions.

Most plumbing and building codes require horizontal piping to be supported based on the diameter of the piping material. Always install support spacing in accordance with applicable plumbing and building codes.

Properly support vertical CPVC piping for the vertical load involved. The design should include a mid-story guide, unless thermal expansion requirements dictate a different approach. Do not tightly anchor pipe to the supports; instead, secure it to allow for natural thermal-induced movement.

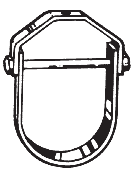
The following chart shows the recommended support spacing for ChemDrain® CPVC pipe. This spacing recommendation applies to continuous spans of un-insulated lines with no concentrated loads when carrying liquids with a specific gravity of 1.00 or less.

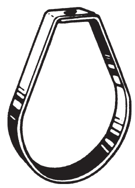
Recommended Support Guidelines (in feet)

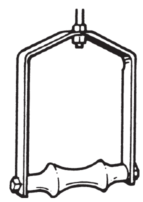
Pipe Diameter (in.)	Temperature °F					
	60	80	100	120	140	180
1½	6½	6½	6½	5½	5	3
2	6½	6	6	5½	5	3
3	8	7	7	7	6	3½
4	8½	7½	7½	7	6½	4
6	9½	8½	8	7½	7	4½
8	9½	8½	8	7½	7	5

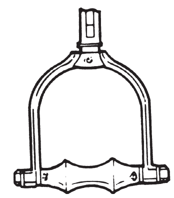
NOTE: Always follow local code requirements for horizontal hanger spacing. Most plumbing codes require that CPVC pipe have a maximum horizontal hanger spacing of not more than four feet for pipe sizes 1½ inch and larger.

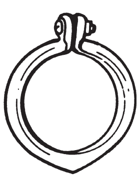
Pipe Hangers, Clamps and Supports

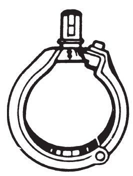

Clevis Hanger
½ to 30 in. pipe

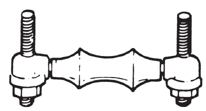

Band Hanger
½ to 8 in. pipe

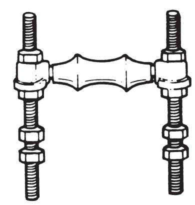

Roller Hanger
2½ to 20 in. pipe

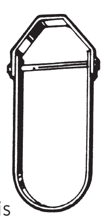

Adj. Swivel Roller Hanger
2½ to 12 in. pipe

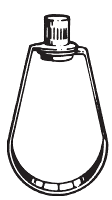

Split Ring Hanger
⅜ to 8 in. pipe

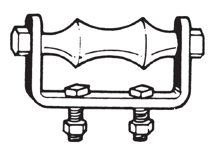

Split Ring Hanger
Adj. Swivel Ring
¾ to 8 in. pipe

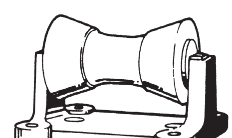

Single Pipe Roll
1 to 30 in. pipe


Adj. Pipe Roll Support
1 to 30 in. pipe

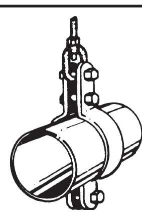

Adj. Clevis
For Insulated Lines
¾ to 12 in. pipe

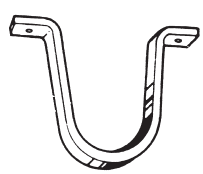

Adj. Swivel Ring
½ to 8 in. pipe

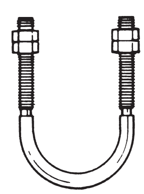

Roller Chair
2 to 12 in. pipe


Pipe Roll Stand
2 to 42 in. pipe


Pipe Clamp
½ to 24 in. pipe


Double Bolt Pipe Clamp
¾ to 36 in. pipe


Anchor Strap
½ to 4 in. pipe


U Bolt
½ to 30 in. pipe

Chemical Resistance

CPVC is resistant to most acids, bases, salts and a wide variety of organic compounds; see list of specific chemicals starting on page 17. Charlotte ChemDrain® CPVC is very well suited to use in commercial, institutional and academic laboratory drainage. This chemical resistance data is for CPVC in a typical laboratory drainage environment. Laboratory drainage is defined as:

The routine disposal of a wide variety of hot (up to 220°F) and cold chemicals in relatively small quantities in a gravity drainage system accompanied by water sufficient for the purpose of dilution and flushing.

NOTICE

The Chemical Resistance data located in this manual is for CPVC in a typical laboratory drainage environment. To reduce the risk of system failure, always evaluate the chemical resistance information and project specific factors.

- Laboratory Drainage is defined as: The routine non-continuous disposal of a wide variety of hot and cold chemicals in relatively small quantities in a gravity drainage system accompanied by water sufficient for the purpose of dilution and flushing.
- Refer to the Plastics Technical and Installation Manual available at www.charlottepipe.com for chemical resistance information for industrial or continuous chemical drainage applications.
- Chemical resistance of plastics is dependent on concentration, possible interactions with other chemicals, temperature, stress and other factors.

CPVC can be used for industrial (continuous chemical) drainage, but for those applications the chemical resistance charts in the Charlotte® Plastics Technical Manual must be used. Contact Charlotte Technical Services for more information or assistance at www.charlottepipe.com. Chemical resistance data contained in those manuals is provided for initial compatibility evaluation purposes only. Due to the many variables involved and possible interaction and mixing of chemicals within systems, Charlotte recommends that users test under actual service conditions to determine final suitability for a particular purpose. This chemical resistance chart does not represent a warranty for the performance of CPVC piping systems in any specific application.

⚠ WARNING

- Failure to follow proper installation practices, procedures, or techniques may result in system failure, personal injury and property damage.
- ChemDrain is not recommended for DWV applications.

Important Note:

- Some chemicals that do not normally adversely effect CPVC can cause environmental stress cracking when a piping system is exposed to excessive stress. Types of external stresses include expansion/contraction, improper support or installation. Tests show that samples under external stress may exhibit cracking when exposed to strong surfactants and certain oils and/or animal or vegetable fats. Special consideration should be taken during design and installation to avoid unusual stress in the piping system. CPVC Chemical Waste systems are not listed nor recommended for sanitary DWV applications.

HVAC or DWV Applications

Exercise caution when using ChemDrain pipe or fittings for HVAC or refrigerant-condensate lines. Some refrigerant systems contain oils that may damage CPVC products. In HVAC applications, some heat exchangers or condenser coils may contain residual oils from the manufacturing process which can cause cracking of CPVC. Caution should be exercised when installing CPVC in combination hot/air handling units or as condensate-drain lines from air conditioning systems. Confirm the compatibility of CPVC with residual oils prior to installation. The interior of heat exchangers or the exterior of condenser coils may be thoroughly cleaned with a detergent solution to remove incompatible oils prior to piping installation. A rinse with clean water to completely clean the system is advisable as a final flushing. Charlotte Pipe and Foundry will not accept responsibility for failure resulting from exposure to compressor oils in HVAC or refrigerant condensate lines.

NOTICE

Prior to installation, check with the manufacturer of the HVAC equipment to confirm the compatibility of residual oils and refrigerants with ABS, CPVC, or PVC.

Prior to installing CPVC or PVC piping in hydronic applications, it is important to flush the interior of the heat exchangers and the exterior of the evaporator coils thoroughly with a mild ionic detergent solution to remove incompatible oils. Failing to do so could result in system failure and property damage.

Verify that all boiler cleaning and sealing chemicals used in hydronic radiant heating systems are compatible with CPVC or PVC. Failure to do so could result in system failure and property damage.

Equipment leaks in refrigeration or HVAC systems may release POE oils or other contaminants into the piping system. These oils and contaminants are incompatible with CPVC or PVC and such exposure may result in pipe or fitting failure regardless of flushing.

ChemDrain CPVC is not recommended for sanitary DWV applications for the following reasons:

- ChemDrain is manufactured to ASTM F 2618 and this standard does not address sanitary waste applications. ChemDrain is a special drainage system for corrosive or acid waste applications.
- ChemDrain may experience environmental stress cracking if continuously exposed to animal or vegetable fats, oils and greases (FOG's) which would be common in a commercial kitchen DWV application.

Chemical Resistance

⚠ CAUTION

The chemical resistance table shown within this manual is for CPVC in a typical laboratory drainage environment. To reduce the risk of system failure, always evaluate the chemical resistance information and project specific factors.

The following table lists the chemical resistance suitability of CPVC ChemDrain thermoplastic piping materials and Fluoroelastomer (FKM), a commonly used seal material. The information shown is based upon laboratory tests conducted by the manufacturers of the materials, and it is intended to provide a general guideline on the resistance of these materials to various chemicals. **NOTICE:** This information is not a guarantee, and any piping systems using products made of these materials should be tested under actual service conditions to determine their suitability for a particular purpose. See website for most current data: www.charlottepipe.com.

C = Consult Charlotte Pipe　NR = Not Recommended
R = Recommended　• • = No Data

	ChemDrain® CPVC in Laboratory Drainage Service	Fluoroelastomer (FKM) Transition Couplings (AW 95C, AW 96C)
Acetaldehyde, pure	**NR**	NR
Acetic Acid	**R**	R
Acetic Anhydride	**R**	NR
Acetone, <20%	**R**	R
Acetone, pure	**NR**	NR
Acetonitrile, pure	**R**	NR
Acetyl Chloride	**R**	R
Acetophenone	**NR**	NR
Acrylic Acid, pure	**R**	NR
Acrylonitrile, pure	**R**	NR
Adipic Acid	**R**	R
Alcohol, Allyl, pure	**R**	NR
Alcohol, Amyl, up to 1%	**R**	R
Alcohol, Amyl, >1%	**NR**	R
Alcohol, Benzyl	**R**	R
Alcohol, Butyl (Butanol)	**R**	R
Alcohol, Diacetone	**R**	NR
Alcohol, Ethyl (Ethanol)	**R**	R
Alcohol, Hexyl (Haxanol)	**R**	R
Alcohol, Isopropyl (Isopropanol)	**R**	R
Alcohol, Methyl (Methanol)	**R**	NR
Alcohol, Octyl (1-n-Octanol)	**R**	R
Alcohol, Propyl (Propanol)	**R**	R
Allyl Alcohol, pure	**R**	NR
Allyl Chloride	**NR**	R
Alum	**R**	R
Aluminum Acetate	**R**	NR
Aluminum Chloride	**R**	R
Aluminum Fluoride	**R**	R
Aluminum Hydroxide	**R**	R
Aluminum Nitrate	**R**	R
Aluminum Sulfate	**R**	R
Amines	**C**	NR
Ammonia	**R**	NR
Ammonium Acetate	**R**	NR

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	ChemDrain® CPVC in Laboratory Drainage Service	Fluoroelastomer (FKM) Transition Couplings (AW 95C, AW 96C)
Ammonium Benzoate	**R**	• •
Ammonium Bifluoride	**R**	R
Ammonium Carbonate	**R**	R
Ammonium Chloride	**R**	R
Ammonium Citrate	**R**	• •
Ammonium Dichromate	**R**	• •
Ammonium Fluoride	**R**	R
Ammonium Hydroxide	**R**	NR
Ammonium Metaphosphate	**R**	• •
Ammonium Nitrate	**R**	R
Ammonium Persulfate	**R**	R
Ammonium Phosphate	**R**	R
Ammonium Sulfamate	**R**	NR
Ammonium Sulfate	**R**	R
Ammonium Sulfide	**R**	R
Ammonium Thiocyanate	**R**	R
Ammonium Tartrate	**R**	• •
Amyl Acetate	**NR**	NR
Amyl Alcohol, up to 1%	**R**	R
Amyl Alcohol, >1%	**NR**	R
Amyl Chloride	**C**	R
Aniline	**NR**	R
Aniline Hydrochloride	**NR**	R
Anthraquinone	**NR**	NR
Anti-Freeze: See Alcohols, Glycols and Glycerin		
Antimony Trichloride, aqueous	**R**	R
Aqua Regia	**R**	R
Arsenic Acid	**R**	R
Aryl Sulfonic Acid	**R**	• •
Asphalt	**NR**	R
Barium Carbonate	**R**	R
Barium Chloride	**R**	R
Barium Hydroxide	**R**	R
Barium Nitrate	**R**	R
Barium Sulfate	**R**	R

Chemical Resistance

CAUTION

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	ChemDrain® CPVC in Laboratory Drainage Service	Fluoroelastomer (FKM) Transition Couplings (AW 95C, AW 96C)
Barium Sulfide	**R**	R
Beer	**R**	R
Beet Sugar Liquors	**R**	R
Benzaldehyde	**NR**	NR
Benzene	**NR**	R
Benzene Sulfonic Acid	**R**	R
Benzoic Acid, aqueous	**R**	R
Benzyl Alcohol	**R**	R
Benzyl Chloride	**NR**	R
Bismuth Carbonate	**R**	R
Black Liquor	**R**	R
Bleach	**R**	R
Blood	**R**	R
Borax	**R**	R
Boric Acid	**R**	R
Brine Acid	**R**	• •
Bromic Acid	**R**	• •
Bromine, liquid	**R**	R
Bromine, aqueous	**R**	R
Bromobenzene	**NR**	R
Bromotoluene	**NR**	• •
Butanol, pure	**R**	R
Butyl Acetate	**NR**	NR
Butyl Carbitol	**R**	R
Butyl Cellosolve	**NR**	NR
Butyl Phenol	**NR**	• •
Butyric Acid, >1%	**NR**	NR
Cadmium Acetate	**R**	NR
Cadmium Chloride	**R**	• •
Cadmium Cyanide	**R**	R
Cadmium Sulfate	**R**	• •
Calcium Acetate	**R**	NR
Calcium Bisulfide	**R**	R
Calcium Bisulfite	**R**	R
Calcium Carbonate	**R**	R

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	ChemDrain® CPVC in Laboratory Drainage Service	Fluoroelastomer (FKM) Transition Couplings (AW 95C, AW 96C)
Calcium Chlorate	**R**	R
Calcium Chloride	**R**	R
Calcium Hydroxide	**R**	R
Calcium Hypochlorite	**R**	R
Calcium Nitrate	**R**	R
Calcium Oxide	**R**	R
Calcium Sulfate	**R**	R
Cane Sugar Liquors	**R**	R
Caprolactam, aqueous	**R**	NR
Caprolactone, aqueous	**R**	NR
Carbitol	**R**	R
Carbolic Acid, pure	**R**	R
Carbon Disulfide	**NR**	R
Carbon Tetrachloride	**NR**	R
Carbonic Acid	**R**	R
Castor Oil	**NR**	R
Caustic Potash	**R**	R
Caustic Soda (Sodium Hydroxide)	**R**	NR
Cellosolve	**NR**	NR
Cellosolve Acetate	**NR**	NR
Chloramine	**R**	NR
Chloramine Water, (Sat'd)	**R**	R
Chloric Acid	**R**	• •
Chlorine, aqueous	**R**	R
Chlorine Dioxide, aqueous	**R**	R
Chloroacetic Acid, pure	**R**	NR
Chlorobenzene	**NR**	R
Chloroform	**NR**	R
Chromic Acid, 40%	**R**	R
Chromium Nitrate	**R**	• •
Citric Acid	**R**	R
Citrus Oils	**R**	• •
Coconut Oil	**NR**	R
Coffee	**R**	• •
Copper Acetate	**R**	NR
Copper Carbonate	**R**	R

See www.charlottepipe.com for most current data.

Chemical Resistance

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Copper Chloride	**R**	R
Copper Cyanide	**R**	R
Copper Fluoride	**R**	• •
Copper Nitrate	**R**	R
Copper Sulfate	**R**	R
Corn Oil	**NR**	R
Corn Syrup	**R**	R
Cottonseed Oil	**NR**	R
Creosote	**NR**	R
Cresol	**NR**	R
Crotonaldehyde	**R**	NR
Cumene	**NR**	R
Cupric Fluoride	**R**	R
Cupric Sulfate	**R**	R
Cuprous Chloride	**R**	• •
Cyclohexane	**R**	R
Cyclohexanol	**R**	R
Cyclohexanone	**R**	NR
Decahydronaphthalene	**R**	• •
Detergents	**R**	R
Dextrin	**R**	R
Dextrose	**R**	R
Diacetone Alcohol	**R**	NR
Dibutoxyethyl Phthalate	**NR**	NR
Dibutyl Ether	**NR**	NR
Dibutyl Phthalate	**NR**	NR
Dibutyl Sebacate	**NR**	NR
Dichlorobenzene	**NR**	R
Dichloroethylene	**NR**	NR
Diesel Fuel	**NR**	R
Diethylamine	**NR**	NR
Diethyl Cellosolve	**R**	NR
Diethyl Ether	**NR**	NR
Diglycolic Acid	**R**	• •
Dill Oil	**C**	• •

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	ChemDrain® CPVC in Laboratory Drainage Service	Fluoroelastomer (FKM) Transition Couplings (AW 95C, AW 96C)
Dimethyl Phthalate	**NR**	R
Dimethylamine	**NR**	NR
Dimethylformamide (DMF)	**NR**	NR
Dimethylhydrazine	**NR**	NR
Dioctyl Phthalate	**NR**	R
Disodium Phosphate	**R**	R
Dioxane, pure	**R**	NR
Distilled Water	**R**	R
Dry Cleaning Fluid	**NR**	R
EDTA, Tetrasodium Aqueous	**R**	R
Ethanol, pure	**R**	R
Ethyl Acetate	**R**	NR
Ethyl Acetoacetate	**R**	NR
Ethyl Acrylate	**R**	NR
Ethyl Benzene	**NR**	R
Ethyl Chloride	**NR**	R
Ethyl Chloroacetate	**NR**	• •
Ethyl Ether	**NR**	NR
Ethyl Formate	**NR**	R
Ethyl Mercaptan	**NR**	R
Ethyl Oxalate	**NR**	R
Ethylene Bromide	**NR**	• •
Ethylene Chloride	**NR**	R
Ethylene Chlorohydrin	**NR**	R
Ethylene Glycol, <50%	**R**	R
Ethylene Glycol, >50%	**NR**	R
Ethylene Oxide	**R**	NR
Ethylenediamine	**R**	NR
2-Ethylhexanol	**NR**	R
Fatty Acids	**C**	R
Ferric Chloride	**R**	R
Ferric Hydroxide	**R**	R
Ferric Nitrate	**R**	R
Ferric Sulfate	**R**	R
Ferrous Chloride	**R**	R

Chemical Resistance

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R = Recommended • • = No Data

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Ferrous Hydroxide	**R**	R
Ferrous Nitrate	**R**	R
Ferrous Sulfate	**R**	R
Fish Oil	**C**	R
Fluoboric Acid	**R**	• •
Fluosilicic Acid	**R**	R
Formaldehyde, 35-50% aqueous	**R**	NR
Formalin (37% to 50% Formaldehyde)	**R**	NR
Formic Acid, pure	**R**	NR
Fructose	**R**	R
Furfural	**NR**	NR
Gallic Acid, aqueous	**R**	R
Gasoline	**NR**	R
Gelatine	**R**	R
Glucose	**R**	R
Glycerine	**R**	R
Glycol, Ethylene, <50%	**R**	R
Glycol, Ethylene, >50%	**NR**	R
Glycol, Polyethylene (carbowax)	**R**	R
Glycol, Polypropylene, >25%	**NR**	R
Glycol, Propylene, <25%	**R**	R
Glycol, Propylene, >25%	**NR**	R
Glycolic Acid	**R**	• •
Glyoxal, aqueous	**R**	• •
Green Liquor	**R**	• •
Halocarbon Oils	**NR**	• •
Heptane	**R**	R
Hexane	**R**	R
Hexanol	**R**	R
Hydrazine	**R**	NR
Hydrobromic Acid	**R**	R
Hydrochloric Acid	**R**	R
Hydrocyanic Acid	**R**	R
Hydrofluoric Acid	**R**	NR
Hydrogen Peroxide, 50%	**R**	R

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	ChemDrain® CPVC in Laboratory Drainage Service	Fluoroelastomer (FKM) Transition Couplings (AW 95C, AW 96C)
Hydrogen Sulfide, aqueous	**R**	NR
Hydroquinone, aqueous	**R**	R
Hydroxylamine Sulfate	**R**	• •
Hypochlorous Acid	**R**	R
Iodine	**R**	R
Isobutyl Alcohol	**R**	R
Isophorone	**NR**	NR
Isopropanol, pure	**R**	R
Isopropyl Acetate	**R**	NR
Isopropyl Chloride	**NR**	R
Isopropyl Ether	**NR**	NR
Kerosene	**NR**	R
Ketchup	**R**	R
Kraft Liquors	**R**	R
Lactic Acid	**R**	R
Lard Oil	**NR**	R
Lauryl Chloride	**R**	R
Lead Acetate	**R**	NR
Lead Chloride	**R**	R
Lead Nitrate	**R**	R
Lead Sulfate	**R**	R
Lemon Oil	**C**	R
Ligroin	**R**	R
Limonene	**R**	R
Linoleic Acid	**C**	R
Linseed Oil	**C**	R
Lithium Bromide	**R**	R
Lithium Chloride	**R**	R
Lithium Hydroxide	**R**	NR
Lithium Sulfate	**R**	R
Lubricating Oils (Petroleum Based)	**R**	R
Magnesium Carbonate	**R**	R
Magnesium Chloride	**R**	R
Magnesium Citrate	**R**	R
Magnesium Fluoride	**R**	R

Chemical Resistance

CAUTION

The chemical resistance table shown within this manual is for CPVC in a typical laboratory drainage environment. To reduce the risk of system failure, always evaluate the chemical resistance information and project specific factors.

The following table lists the chemical resistance suitability of CPVC ChemDrain thermoplastic piping materials and Fluoroelastomer (FKM), a commonly used seal material. The information shown is based upon laboratory tests conducted by the manufacturers of the materials, and it is intended to provide a general guideline on the resistance of these materials to various chemicals. **NOTICE:** This information is not a guarantee, and any piping systems using products made of these materials should be tested under actual service conditions to determine their suitability for a particular purpose. See website for most current data: www.charlottepipe.com.

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	ChemDrain® CPVC in Laboratory Drainage Service	Fluoroelastomer (FKM) Transition Couplings (AW 95C, AW 96C)
Magnesium Hydroxide	**R**	R
Magnesium Nitrate	**R**	R
Magnesium Oxide	**R**	R
Magnesium Sulfate	**R**	R
Maleic Acid	**R**	R
Malic Acid	**R**	R
Manganese Sulfate	**R**	R
Mercuric Chloride	**R**	R
Mercuric Cyanide	**R**	R
Mercuric Sulfate	**R**	R
Mercurous Nitrate	**R**	R
Mercury	**R**	R
Methanesulfonic Acid	**R**	• •
Methanol, up to 10%	**R**	NR
Methanol	**R**	NR
Methanol, pure	**R**	NR
Methyl Acetate, pure	**NR**	NR
Methyl Cellosolve	**NR**	NR
Methyl Chloride	**NR**	R
Methyl Chloroform	**NR**	R
Methyl Ethyl Ketone	**NR**	NR
Methyl Formate	**NR**	NR
Methyl Isobutyl Ketone	**NR**	NR
Methyl Isopropyl Ketone	**NR**	NR
Methyl Methacrylate	**NR**	NR
Methylamine	**NR**	NR
Methylene Bromide	**NR**	NR
Methylene Chloride	**NR**	NR
Methylene Chlorobromide	**NR**	NR
Methylene Iodide	**NR**	NR
Mineral Oil	**R**	R
Molasses	**R**	R
Monoethanolamine	**NR**	NR
Morpholine	**R**	• •
Motor Oil (Petroleum Based)	**R**	R

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	ChemDrain® CPVC in Laboratory Drainage Service	Fluoroelastomer (FKM) Transition Couplings (AW 95C, AW 96C)
Muriatic Acid	**R**	R
Naphtha	**C**	R
Naphthalene	**NR**	R
Nickel Acetate	**R**	NR
Nickel Chloride	**R**	R
Nickel Nitrate	**R**	R
Nickel Sulfate	**R**	R
Nitric Acid, <30%	**R**	R
Nitrobenzene	**NR**	NR
Nitroethane	**NR**	NR
Nitroglycerine	**C**	• •
Nitromethane	**NR**	NR
Nitrous Acid	**R**	C
Octane	**R**	R
Octanol	**R**	R
Oil, Crude	**C**	R
Oleum	**R**	R
Olive Oil	**C**	R
Oxalic Acid	**R**	R
Ozonated Water	**R**	NR
Palm Oil	**C**	R
Paraffin	**R**	R
Peanut Oil	**C**	R
Peppermint Oil	**C**	R
Peracetic Acid	**R**	• •
Perchloric Acid, 10%	**R**	R
Perchloroethylene	**NR**	R
Phenol, pure	**R**	R
Phenylhydrazine	**NR**	NR
Phosphate Esters	**NR**	NR
Phosphoric Acid	**R**	R
Phosphorus Pentoxide	**R**	• •
Phosphorus Trichloride	**R**	R
Photographic Solutions	**R**	R
Phthalic Acid	**NR**	NR

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	ChemDrain® CPVC in Laboratory Drainage Service	Fluoroelastomer (FKM) Transition Couplings (AW 95C, AW 96C)
Picric Acid, <10%	**R**	R
Pine Oil	**R**	R
Plating Solutions	**R**	R
POE Oil (Polyolester)	**NR**	NR
Polyethylene Glycol (carbowax)	**R**	R
Polyvinyl Alcohol	**R**	R
Potash	**R**	R
Potassium Acetate	**R**	NR
Potassium Bicarbonate	**R**	R
Potassium Bichromate	**R**	R
Potassium Bisulfate	**R**	R
Potassium Borate	**R**	R
Potassium Bromate	**R**	R
Potassium Bromide	**R**	R
Potassium Carbonate	**R**	R
Potassium Chlorate	**R**	R
Potassium Chloride	**R**	R
Potassium Chromate	**R**	R
Potassium Cyanate	**R**	R
Potassium Cyanide	**R**	R
Potassium Dichromate	**R**	R
Potassium Ferricyanide	**R**	R
Potassium Ferrocyanide	**R**	R
Potassium Fluoride	**R**	R
Potassium Hydroxide	**R**	NR
Potassium Hypochlorite	**R**	NR
Potassium Iodide	**R**	R
Potassium Nitrate	**R**	R
Potassium Perborate	**R**	R
Potassium Perchlorate	**R**	R
Potassium Permanganate	**R**	R
Potassium Persulfate	**R**	R
Potassium Phosphate	**R**	R
Potassium Sulfate	**R**	R
Potassium Sulfide	**R**	R

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	ChemDrain® CPVC in Laboratory Drainage Service	Fluoroelastomer (FKM) Transition Couplings (AW 95C, AW 96C)
Potassium Sulfite	**R**	R
Potassium Tripolyphosphate	**R**	R
Propanol, pure	**R**	R
Propargyl Alcohol	**R**	• •
Propionic Acid, >5%	**R**	R
Propionic Acid, pure	**R**	NR
Propyl Acetate	**NR**	NR
Propyl Bromide	**NR**	NR
Propylene Dichloride	**NR**	R
Propylene Glycol, <25%	**R**	R
Propylene Glycol, >25%	**NR**	R
Propylene Oxide	**R**	NR
Pyridine	**R**	NR
Pyrogallol	**R**	• •
Pyrrole	**NR**	NR
Reverse Osmosis Water	**R**	R
Salicylaldehyde	**R**	• •
Sea Water	**R**	R
Silicic Acid	**R**	• •
Silicone Oil	**R**	R
Silver Chloride	**R**	• •
Silver Cyanide	**R**	R
Silver Nitrate	**R**	R
Silver Sulfate	**R**	R
Soaps	**R**	R
Sodium Acetate	**R**	R
Sodium Aluminate	**R**	R
Sodium Arsenate	**R**	R
Sodium Benzoate	**R**	R
Sodium Bicarbonate	**R**	R
Sodium Bichromate	**R**	R
Sodium Bisulfate	**R**	R
Sodium Bisulfite	**R**	R
Sodium Borate	**R**	R
Sodium Bromide	**R**	R

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	ChemDrain® CPVC in Laboratory Drainage Service	Fluoroelastomer (FKM) Transition Couplings (AW 95C, AW 96C)
Sodium Carbonate	**R**	R
Sodium Chlorate	**R**	R
Sodium Chloride	**R**	R
Sodium Chlorite	**R**	R
Sodium Chromate	**R**	R
Sodium Cyanide	**R**	R
Sodium Dichromate	**R**	R
Sodium Ferricyanide	**R**	R
Sodium Ferrocyanide	**R**	R
Sodium Fluoride	**R**	R
Sodium Formate	**R**	• •
Sodium Hydroxide	**R**	NR
Sodium Hypobromite	**R**	• •
Sodium Hypochlorite	**R**	R
Sodium Iodide	**R**	R
Sodium Metaphosphate	**R**	R
Sodium Nitrate	**R**	R
Sodium Nitrite	**R**	R
Sodium Palmitate	**R**	• •
Sodium Perborate	**R**	R
Sodium Perchlorate	**R**	• •
Sodium Peroxide	**R**	R
Sodium Phosphate	**R**	R
Sodium Silicate	**R**	R
Sodium Sulfate	**R**	R
Sodium Sulfide	**R**	R
Sodium Sulfite	**R**	R
Sodium Thiosulfate	**R**	R
Sodium Tripolyphosphate	**R**	• •
Soybean Oil	**C**	R
Stannic Chloride	**R**	R
Stannous Chloride	**R**	R
Stannous Sulfate	**R**	R
Starch	**R**	R
Stearic Acid	**R**	R

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	ChemDrain® CPVC in Laboratory Drainage Service	Fluoroelastomer (FKM) Transition Couplings (AW 95C, AW 96C)
Strontium Chloride	**R**	• •
Styrene Monomer	**NR**	R
Succinic Acid	**R**	R
Sugar	**R**	R
Sulfamic Acid	**R**	R
Sulfuric Acid	**R**	R
Sulfurous Acid	**R**	R
Tall Oil	**R**	R
Tannic Acid	**R**	R
Tartaric Acid	**R**	R
Tetrachloroethylene	**NR**	R
Tetrahydrofuran	**NR**	NR
Tetrahydronaphthalene	**NR**	R
Tetrasodium Pyrophosphate	**R**	• •
Thionyl Chloride	**R**	R
Toluene	**NR**	R
Tomato Juice	**R**	R
Tributyl Citrate	**NR**	NR
Tributyl Phosphate	**NR**	NR
Trichloroacetic Acid	**R**	NR
Trichloroethylene	**NR**	R
Triethanolamine	**R**	NR
Triethylamine	**R**	NR
Trimethyl Propane	**R**	• •
Trisodium Phosphate	**R**	• •
Tung Oil	**C**	R
Turpentine	**C**	R
Urea	**R**	• •
Urine	**R**	• •
Vegetable Oils	**C**	R
Vinegar	**R**	R
Vinyl Acetate	**R**	NR
Water	**R**	R
Water - Deionized	**R**	R
Whiskey	**R**	R

Chemical Resistance

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	ChemDrain® CPVC in Laboratory Drainage Service	Fluoroelastomer (FKM) Transition Couplings (AW 95C, AW 96C)
White Liquor	**R**	R
Wine	**R**	R
Xylene	**NR**	R
Zinc Acetate	**R**	NR
Zinc Carbonate	**R**	R

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	ChemDrain® CPVC in Laboratory Drainage Service	Fluoroelastomer (FKM) Transition Couplings (AW 95C, AW 96C)
Zinc Chloride	**R**	R
Zinc Nitrate	**R**	R
Zinc Sulfate	**R**	R

Note: Most aqueous solutions of water-soluble chemicals not specified here can be used in CPVC drainage systems.

Temperature Conversion

Degrees Fahrenheit	Degrees Centigrade	Degrees Fahrenheit	Degrees Centigrade
-10	-23.3	90	32.2
-5	-20.6	95	35.0
0	-17.8	100	37.8
5	-15.0	110	43.3
10	-12.2	120	48.9
15	-9.4	130	54.4
20	-6.7	140	60.0
25	-3.9	150	65.6
32	0	160	71.1
35	1.7	170	76.7
40	4.4	180	82.2
45	7.2	190	87.8
50	10.0	200	93.3
55	12.8	212	100.0
60	15.6	220	104.4
65	18.3	230	110.0
70	21.1	240	115.6
75	23.9	250	121.1
80	26.7	260	126.7
85	29.4		

For temperatures not shown, the following formulas apply:

°F to °C = (°F-32)/1.8 °C to °F = 9/5 (°C x 1.8) +32

Metric Conversion

Pipe Size (mm)	Pipe Size (in.)	Pipe Size (mm)	Pipe Size (in.)
6mm	⅛ in.	90mm	3½ in.
7mm	3⁄16 in.	100mm	4 in.
8mm	¼ in.	125mm	5 in.
10mm	⅜ in.	150mm	6 in.
15mm	½ in.	200mm	8 in.
18mm	⅝ in.	250mm	10 in.
20mm	¾ in.	300mm	12 in.
25mm	1 in.	350mm	14 in.
32mm	1¼ in.	400mm	16 in.
40mm	1½ in.	450mm	18 in.
50mm	2 in.	500mm	20 in.
65mm	2½ in.	600mm	24 in.
80mm	3 in.		

The Conversion of Fractions to Decimals

Fraction	Decimal	Fraction	Decimal
1/64	0.015625	33/64	0.515625
1/32	0.031250	17/32	0.53125
3/64	0.046875	35/64	0.546875
1/16	0.062500	9/16	0.5625
5/64	0.078125	37/64	0.578125
3/32	0.937500	19/32	0.59375
7/64	0.109375	38/64	0.609375
1/8	0.125000	5/8	0.625
9/64	0.140625	41/64	0.640625
5/32	0.156250	21/32	0.65625
11/64	0.171900	43/64	0.67187
3/16	0.187500	11/16	0.6875
13/64	0.203100	45/64	0.70312
7/32	0.218800	23/32	0.71875
15/64	0.234375	47/64	0.734375
1/4	0.250000	3/4	0.75
17/64	0.265625	49/64	0.765625
9/32	0.281250	25/32	0.78125
19/64	0.296875	51/64	0.79875
5/16	0.312500	13/16	0.8125
21/64	0.328125	53/64	0.82125
11/32	0.343750	27/32	0.84375
23/64	0.359375	55/64	0.859375
3/8	0.375000	7/8	0.875
25/64	0.398625	57/64	0.890625
13/32	0.406250	29/32	0.90625
27/64	0.421875	59/64	0.921875
7/16	0.437500	15/16	0.9375
29/64	0.453125	61/64	0.953125
15/32	0.468750	31/32	0.96875
31/64	0.484375	63/64	0.984375
1/2	0.500000	1″	1

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.

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.

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.

1

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.

2

- 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.

3

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.

4

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.

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- 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.

6

- 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**

7

- 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

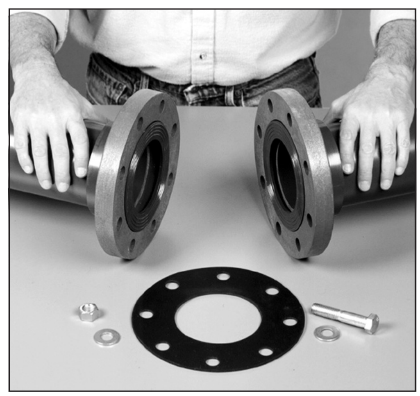
- Exceeding recommended flange bolt torque may result in component damage, system failure and property damage.
- Use the proper bolt tightening sequence as marked on the flange.
- Make sure the system is in proper alignment.
- Flanges may not be used to draw piping assemblies together.
- Flat washers 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.



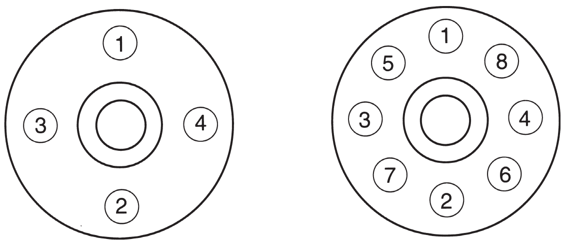
3. Align the flanges and gasket by inserting all of the bolts through the mating flange bolt holes. Be sure to use properly sized flat washers under all bolt heads and nuts.
4. Sequentially tighten the bolts corresponding to the following patterns shown.
5. Use a torque wrench to tighten the bolts to 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

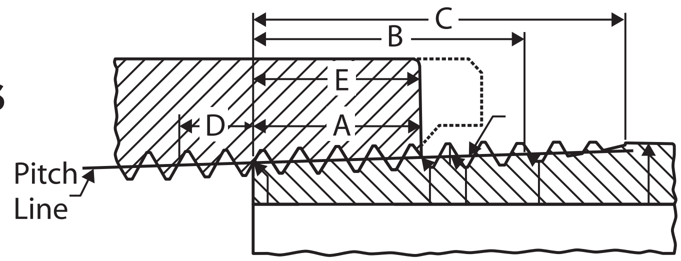
Pipe or fittings may be damaged by contact with products containing incompatible chemicals resulting in personal injury or property damage.

- 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

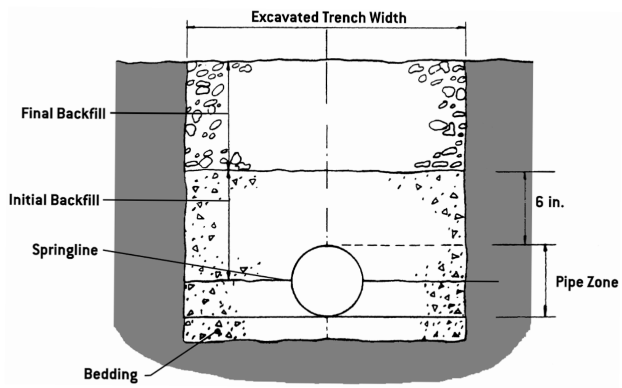
PIPE		* EXTERNAL THREAD				* INTERNAL THREAD	
Nominal Size In Inches	Outside Diameter In Inches	Number of Threads Per Inch	Normal Engagement By Hand In Inches (A)	Length of Effective Thread In Inches (B)	Total Length: End of Pipe to Vanish Point In Inches (C)	Overall Thread Internal Length In Inches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

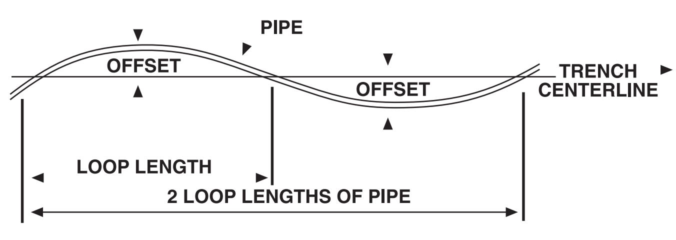


Recommendations for underground installation of plastic drainage pipe:

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.

Testing a ChemDrain® CPVC System

It is important to test and inspect all plumbing for leaks before covering the system with drywall or other permanent materials. Charlotte Pipe and Foundry recommends hydrostatic (water) testing as this is the best option to identify even small leaks while reducing the risk of injury to installation personnel.

In accordance with PPFA User Bulletin 4-80 and ASTM D 1785, Charlotte Pipe strenuously discourages air or gas testing. **WARNING:** Pipe and fitting material under air or gas pressure can explode, causing serious injury or death. Because Charlotte Pipe has specifically warned against the dangers of air or gas testing, it will not be responsible or liable for injury or death to persons or damage to property or for claims for labor and/or material arising from any alleged failure of our products during testing with air or compressed gases.

⚠ 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.

Test CPVC pipe hydrostatically in accordance with applicable plumbing and building codes. Bleed all air from the lines at the highest point before pressurizing. **WARNING:** Failure to bleed trapped air may give faulty test results and may result in an explosion.

⚠ 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.

Hydrostatic Test

A water or hydrostatic test is the best option for inspecting the installation of a completed plastic piping system. It also is the test most often recommended in local plumbing codes.

The purpose of the test is to locate any leaks in joints and correct them prior to putting the system into service. Since it is important to be able to visually inspect the joints, conduct a water test prior to closing off access to interior piping or backfilling underground piping.

To isolate each floor or section being tested, insert test plugs through test tees in the stack. Plug or cap all other openings with test plugs or test caps. Adequately anchor the piping system to limit movement caused by the thrust forces of water under pressure. Provide thrust blocking at changes of direction, changes of size and dead ends.

From the highest opening, fill the system to be tested with water. 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).

Fill the system slowly (flow velocity should not exceed 5 feet per second) to allow any air in the system to escape as water rises in the pipe. Expel all trapped air from the system before the test begins. Failure to remove entrapped air may yield faulty results.

WARNING: Trapped air is extremely dangerous and may cause explosion resulting in death or serious injury; always slowly and completely vent system prior to testing. To facilitate the removal of trapped air, provide vents at all high points of the piping system. Open all valves and air-relief mechanisms so that the air can be vented while the system is being filled. Once the stack is filled to 10 feet of head, make a visual inspection of the section being tested.

If a leak is found, cut out the joint and replace it with a new section. Once a portion of the system has been tested successfully, drain it to allow the next section to be tested.

⚠ 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.

LIMITED WARRANTY

Charlotte Pipe and Foundry Company® (Charlotte Pipe®) Products are warranted to be free from manufacturing defects and to conform to currently applicable ASTM standards for a period of five (5) years from date of delivery. Buyer's remedy for breach of this warranty is limited to replacement of, or credit for, the defective product. This warranty excludes any expense for removal or reinstallation of any defective product and any other incidental, consequential, or punitive damages. **This limited warranty is the only warranty made by seller and is expressly in lieu of all other warranties, express and implied, including any warranties of merchantability and fitness for a particular purpose.** No statement, conduct or description by Charlotte Pipe or its representative, in addition to or beyond this Limited Warranty, shall constitute a warranty. This Limited Warranty may only be modified in writing signed by an officer of Charlotte Pipe.

This Limited Warranty will not apply if:

1) The Products are used for purposes other than their intended purpose as defined by local plumbing and building codes, and the applicable ASTM standard.
2) The Products are not installed in good and workmanlike manner consistent with normal industry standards; installed in compliance with the latest instructions published by Charlotte Pipe and good plumbing practices; and installed in conformance with all applicable plumbing, fire and building code requirements.
3) This limited warranty does not apply when the products of Charlotte Pipe are used with the products of other manufacturers that do not meet the applicable ASTM or CISPI standards or that are not marked in a manner to indicate the entity that manufactured them.
4) In hubless cast iron installations, this warranty will not apply if products are joined with unshielded hubless couplings. Charlotte Pipe requires that its hubless cast iron pipe and fittings be joined only with shielded hubless couplings manufactured in accordance with CISPI 310, ASTM C 1277 and certified by NSF® International or with Heavy Duty Couplings meeting ASTM C 1540.
5) The Products fail due to defects or deficiencies in design, engineering, or installation of the piping system of which they are a part.
6) The Products have been the subject of modification; misuse; misapplication; improper maintenance or repair; damage caused by the fault or negligence of anyone other than Charlotte Pipe; or any other act or event beyond the control of Charlotte Pipe.
7) The Products fail due to the freezing of water in the Products.
8) The Products fail due to contact with chemical agents, fire stopping materials, thread sealant, plasticized vinyl products, or other aggressive chemical agents that are not compatible.
9) Pipe outlets, sound attenuation systems or other devices are permanently attached to the surface of Charlotte® PVC, ABS or CPVC products with solvent cement or adhesive glue.

Charlotte Pipe products are manufactured to the applicable ASTM or CISPI standard. Charlotte Pipe and Foundry **cannot** accept responsibility for the performance, dimensional accuracy, or compatibility of pipe, fittings, gaskets, or couplings not manufactured or sold by Charlotte Pipe and Foundry.

This Limited Warranty will not apply unless written notice of a claim is mailed to Charlotte Pipe at the address below within 30 days of discovery of the allegedly defective product.

Any Charlotte Pipe products alleged to be defective **must** be made available to Charlotte Pipe at the following address for verification, inspection and determination of cause:

Charlotte Pipe and Foundry Company
Attention: Technical Services
2109 Randolph Road
Charlotte, North Carolina 28207

Purchaser must obtain a return materials authorization and instructions for return shipment to Charlotte Pipe of any product claimed defective or shipped in error.

Any Charlotte Pipe product **proved** to be defective in manufacture will be replaced F.O.B. point of original delivery, or credit will be issued, at the discretion of Charlotte Pipe.

4/20/21

PO BOX 35430 CHARLOTTE, NORTH CAROLINA 28235
SALES PHONE (704) 348 6450 (800) 572 4199
TECHNICAL PHONE (800) 438 6091 FAX (800) 553 1605
WWW.CHARLOTTEPIPE.COM

REFERENCE STANDARDS FOR CHEMDRAIN

ASTM INTERNATIONAL

ASTM	TITLE
ASTM D 635	STANDARD TEST METHOD FOR RATE OF BURNING AND/OR EXTENT AND TIME OF BURNING OF PLASTICS IN A HORIZONTAL POSITION
SCOPE:	THIS FIRE-TEST-RESPONSE TEST METHOD COVERS A SMALL-SCALE LABORATORY SCREENING PROCEDURE FOR COMPARING THE RELATIVE LINEAR RATE OF BURNING OR EXTENT AND TIME OF BURNING, OR BOTH, OF PLASTICS IN THE HORIZONTAL POSITION.
ASTM D 1784	SPECIFICATION FOR RIGID POLY (VINYL CHLORIDE) (PVC) COMPOUNDS AND CHLORINATED POLY (VINYL CHLORIDE) (CPVC) COMPOUNDS
SCOPE:	THIS SPECIFICATION COVERS RIGID PVC AND CPVC COMPOUNDS INTENDED FOR GENERAL PURPOSE USE IN EXTRUDED OR MOLDED FORM.
ASTM F 493	SPECIFICATION FOR SOLVENT CEMENTS FOR CHLORINATED POLY (VINYL CHLORIDE) (CPVC) PLASTIC PIPE AND FITTINGS
SCOPE:	THIS SPECIFICATION PROVIDES REQUIREMENTS FOR CPVC SOLVENT CEMENT TO BE USED IN JOINING CPVC PIPE AND SOCKET TYPE FITTINGS.
ASTM F 2618	SPECIFICATON FOR CHLORINATED POLY (VINYL CHLORIDE) CPVC PLASTIC CHEMICAL WASTE DRAINAGE SYSTEM
SCOPE:	THIS SPECIFICATION COVERS REQUIREMENTS FOR (CPVC) PLASTIC CHEMICAL WASTE DRAINAGE SYSTEM PIPE AND FITTINGS AND INTENDED FOR SERVICE UP TO AND INCLUDING 220 DEGREES FAHRENHEIT.

NSF INTERNATIONAL

NSF / ANSI	TITLE
NSF 14	PLASTICS PIPING SYSTEM COMPONENTS AND RELATED MATERIALS
SCOPE:	THIS STANDARD ESTABLISHES MINIMUM PHYSICAL, PERFORMANCE, HEALTH EFFECTS, QUALITY ASSURANCE, MARKING AND RECORD-KEEPING REQUIREMENTS FOR PLASTIC PIPING COMPONENTS AND RELATED MATERIALS. THE ESTABLISHED PHYSICAL, PERFORMANCE AND HEALTH EFFECTS REQUIREMENTS APPLY TO MATERIALS (RESIN OR BLENDED COMPOUNDS) AND INGREDIENTS USED TO MANUFACTURE PLASTIC PIPING SYSTEM COMPONENTS.

UNDERWRITERS LABORATORIES

UL	TITLE
UL 94	FLAMMABILITY TESTING
SCOPE:	THIS TEST INDICATES THAT THE MATERIAL WAS TESTED IN A VERTICAL POSITION AND SELF-EXTINGUISHED WITHIN A SPECIFIED TIME AFTER THE IGNITION SOURCE WAS REMOVED.

NOTES

NOTES

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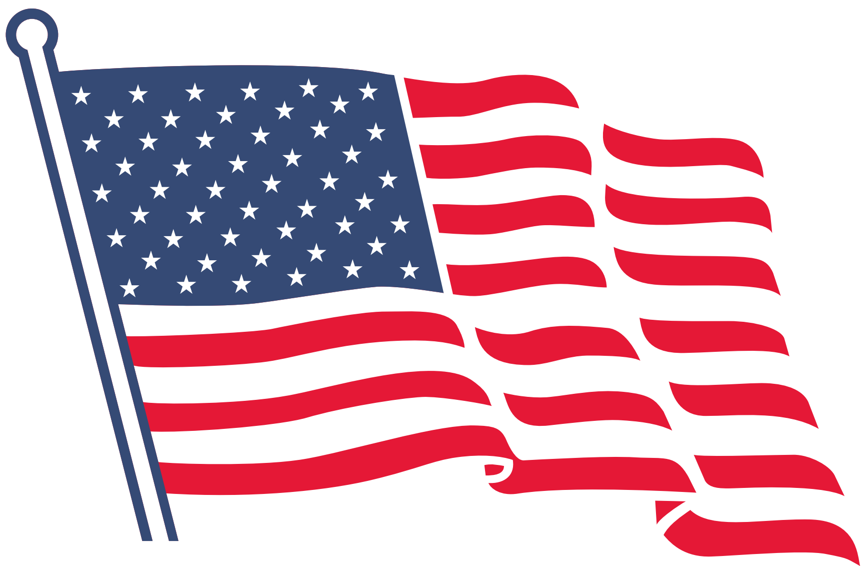

All products manufactured by
Charlotte Pipe and Foundry Company
are proudly made in the U.S.A.