CHARLOTTE
PIPE AND FOUNDRY COMPANY

You can't beat the system.®

# Industrial

TECHNICAL MANUAL

(Updated February 2005)



INSTALLATION

TM-IND

# INTRODUCTION

Monroe, North Carolina

You need a reliable source for high-quality, thermoplastic, industrial piping and we are dedicated to meeting your need. The goal of Charlotte Pipe and Foundry Company's Industrial Division is to earn your business.

To insure that you have a ready supply of highest quality products, we have recently added a 100,000 square foot pipe extrusion facility to our Monroe, North Carolina plant. This industrial extrusion facility is the newest of its kind in the nation and incorporates the most advanced technology available. It is devoted to the manufacture of **Corzan**® CPVC pipe in Schedule 80, and Schedule 40, and PVC Schedule 80 pipe. These pipe products meet or exceed all applicable ASTM and NSF standards for material purity and dimensional accuracy.

Muncy, Pennsylvania

To provide you with the very best in service, we have manufacturing plants strategically located in Monroe, North Carolina; Muncy, Pennsylvania; Cameron, Texas; Wildwood, Florida; and Huntsville, Alabama. This broad-based supply structure of over 1,000,000 square feet allows us to ship most orders within 24 hours of receipt. You receive complete orders, where and when you need them, by utilizing our large inventory of the following products:

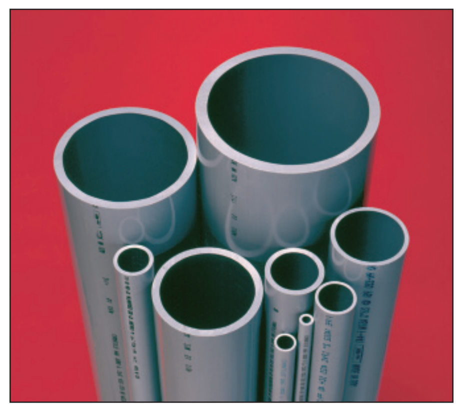
**Corzan CPVC Pipe**
Schedule 80, 1/4 - 12"
Schedule 40, 1/2 - 12"

**Corzan CPVC Schedule 80 Fittings**

**PVC Pipe**
Schedule 80, 1/4 - 16"
Schedule 40, 1/2 - 16"
SDR 13.5, 26 and 21, 1/2 - 3"

**PVC Schedule 80 Fittings**

**PVC Schedule 40 Fittings**



Cameron, Texas

Wildwood, Florida

To meet a wide range of design specifications, Charlotte's Industrial Pipe is available with plain, belled, and threaded end treatments.

We trust this technical manual will help answer your application, design and installation questions for our thermoplastic industrial pipe. However, if you prefer personal assistance, we welcome your call. Ask for the Industrial Division sales department. We thank you for this occasion to be of service.

**Corzan** is a registered trademark of the Noveon IP Holdings Corp. Charlotte Pipe and Foundry Company is licensed to manufacture Corzan CPVC products from Corzan thermoplastic compounds.

CHARLOTTE
PIPE AND FOUNDRY COMPANY
P.O. Box 35430 • Charlotte, North Carolina 28235
704/348-6450 • 800/438-6091 • FAX 800/553-1605
Literature By Fax 800/745-9382
www.charlottepipe.com

MADE IN U.S.A.

# TABLE OF CONTENTS

CHARLOTTE PIPE AND FOUNDRY COMPANY®



MEMBER IAPD INTERNATIONAL ASSOCIATION OF PLASTICS DISTRIBUTORS

NSF

MEMBER OF ASTM

# POLYVINYL CHLORIDE (PVC) AND CORZAN CHLORINATED POLYVINYL CHLORIDE (CPVC) PIPE



## Major Advantages

### Easy Installation
PVC and CPVC pipe are light in weight (approximately one-half the weight of aluminum and one-sixth the weight of steel). They have smooth, seamless interior walls. No special tools are required for cutting. They can be installed using solvent cementing, threading, flanging and roll-grooved joining techniques.

### Chemical Resistance
PVC and CPVC pipe are inert to attack by strong acids, alkalies, salt solutions, alcohols, and many other chemicals. They are dependable in corrosive applications and impart no tastes or odors to materials carried in them. They do not react with materials carried, nor act as a catalyst. All possibility of contamination, or chemical process changes, and all danger of clouding, sludging, or discoloration are eliminated. (See chemical resistance charts.)

### Strength
PVC and CPVC pipe are highly resilient, tough and durable products that have high tensile and high impact strength. They will withstand surprisingly high pressure for long periods.

### Fire Resistance
PVC and CPVC pipe products are self extinguishing and will not support combustion. They have an ASTM E-84 flame spread rate of 25 or less.

### Internal Corrosion Resistance
PVC and CPVC pipe resist chemical attack by most acids, alkalies, salts, and organic media such as alcohols and aliphatic hydrocarbons, within certain limits of temperature and pressure. They provide the needed chemical resistance, while eliminating the disadvantages of special metals, lined piping, glass, wood, ceramics, or other special corrosion-resisting materials, which formerly had to be used.

### External Corrosion Resistance
Industrial fumes, humidity, salt water, weather, atmospheric, or underground conditions, regardless of type of soil or moisture encountered, cannot harm rigid PVC and CPVC plastic pipe. Scratches or surface abrasions do not provide points which corrosive elements can attack.

### Immunity to Galvanic or Electrolytic Attack
PVC and CPVC pipe are inherently immune to galvanic or electrolytic action. They can be used underground, underwater, in the presence of metals, and can also be connected to metals.

### Freedom from Toxicity, Odors, Tastes
PVC and CPVC piping are non-toxic, odorless, and tasteless. They have been listed by the National Sanitation Foundation for use with potable water.

### Corrosion Free
With many other pipe materials, slight corrosion may occur. The corroded particles can contaminate the piped fluid, complicating further processing, or causing bad taste, odors, or discoloration. This is particularly undesirable when the piped fluid is for domestic consumption. With PVC and CPVC, there are no corrosive by-products, therefore, no contamination of the piped fluid.

### Low Friction Loss
The smooth interior surfaces of PVC and CPVC pipe, compared to metal and other piping materials, assure low friction loss and high flow rates. Additionally, since PVC and CPVC pipe will not rust, pit, scale, or corrode, the high flow rates will be maintained for the life of the piping system.

### Low Thermal Conductivity
PVC and CPVC pipe have a much lower thermal conductivity factor than metal pipe. Therefore, fluids being piped maintain a more constant temperature. In most cases, pipe insulation is not required.

### Low Installation Cost
PVC and CPVC pipe are extremely light weight, convenient to handle, relatively flexible, and easy to install. These features lead to lower installed costs than conventional metal piping.

### Maintenance Free
Once a PVC or CPVC piping system is properly selected, designed, and installed, it is virtually maintenance free. It will not rust, scale, pit, corrode, or promote build-up on the interior. Therefore, years of trouble-free service can be expected when using Charlotte Pipe and Foundry PVC and CPVC pipe.

**Charlotte Pipe and Foundry PVC and Corzan CPVC pipe products meet or exceed all applicable NSF standards and are NSF listed for potable water. PVC AND CPVC PIPING PRODUCTS ARE NOT RECOMMENDED FOR SYSTEMS WHICH TRANSPORT OR STORE COMPRESSED AIR OR GASES. DO NOT TEST PVC OR CPVC PIPING SYSTEMS WITH COMPRESSED AIR OR GASES. ALWAYS BLEED ALL ENTRAPPED AIR FROM THE SYSTEM PRIOR TO TESTING.**

# PHYSICAL PROPERTIES OF PVC AND CORZAN CPVC MATERIALS

CHARLOTTE PIPE AND FOUNDRY COMPANY®



| PROPERTY | PVC 1120 | CPVC 4120 | UNITS | ASTM No. |
|---|---|---|---|---|
| Specific Gravity | 1.40 | 1.55 | g/cc | D 792 |
| Tensile Strength (73°F) | 7,000 | 7,000 | psi | D 638 |
| Modulus of Elasticity in Tension (73°F) | 400,000 | 360,000 | psi | D 638 |
| Flexural Strength (73°F) | 14,000 | 15,100 | psi | D 790 |
| Izod Impact (notched at 73°F) | 0.65 | 1.5 | ft lb/ in. | D 256 |
| Hardness (Durometer D) | 80 ± 3 | — | | D 2240 |
| Hardness (Rockwell R) | 110 - 120 | 119 | | D 785 |
| Compressive Strength (73°F) | 9,600 | 10,100 | psi | D 695 |
| Hydrostatic Design Stress | 2,000 | 2,000 | psi | |
| Coefficient of Linear Expansion | $3.0 \times 10^{-5}$ | $3.4 \times 10^{-5}$ | in./ in./ °F | D 696 |
| Heat Distortion Temperature at 264 psi | 160 | 212 | degrees F | D 648 |
| Coefficient of Thermal Conductivity | 1.2 | .95 | BTU/ hr/sq ft/ °F/ in. | C 177 |
| Specific Heat | 0.25 | — | cal/ °C/ gm | D 2766 |
| Water Absorption (24 hrs at 73°F) | .05 | .03 | % weight gain | D 570 |
| Cell Classification | 12454 | 23447 - 24448 | | D 1784 |

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.

## PVC and CPVC Pipe Standards

| TYPE PIPE | STANDARD SPECIFICATIONS | |
|---|---|---|
| | MATERIAL | DIMENSIONS |
| PVC SDR (Plain End) | ASTM D 1784 | ASTM D 2241 |
| PVC SDR (Belled-End)* | ASTM D 1784 | ASTM D 2672 |
| PVC Schedule 40 | ASTM D 1784 | ASTM D 1785 |
| PVC Schedule 40 (DWV) | ASTM D 1784 | ASTM D 2665 |
| PVC Schedule 40 (Belled-End)* | ASTM D 1784 | ASTM D 2672 or F 480 |
| PVC Schedule 80* | ASTM D 1784 | ASTM D 1785 |
| CPVC Schedule 40 and 80 | ASTM D 1784 | ASTM F 441 |

*See page 14 for socket dimensions of Belled-End pipe.

## Suggested Specification

**System:** **Corzan® CPVC Schedule 40 and 80 Pressure Pipe and Fitting System**

**Scope:** This specification covers CPVC Schedule 40 and 80 pipe and Schedule 80 fittings for pressure applications. This system is intended for pressure applications where the operating temperature will not exceed 200°F.

**Specification:** Pipe and fittings shall be manufactured from virgin rigid CPVC (chlorinated polyvinyl chloride) vinyl compounds with a Cell Class of 24448 in sizes 1/4" through 8" and Cell Class of 23447 in size 10" and 12" as identified in ASTM D 1784.

CPVC Schedule 40 and 80 pipe shall be Iron Pipe Size (IPS) conforming to ASTM F 441. CPVC Schedule 80 fittings shall conform to ASTM F 439. CPVC Schedule 80 threaded fittings shall conform to ASTM F 437. Pipe and fittings shall be manufactured as a system and be the product of one manufacturer. All pipe and fittings shall be manufactured in the United States. Pipe and fittings shall conform to National Sanitation Foundation (NSF) Standard 61 or the health effects portion of NSF Standard 14.

Installation shall comply with the latest installation instructions published by Charlotte Pipe and Foundry and shall conform to all local plumbing, building, and fire code requirements. Solvent cement joints shall be made in a two step process with primer manufactured for thermoplastic piping systems and solvent cement conforming to ASTM F 493. The system shall be protected from chemical agents, fire stopping materials, thread sealant, plasticized vinyl products, or other aggressive chemical agents not compatible with CPVC compounds. Systems shall be hydrostatically (water) tested after installation. Testing with compressed air or gas is not recommended.

**Referenced Standards:**

| | |
|---|---|
| ASTM D 1784 | Rigid Vinyl Compounds |
| ASTM F 437 | Threaded CPVC Plastic Fittings, Schedule 80 |
| ASTM F 439 | CPVC Plastic Fittings, Schedule 80 |
| ASTM F 441 | CPVC Plastic Pipe, Schedules 40 and 80 |
| ASTM F 493 | Solvent Cements for CPVC Pipe and Fittings |
| NSF Standard 14 | Plastic Piping Components and Related Materials |
| NSF Standard 61 | Drinking Water System Components - Health Effects |

Note: Latest revision of all standards apply.

# Suggested Specification

**System:** **PVC Schedule 40 Pressure Pipe and Fitting System**

**Scope:** This specification covers PVC Schedule 40 pipe and fittings for pressure applications. This system is intended for pressure applications where the operating temperature will not exceed 140°F.

**Specification:** Pipe and fittings shall be manufactured from virgin rigid PVC (polyvinyl chloride) vinyl compounds with a Cell Class of 12454 as identified in ASTM D 1784.

PVC Schedule 40 pipe shall be Iron Pipe Size (IPS) conforming to ASTM D 1785. PVC Schedule 40 fittings shall conform to ASTM D 2466. Pipe and fittings shall be manufactured as a system and be the product of one manufacturer. All pipe and fittings shall be manufactured in the United States. Pipe and fittings shall conform to National Sanitation Foundation (NSF) Standard 61 or the health effects portion of NSF Standard 14.

Installation shall comply with the latest installation instructions published by Charlotte Pipe and Foundry and shall conform to all local plumbing, building, and fire code requirements. Solvent cement joints shall be made in a two step process with primer manufactured for thermoplastic piping systems and solvent cement conforming to ASTM D 2564. The system shall be protected from chemical agents, fire stopping materials, thread sealant, plasticized vinyl products, or other aggressive chemical agents not compatible with PVC compounds. Systems shall be hydrostatically tested after installation. Testing with compressed air or gas is not recommended.

**Referenced Standards:**

| | |
|---|---|
| ASTM D 1784 | Rigid Vinyl Compounds |
| ASTM D 1785 | PVC Plastic Pipe, Schedule 40 |
| ASTM D 2466 | PVC Plastic Fittings, Schedule 40 |
| ASTM D 2564 | Solvent Cements for PVC Pipe and Fittings |
| NSF Standard 14 | Plastic Piping Components and Related Materials |
| NSF Standard 61 | Drinking Water System Components - Health Effects |

Note: Latest revision of all standards apply.

## Suggested Specification

**System:** **PVC Schedule 80 Pressure Pipe and Fitting System**

**Scope:** This specification covers PVC Schedule 80 pipe and fittings for pressure applications. This system is intended for pressure applications where the operating temperature will not exceed 140°F.

**Specification:** Pipe and fittings shall be manufactured from virgin rigid PVC (polyvinyl chloride) vinyl compounds with a Cell Class of 12454 as identified in ASTM D 1784.

PVC Schedule 80 pipe shall be Iron Pipe Size (IPS) conforming to ASTM D 1785. PVC Schedule 80 fittings shall conform to ASTM D 2467. PVC Schedule 80 threaded fittings shall conform to ASTM D 2464.Pipe and fittings shall be manufactured as a system and be the product of one manufacturer. All pipe and fittings shall be manufactured in the United States. Pipe and fittings shall conform to National Sanitation Foundation (NSF) Standard 61 or the health effects portion of NSF Standard 14.

Installation shall comply with the latest installation instructions published by Charlotte Pipe and Foundry and shall conform to all local plumbing, building, and fire code requirements. Solvent cement joints shall be made in a two step process with primer manufactured for thermoplastic piping systems and solvent cement conforming to ASTM D 2564. The system shall be protected from chemical agents, fire stopping materials, thread sealant, plasticized vinyl products, or other aggressive chemical agents not compatible with PVC compounds. Systems shall be hydrostatically tested after installation. Testing with compressed air or gas is not recommended.

**Referenced Standards:**

| | |
|---|---|
| ASTM D 1784 | Rigid Vinyl Compounds |
| ASTM D 1785 | PVC Plastic Pipe, Schedule 80 |
| ASTM D 2464 | PVC Threaded Fittings, Schedule 80 |
| ASTM D 2467 | PVC Plastic Fittings, Schedule 80 |
| ASTM D 2564 | Solvent Cements for PVC Pipe and Fittings |
| NSF Standard 14 | Plastic Piping Components and Related Materials |
| NSF Standard 61 | Drinking Water System Components - Health Effects |

Note: Latest revision of all standards apply.

## Suggested Specification

**System:** **PVC SDR Pressure Pipe and Fitting System**

**Scope:** This specification covers PVC Standard Dimensional Ratio (SDR) pipe and fittings for pressure applications. This system is intended for pressure applications where the operating temperature will not exceed 140°F.

**Specification:** Pipe and fittings shall be manufactured from virgin rigid PVC (polyvinyl chloride) vinyl compounds with a Cell Class of 12454 as identified in ASTM D 1784.

PVC SDR pipe shall be Iron Pipe Size (IPS) conforming to ASTM D 2241 for plain end pipe and ASTM D 2672 for belled-end pipe. PVC Schedule 40 (IPS) fittings shall conform to ASTM D 2466. Pipe and fittings shall be manufactured as a system and be the product of one manufacturer. All pipe and fittings shall be manufactured in the United States. Pipe and fittings shall conform to National Sanitation Foundation (NSF) Standard 61 or the health effects portion of NSF Standard 14.

Installation shall comply with the latest installation instructions published by Charlotte Pipe and Foundry and shall conform to all local plumbing, building, and fire code requirements. Solvent cement joints shall be made in a two step process with primer manufactured for thermoplastic piping systems and solvent cement conforming to ASTM D 2564. The system shall be protected from chemical agents, fire stopping materials, thread sealant, plasticized vinyl products, or other aggressive chemical agents not compatible with PVC compounds. Systems shall be hydrostatically tested after installation. Testing with compressed air or gas is not recommended.

**Referenced Standards:**

| | |
|---|---|
| ASTM D 1784 | Rigid Vinyl Compounds |
| ASTM D 2241 | PVC Pressure Rated Pipe (SDR Series) |
| ASTM D 2672 | Joints for IPS PVC Pipe Using Solvent Cement |
| ASTM D 2466 | PVC Plastic Fittings, Schedule 40 |
| ASTM D 2564 | Solvent Cements for PVC Pipe and Fittings |
| NSF Standard 14 | Plastic Piping Components and Related Materials |
| NSF Standard 61 | Drinking Water System Components - Health Effects |

Note: Latest revision of all standards apply.

## Suggested Specification

**System:** **PVC Schedule 40 Solid Wall Pipe and PVC DWV Fitting System**

**Scope:** This specification covers PVC Schedule 40 solid wall pipe and PVC DWV fittings used in sanitary drain, waste, and vent (DWV), sewer, and storm drainage applications. This system is intended for use in non-pressure applications where the operating temperature will not exceed 140°F.

**Specification:** Pipe and fittings shall be manufactured from virgin rigid PVC (polyvinyl chloride) vinyl compounds with a Cell Class of 12454 as identified in ASTM D 1784.

PVC Schedule 40 pipe shall be Iron Pipe Size (IPS) conforming to ASTM D 1785 and ASTM D 2665. PVC DWV fittings shall conform to ASTM D 2665. Pipe and fittings shall be manufactured as a system and be the product of one manufacturer. All pipe and fittings shall be manufactured in the United States. All systems shall utilize a separate waste and vent system. Pipe and fittings shall conform to National Sanitation Foundation Standard 14.

Installation shall comply with the latest installation instructions published by Charlotte Pipe and Foundry and shall conform to all local plumbing, building, and fire code requirements. Solvent cement joints shall be made in a two step process with primer manufactured for thermoplastic piping systems and solvent cement conforming to ASTM D 2564. The system shall be protected from chemical agents, fire stopping materials, thread sealant, plasticized vinyl products, or other aggressive chemical agents not compatible with PVC compounds. Systems shall be hydrostatically tested after installation. Testing with compressed air or gas is not recommended.

**Referenced Standards:**

| | |
|---|---|
| ASTM D 1784 | Rigid Vinyl Compounds |
| ASTM D 1785 | PVC Plastic Pipe, Schedule 40 |
| ASTM D 2665 | PVC Drain, Waste, and Vent Pipe & Fittings |
| ASTM D 2564 | Solvent Cements for PVC Pipe and Fittings |
| NSF Standard 14 | Plastic Piping Components and Related Materials |

Note: Latest revision of all standards apply.

# HANDLING AND STORAGE OF PVC AND CPVC PIPE

CHARLOTTE PIPE AND FOUNDRY COMPANY®

## RECEIVING PIPE:

As pipe is received, it must always be thoroughly inspected, prior to unloading. The person receiving the pipe must look for any transportation damage caused by over-tightened tie-down straps, improper treatment, or a shift in the load.

Pipe received in a closed trailer must be inspected as the trailer is opened. Take extra time to ensure that the pipe has not been damaged by other materials having been stacked on top of it, load shift, or rough handling.

Visually examine the pipe ends for any cracks, splits, gouges, or other forms of damage. Additionally, the pipe should be inspected for severe deformation which could later cause joining problems. The entire inside diameter of larger diameter pipe (4" and above) must be checked for any internal splits or cracks which could have been caused by loading or transit. The use of a flashlight may be necessary to perform this inspection.

Any damages must be observed by all parties involved, including the driver, and should be clearly noted on the bill of lading and/or delivery ticket. A copy of this document should be retained by the receiver. In addition, the manufacturer and carrier should be notified, within 24 hours, of any damages, shortages, or mis-shipped products.

## HANDLING PIPE:

The pipe should be handled with reasonable care. Because thermoplastic pipe is much lighter in weight than metal pipe, there is sometimes a tendency to throw it around. This should be avoided.

The pipe should never be dragged or pushed from a truck bed. Removing and handling pallets of pipe should be done with a forklift. Loose pipe lengths require special handling to avoid damage. Precautions to follow when unloading and handling loose pieces include not banging lengths together or dropping lengths, even from low heights, on hard or uneven surfaces.

In all cases, severe contact with any sharp objects (rocks, angle irons, forks on forklifts, etc.) should be avoided. Also, the pipe should never be lifted or moved by inserting the forks of a forklift into the pipe ends.

Handling PVC and particularly CPVC pipe diameters greater than 4-inch requires extra care as the added pipe weight can cause cracking from relatively minor impacts. Also, plastic pipe becomes more brittle as the temperature decreases. The impact strength and flexibility of PVC and especially CPVC pipe are reduced. Therefore, take extra care when handling skids or loose lengths when the temperature drops below 50° F.

## STORING PIPE:

If possible, pipe should be stored inside. When this is not possible, the pipe should be stored on level ground which is dry and free from sharp objects. If different schedules of pipe are stacked together, the pipe with the thickest walls should be on the bottom.

If the pipe is in pallets, the pallets should be stacked with the pallet boards touching, rather than pallet boards being placed on the pipe. This will prevent damage to or bowing of the pipe.

If the pipe is stored in racks, it should be continuously supported along its length. If this is not possible, the spacing of the supports should not exceed three feet (3').

The pipe should be protected from the sun and be in an area with proper ventilation. This will lessen the effects of ultraviolet rays and help prevent heat build-up.

# DIMENSIONS AND WEIGHTS

## PVC and CPVC Schedule 40 Pipe

| Nominal Pipe Size (in.) | Outside Diameter | Min. Wall | Approximate Wt. (lbs/100 ft) | |
|---|---|---|---|---|
| | | | PVC | CPVC |
| 1/2 | .840 | .109 | 16.2 | 17.3 |
| 3/4 | 1.050 | .113 | 21.4 | 23.0 |
| 1 | 1.315 | .133 | 31.5 | 34.2 |
| 1 1/4 | 1.660 | .140 | 42.6 | 46.3 |
| 1 1/2 | 1.900 | .145 | 50.8 | 55.3 |
| 2 | 2.375 | .154 | 68.2 | 74.3 |
| 2 1/2 | 2.875 | .203 | 107.0 | 117.9 |
| 3 | 3.500 | .216 | 140.8 | 154.2 |
| 4 | 4.500 | .237 | 200.5 | 219.6 |
| 5 | 5.563 | .258 | 272.5 | — |
| 6 | 6.625 | .280 | 353.3 | 386.1 |
| 8 | 8.625 | .322 | 538.6 | 581.1 |
| 10 | 10.750 | .365 | 755.0 | 823.8 |
| 12 | 12.750 | .406 | 1001.0 | 1089.2 |
| 14 | 14.000 | .438 | 1180.1 | — |
| 16 | 16.000 | .500 | 1543.1 | — |

## PVC and CPVC Schedule 80 Pipe

| Nominal Pipe Size (in.) | Outside Diameter | Min. Wall | Approximate Wt. (lbs/100 ft) | |
|---|---|---|---|---|
| | | | PVC | CPVC |
| 1/4 | .540 | .119 | 10.0 | 10.9 |
| 3/8 | .675 | .126 | 13.8 | 15.0 |
| 1/2 | .840 | .147 | 20.4 | 22.1 |
| 3/4 | 1.050 | .154 | 27.0 | 30.0 |
| 1 | 1.315 | .179 | 41.0 | 44.2 |
| 1 1/4 | 1.660 | .191 | 52.2 | 61.0 |
| 1 1/2 | 1.900 | .200 | 66.8 | 73.9 |
| 2 | 2.375 | .218 | 94.5 | 102.2 |
| 2 1/2 | 2.875 | .276 | 144.5 | 155.9 |
| 3 | 3.500 | .300 | 194.2 | 208.6 |
| 4 | 4.500 | .337 | 275.2 | 304.9 |
| 5 | 5.563 | .375 | 387.3 | — |
| 6 | 6.625 | .432 | 541.5 | 581.5 |
| 8 | 8.625 | .500 | 805.2 | 882.9 |
| 10 | 10.750 | .593 | 1200.0 | 1309.1 |
| 12 | 12.750 | .687 | 1650.0 | 1801.2 |
| 14 | 14.000 | .750 | 1930.0 | — |
| 16 | 16.000 | .843 | 2544.1 | — |

Note: All dimensions are in inches.

## SDR Pressure Pipe

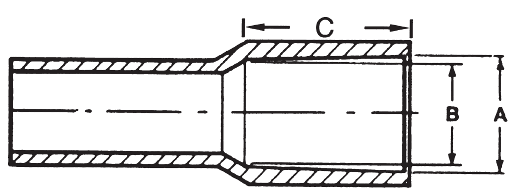
| Nominal Pipe Size (in.) | Outside Diameter | SDR 13.5 (PR 315) | | SDR 21 (PR 200) | | SDR 26 (PR 160) | |
|---|---|---|---|---|---|---|---|
| | | Min. Wall | Approx. Wt. (lbs/100 ft) | Min. Wall | Approx. Wt. (lbs/100 ft) | Min. Wall | Approx. Wt. (lbs/100 ft) |
| 1/2 | .840 | .062 | 9.5 | | | | |
| 3/4 | 1.050 | | | .060 | 12.9 | | |
| 1 | 1.315 | | | .063 | 17.1 | | |
| 1 1/4 | 1.660 | | | .079 | 26.3 | .064 | 21.4 |
| 1 1/2 | 1.900 | | | .090 | 33.8 | .073 | 27.7 |
| 2 | 2.375 | | | .113 | 52.1 | .091 | 42.8 |
| 2 1/2 | 2.875 | | | .137 | 75.8 | .110 | 63.9 |
| 3 | 3.500 | | | .167 | 111.8 | .135 | 93.4 |
| 4 | 4.500 | | | .214 | 184.8 | .173 | 151.0 |
| 5 | 5.563 | | | .265 | 282.3 | .214 | 230.9 |
| 6 | 6.625 | | | .316 | 417.5 | .255 | 336.9 |
| 8 | 8.625 | | | .410 | 676.5 | .332 | 553.4 |
| 10 | 10.750 | | | .511 | 1051.6 | .413 | 858.9 |
| 12 | 12.750 | | | | | .490 | 1208.5 |
| 14 | 14.000 | | | | | .538 | 1472.0 |
| 16 | 16.000 | | | | | .615 | 1919.0 |

Note: All dimensions are in inches.

## Socket Dimensions For Belled-End Pipe

| NOM. Pipe size | ASTM Standard | SOCKET ENTRANCE (A) | | SOCKET BOTTOM (B) | | SOCKET LENGTH (C) | | |
|---|---|---|---|---|---|---|---|---|
| | | I.D. Min. | I.D. Max. | I.D. Min. | I.D. Max. | SDR | Schedule 40 | Schedule 80 |
| 1/2 | D 2672 | .844 | 0.852 | 0.832 | 0.840 | 2.000 | 2.000 | 1.000 |
| 3/4 | D 2672 | 1.054 | 1.062 | 1.042 | 1.050 | 2.250 | 2.250 | 1.250 |
| 1 | D 2672 | 1.320 | 1.330 | 1.305 | 1.315 | 2.500 | 2.500 | 1.500 |
| 1 1/4 | D 2672 | 1.665 | 1.675 | 1.650 | 1.660 | 2.750 | 2.750 | 1.750 |
| 1 1/2 | D 2672 | 1.906 | 1.918 | 1.888 | 1.900 | 3.000 | 3.000 | 2.000 |
| 2 | D 2672 | 2.381 | 2.393 | 2.357 | 2.369 | 4.000 | — | 2.250 |
| 2 | F 480 | 2.380 | 2.392 | 2.357 | 2.369 | — | 4.000 | — |
| 2 1/2 | D 2672 | 2.882 | 2.896 | 2.854 | 2.868 | 4.000 | — | 2.500 |
| 2 1/2 | F 480 | 2.880 | 2.894 | 2.854 | 2.868 | — | 4.000 | — |
| 3 | D 2672 | 3.508 | 3.524 | 3.476 | 3.492 | 4.000 | — | 3.250 |
| 3 | F 480 | 3.506 | 3.522 | 3.476 | 3.492 | — | 4.000 | — |
| 4 | D 2672 | 4.509 | 4.527 | 4.473 | 4.491 | 5.000 | — | 4.000 |
| 4 | F 480 | 4.508 | 4.526 | 4.473 | 4.491 | — | 5.000 | — |
| 6 | D 2672 | 6.636 | 6.658 | 6.592 | 6.614 | 6.500 | — | 6.000 |
| 6 | F 480 | 6.637 | 6.659 | 6.592 | 6.614 | — | 6.500 | — |
| 8 | D 2672 | 8.640 | 8.670 | 8.583 | 8.613 | — | — | 6.000 |
| 8 | F 480 | 8.634 | 8.664 | 8.583 | 8.613 | — | 7.000 | — |
| 10 | D 2672 | 10.761 | 10.791 | 10.707 | 10.737 | — | 9.000 | 7.500 |
| 12 | D 2672 | 12.763 | 12.793 | 12.706 | 12.736 | — | 10.000 | 8.500 |
| 14 | D 2672 | 14.020 | 14.050 | 13.970 | 14.000 | — | 10.000 | 9.000 |
| 16 | D 2672 | 16.030 | 16.060 | 15.965 | 15.995 | — | 10.000 | 10.000 |

Note: All dimensions are in inches.



## MAXIMUM OPERATING PRESSURE (PSI) AT 73°F

| Nominal Pipe Size | Schedule 80 PVC and CPVC | | Schedule 40 PVC and CPVC (2) | SDR 26 PVC (2) | SDR 21 PVC (2) | SDR 13.5 PVC (2) |
|---|---|---|---|---|---|---|
| | Plain End | Threaded | | | | |
| 1/4 | 1130 | 570 | 780 | — | — | — |
| 3/8 | 920 | 460 | 620 | — | — | — |
| 1/2 | 850 | 420 | 600 | — | — | 315 |
| 3/4 | 690 | 340 | 480 | — | 200 | — |
| 1 | 630 | 320 | 450 | — | 200 | — |
| 1 1/4 | 520 | 260 | 370 | 160 | 200 | — |
| 1 1/2 | 470 | 240 | 330 | 160 | 200 | — |
| 2 | 400 | 200 | 280 | 160 | 200 | — |
| 2 1/2 | 420 | 210 | 300 | 160 | 200 | — |
| 3 | 370 | 190 | 260 | 160 | 200 | — |
| 4 | 320 | 160 | 220 | 160 | 200 | — |
| 5 | 290 | Threading | 190 | 160 | 200 | — |
| 6 | 280 | pipe above | 180 | 160 | 200 | — |
| 8 | 250 | 4" is not | 160 | 160 | 200 | — |
| 10 | 230 | recommended | 140 | 160 | 200 | — |
| 12 | 230 | | 130 | 160 | 200 | — |
| 14 | 220 (1) | | 130 (1) | 160 | — | — |
| 16 | 220 (1) | | 130 (1) | 160 | — | — |

The operating pressures listed above are based on the hydrostatic design of the pipe using water at 73° F as the test medium. See page 17 for correction factors for temperatures above 73° F.

The PVC pipe shown is for PVC 1120 with a cell class of 12454. The CPVC pipe shown is for CPVC 4120 with a cell class of 24448 or 23447.

The pressure ratings for the pipe shown were derived by using the following equation:

$$P = \frac{2ST}{D-T}$$

Where: **P** = pressure (psi)
**D** = average outside diameter
**T** = minimum wall thickness
**S** = hydrostatic design stress (HDS)*

*The HDS for Charlotte Pipe and Foundry's PVC and CPVC compounds is 2,000 psi.
(1) PVC only.
(2) Threading is not recommended. Also, PVC and CPVC Schedule 80 pipe operating above 130° F should not be threaded.

**PVC AND CPVC PIPING PRODUCTS ARE NOT RECOMMENDED FOR SYSTEMS WHICH TRANSPORT OR STORE COMPRESSED AIR OR GASES. DO NOT TEST PVC OR CPVC PIPING SYSTEMS WITH COMPRESSED AIR OR GASES. ALWAYS BLEED ALL ENTRAPPED AIR FROM THE SYSTEM PRIOR TO TESTING.**

# PRESSURE/TEMPERATURE RELATIONSHIP

The operating pressure of PVC and CPVC pipe will be reduced as the operating temperature increases above 73° F. To calculate this reduction, multiply the operating pressures shown on the previous page by the correction factors shown below:

| Operating Temperature (°F) | Correction Factors PVC | CPVC |
|---|---|---|
| 73 | 1.00 | 1.00 |
| 80 | .88 | 1.00 |
| 90 | .75 | .91 |
| 100 | .62 | .82 |
| 110 | .50 | .77 |
| 120 | .40 | .65 |
| 130 | .30 | .62 |
| 140 | .22 | .50 |
| 150 | NR | .47 |
| 160 | NR | .40 |
| 170 | NR | .32 |
| 180 | NR | .25 |
| 200 | NR | .20 |

For example, the operating pressure for 6" Schedule 80 CPVC pipe is 280 psi. If the operating temperature is 140° F, the maximum operating pressure is now 140 psi (280 x .50).

Note: Operating temperatures above 140° F for PVC and 200° F for CPVC piping products are not recommended.

# Friction Loss

Friction loss through PVC and CPVC pipe is normally obtained by using the Hazen-Williams equation shown below for water:

$$f = 0.2083 \times \left(\frac{100}{C}\right)^{1.852} \times \frac{Q^{1.852}}{di^{4.8655}}$$

where:

**f** = friction head loss in feet of water per 100 feet of pipe
**C** = constant for inside pipe roughness (C = 150 for PVC and CPVC pipe)
**Q** = flow in U.S. gallons per minute
**di** = inside diameter of pipe in inches

## Water Velocities

Water velocities in feet per second may be calculated as follows:

$$V = 0.408709 \frac{Q}{di^2}$$

where:

**V** = velocity in feet per second
**Q** = flow in U.S. gallons per minute
**di** = inside diameter of pipe in inches

## Manning Roughness Factor ("N" Value)

Another flow coefficient that is used is the Manning "N" value. This coefficient relates to the interior wall smoothness of pipe and is used for liquids with a steady flow, at a constant depth, in a prismatic open channel.

Laboratory tests have shown that the "N" value for PVC and CPVC pipe ranges from .008 to .012. The table below shows "N" values for other piping materials.

### "N" Values For Typical Piping Materials

| Piping Material | "N" Values |
|---|---|
| Cast Iron | .011 - .015 |
| Finished Concrete | .011 - .015 |
| Unfinished Concrete | .013 - .017 |
| Corrugated Metal | .021 - .027 |
| Glass | .009 - .013 |
| Clay | .011 - .017 |

# Friction Loss Through Fittings

The friction loss through fittings is considered to be equivalent to the loss through a certain number of linear feet of pipe of the same diameter as the fittings. To determine the loss through a piping system, add together the number of "equivalent feet" calculated for the fittings in the system.

The chart below shows approximate friction losses, in equivalent feet, for a variety of PVC and CPVC fittings of different sizes.

### Approximate Friction Loss For PVC and CPVC Fittings In Equivalent Feet Of Straight Pipe

| Fitting | 1/2" | 3/4" | 1" | 1 1/4" | 1 1/2" | 2" | 2 1/2" | 3" | 4" | 6" | 8" |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Tee (Run) | 1.0 | 1.4 | 1.7 | 2.3 | 2.7 | 4.3 | 5.1 | 6.2 | 8.3 | 12.5 | 16.5 |
| Tee (Branch) | 4.0 | 5.0 | 6.0 | 7.3 | 8.4 | 12.0 | 15.0 | 16.4 | 22.0 | 32.7 | 49.0 |
| 90° Elbow | 1.5 | 2.0 | 2.5 | 3.8 | 4.0 | 5.7 | 6.9 | 7.9 | 12.0 | 18.0 | 22.0 |
| 45° Elbow | .80 | 1.1 | 1.4 | 1.8 | 2.1 | 2.6 | 3.1 | 4.0 | 5.1 | 8.0 | 10.6 |
| Male/Female Adapter | 1.0 | 1.5 | 2.0 | 2.75 | 3.5 | 4.5 | 5.5 | 6.5 | 9.0 | 14.0 | — |

The tables on pages 19-22 show friction heads in feet and friction losses in psi. They also show the gallons per minute (GPM) and velocities (in feet per second) for various pipe sizes.

# FRICTION LOSS AND FLOW VELOCITY FOR SCHEDULE 40 THERMOPLASTIC PIPE

(Friction head and friction loss are per 100 feet of pipe.) CAUTION: Flow velocity should not exceed 5 feet per second. PVC and CPVC pipe cannot be used for compressed air service.

**1/2 in.**

| Gallons Per Minute | Velocity Feet Per Second | Friction Head Feet | Friction Loss Pounds Per Square Inch |
|---|---|---|---|
| 1 | 1.13 | 2.08 | 0.90 |
| 2 | 2.26 | 4.16 | 1.80 |
| 5 | 5.64 | 23.44 | 10.15 |
| 7 | 7.90 | 43.06 | 18.64 |
| 10 | 11.28 | 82.02 | 35.51 |

**3/4 in.**

| Gallons Per Minute | Velocity Feet Per Second | Friction Head Feet | Friction Loss Pounds Per Square Inch |
|---|---|---|---|
| 1 | 0.63 | 0.51 | 0.22 |
| 2 | 1.26 | 1.02 | 0.44 |
| 5 | 3.16 | 5.73 | 2.48 |
| 7 | 4.43 | 10.52 | 4.56 |
| 10 | 6.32 | 20.04 | 8.68 |
| 15 | 9.48 | 42.46 | 18.39 |
| 20 | 12.65 | 72.34 | 31.32 |

**1 in.**

| Gallons Per Minute | Velocity Feet Per Second | Friction Head Feet | Friction Loss Pounds Per Square Inch |
|---|---|---|---|
| 2 | 0.77 | 0.55 | 0.24 |
| 5 | 1.93 | 1.72 | 0.75 |
| 7 | 2.72 | 3.17 | 1.37 |
| 10 | 3.86 | 6.02 | 2.61 |
| 15 | 5.79 | 12.77 | 5.53 |
| 20 | 7.72 | 21.75 | 9.42 |
| 25 | 9.65 | 32.88 | 14.22 |
| 30 | 11.58 | 46.08 | 19.95 |

**1 1/4 in.**

| Gallons Per Minute | Velocity Feet Per Second | Friction Head Feet | Friction Loss Pounds Per Square Inch |
|---|---|---|---|
| 2 | 0.44 | 0.14 | 0.06 |
| 5 | 1.11 | 0.44 | 0.19 |
| 7 | 1.55 | 0.81 | 0.35 |
| 10 | 2.21 | 1.55 | 0.67 |
| 15 | 3.31 | 3.28 | 1.42 |
| 20 | 4.42 | 5.59 | 2.42 |
| 25 | 5.52 | 8.45 | 3.66 |
| 30 | 6.63 | 11.85 | 5.13 |
| 35 | 7.73 | 15.76 | 6.82 |
| 40 | 8.84 | 20.18 | 8.74 |
| 45 | 9.94 | 25.10 | 10.87 |
| 50 | 11.05 | 30.51 | 13.21 |

**1 1/2 in.**

| Gallons Per Minute | Velocity Feet Per Second | Friction Head Feet | Friction Loss Pounds Per Square Inch |
|---|---|---|---|
| 2 | 0.33 | 0.07 | 0.03 |
| 5 | 0.81 | 0.22 | 0.09 |
| 7 | 1.13 | 0.38 | 0.17 |
| 10 | 1.62 | 0.72 | 0.31 |
| 15 | 2.42 | 1.53 | 0.66 |
| 20 | 3.23 | 2.61 | 1.13 |
| 25 | 4.04 | 3.95 | 1.71 |
| 30 | 4.85 | 5.53 | 2.39 |
| 35 | 5.66 | 7.36 | 3.19 |
| 40 | 6.47 | 9.43 | 4.08 |
| 45 | 7.27 | 11.73 | 5.08 |
| 50 | 8.08 | 14.25 | 6.17 |
| 60 | 9.70 | 19.98 | 8.65 |

**2 in.**

| Gallons Per Minute | Velocity Feet Per Second | Friction Head Feet | Friction Loss Pounds Per Square Inch |
|---|---|---|---|
| 5 | 0.49 | 0.066 | 0.029 |
| 7 | 0.69 | 0.11 | 0.048 |
| 10 | 0.98 | 0.21 | 0.091 |
| 15 | 1.46 | 0.45 | 0.19 |
| 20 | 1.95 | 0.76 | 0.33 |
| 25 | 2.44 | 1.15 | 0.50 |
| 30 | 2.93 | 1.62 | 0.70 |
| 35 | 3.41 | 2.15 | 0.93 |
| 40 | 3.90 | 2.75 | 1.19 |
| 45 | 4.39 | 3.43 | 1.49 |
| 50 | 4.88 | 4.16 | 1.80 |
| 60 | 5.85 | 5.84 | 2.53 |
| 70 | 6.83 | 7.76 | 3.36 |
| 75 | 7.32 | 8.82 | 3.82 |
| 80 | 7.80 | 9.94 | 4.30 |
| 90 | 8.78 | 12.37 | 5.36 |
| 100 | 9.75 | 15.03 | 6.51 |

**2 1/2 in.**

| Gallons Per Minute | Velocity Feet Per Second | Friction Head Feet | Friction Loss Pounds Per Square Inch |
|---|---|---|---|
| 5 | 0.30 | 0.038 | 0.016 |
| 7 | 0.49 | 0.051 | 0.023 |
| 10 | 0.68 | 0.09 | 0.039 |
| 15 | 1.03 | 0.19 | 0.082 |
| 20 | 1.37 | 0.32 | 0.14 |
| 25 | 1.71 | 0.49 | 0.21 |
| 30 | 2.05 | 0.68 | 0.29 |
| 35 | 2.39 | 0.91 | 0.39 |
| 40 | 2.73 | 1.16 | 0.50 |
| 45 | 3.08 | 1.44 | 0.62 |
| 50 | 3.42 | 1.75 | 0.76 |
| 60 | 4.10 | 2.46 | 1.07 |
| 70 | 4.79 | 3.27 | 1.42 |
| 75 | 5.13 | 3.71 | 1.61 |
| 80 | 5.47 | 4.19 | 1.81 |
| 90 | 6.15 | 5.21 | 2.26 |
| 100 | 6.84 | 6.33 | 2.74 |
| 125 | 8.55 | 9.58 | 4.15 |
| 150 | 10.26 | 13.41 | 5.81 |

**3 in.**

| Gallons Per Minute | Velocity Feet Per Second | Friction Head Feet | Friction Loss Pounds Per Square Inch |
|---|---|---|---|
| 5 | 0.22 | 0.015 | 0.007 |
| 7 | 0.31 | 0.021 | 0.009 |
| 10 | 0.44 | 0.03 | 0.013 |
| 15 | 0.66 | 0.07 | 0.030 |
| 20 | 0.88 | 0.11 | 0.048 |
| 25 | 1.10 | 0.17 | 0.074 |
| 30 | 1.33 | 0.23 | 0.10 |
| 35 | 1.55 | 0.31 | 0.13 |
| 40 | 1.77 | 0.40 | 0.17 |
| 45 | 1.99 | 0.50 | 0.22 |
| 50 | 2.21 | 0.60 | 0.26 |
| 60 | 2.65 | 0.85 | 0.37 |
| 70 | 3.09 | 1.13 | 0.49 |
| 75 | 3.31 | 1.28 | 0.55 |
| 80 | 3.53 | 1.44 | 0.62 |
| 90 | 3.98 | 1.80 | 0.78 |
| 100 | 4.42 | 2.18 | 0.94 |
| 125 | 5.52 | 3.31 | 1.43 |
| 150 | 6.63 | 4.63 | 2.00 |
| 175 | 7.73 | 6.16 | 2.67 |
| 200 | 8.83 | 7.88 | 3.41 |
| 250 | 11.04 | 11.93 | 5.17 |

**4 in.**

| Gallons Per Minute | Velocity Feet Per Second | Friction Head Feet | Friction Loss Pounds Per Square Inch |
|---|---|---|---|
| 20 | 0.51 | 0.03 | 0.013 |
| 25 | 0.64 | 0.04 | 0.017 |
| 30 | 0.77 | 0.06 | 0.026 |
| 35 | 0.89 | 0.08 | 0.035 |
| 40 | 1.02 | 0.11 | 0.048 |
| 45 | 1.15 | 0.13 | 0.056 |
| 50 | 1.28 | 0.16 | 0.069 |
| 60 | 1.53 | 0.22 | 0.095 |
| 70 | 1.79 | 0.30 | 0.13 |
| 75 | 1.92 | 0.34 | 0.15 |
| 80 | 2.05 | 0.38 | 0.16 |
| 90 | 2.30 | 0.47 | 0.20 |
| 100 | 2.56 | 0.58 | 0.25 |
| 125 | 3.20 | 0.88 | 0.38 |
| 150 | 3.84 | 1.22 | 0.53 |
| 175 | 4.48 | 1.63 | 0.71 |
| 200 | 5.11 | 2.08 | 0.90 |
| 250 | 6.40 | 3.15 | 1.36 |
| 300 | 7.67 | 4.41 | 1.91 |
| 350 | 8.95 | 5.87 | 2.55 |
| 400 | 10.23 | 7.52 | 3.26 |

**5 in.**

| Gallons Per Minute | Velocity Feet Per Second | Friction Head Feet | Friction Loss Pounds Per Square Inch |
|---|---|---|---|
| 30 | 0.49 | 0.02 | 0.009 |
| 35 | 0.57 | 0.03 | 0.013 |
| 40 | 0.65 | 0.03 | 0.013 |
| 45 | 0.73 | 0.04 | 0.017 |
| 50 | 0.81 | 0.05 | 0.022 |
| 60 | 0.97 | 0.07 | 0.030 |
| 70 | 1.14 | 0.10 | 0.043 |
| 75 | 1.22 | 0.11 | 0.048 |
| 80 | 1.30 | 0.13 | 0.056 |
| 90 | 1.46 | 0.16 | 0.069 |
| 100 | 1.62 | 0.19 | 0.082 |
| 125 | 2.03 | 0.29 | 0.125 |
| 150 | 2.44 | 0.40 | 0.17 |
| 175 | 2.84 | 0.54 | 0.235 |
| 200 | 3.25 | 0.69 | 0.30 |
| 250 | 4.06 | 1.05 | 0.45 |
| 300 | 4.87 | 1.46 | 0.63 |
| 350 | 5.69 | 1.95 | 0.85 |
| 400 | 6.50 | 2.49 | 1.08 |
| 450 | 7.31 | 3.09 | 1.34 |
| 500 | 8.12 | 3.76 | 1.63 |

**6 in.**

| Gallons Per Minute | Velocity Feet Per Second | Friction Head Feet | Friction Loss Pounds Per Square Inch |
|---|---|---|---|
| 50 | 0.56 | 0.02 | 0.009 |
| 60 | 0.67 | 0.03 | 0.013 |
| 70 | 0.79 | 0.04 | 0.017 |
| 75 | 0.84 | 0.05 | 0.022 |
| 80 | 0.90 | 0.05 | 0.022 |
| 90 | 1.01 | 0.06 | 0.026 |
| 100 | 1.12 | 0.08 | 0.035 |
| 125 | 1.41 | 0.12 | 0.052 |
| 150 | 1.69 | 0.16 | 0.069 |
| 175 | 1.97 | 0.22 | 0.096 |
| 200 | 2.25 | 0.28 | 0.12 |
| 250 | 2.81 | 0.43 | 0.19 |
| 300 | 3.37 | 0.60 | 0.26 |
| 350 | 3.94 | 0.79 | 0.34 |
| 400 | 4.49 | 1.01 | 0.44 |
| 450 | 5.06 | 1.26 | 0.55 |
| 500 | 5.62 | 1.53 | 0.66 |
| 750 | 8.43 | 3.25 | 1.41 |
| 1000 | 11.24 | 5.54 | 2.40 |

**8 in.**

| Gallons Per Minute | Velocity Feet Per Second | Friction Head Feet | Friction Loss Pounds Per Square Inch |
|---|---|---|---|
| 125 | 0.65 | 0.03 | 0.012 |
| 150 | 0.81 | 0.035 | 0.015 |
| 175 | 0.97 | 0.04 | 0.017 |
| 200 | 1.14 | 0.055 | 0.024 |
| 250 | 1.30 | 0.07 | 0.030 |
| 300 | 1.63 | 0.11 | 0.048 |
| 350 | 1.94 | 0.16 | 0.069 |
| 400 | 2.27 | 0.21 | 0.091 |
| 450 | 2.59 | 0.27 | 0.12 |
| 500 | 2.92 | 0.33 | 0.14 |
| 750 | 3.24 | 0.40 | 0.17 |
| 1000 | 4.86 | 0.85 | 0.37 |
| 1250 | 6.48 | 1.45 | 0.63 |
| 1500 | 8.11 | 2.20 | 0.95 |
| 2000 | 9.72 | 3.07 | 1.33 |

**10 in.**

| Gallons Per Minute | Velocity Feet Per Second | Friction Head Feet | Friction Loss Pounds Per Square Inch |
|---|---|---|---|
| 200 | 0.82 | 0.027 | 0.012 |
| 250 | 1.03 | 0.035 | 0.015 |
| 300 | 1.23 | 0.05 | 0.022 |
| 350 | 1.44 | 0.065 | 0.028 |
| 400 | 1.64 | 0.09 | 0.039 |
| 450 | 1.85 | 0.11 | 0.048 |
| 500 | 2.05 | 0.13 | 0.056 |
| 750 | 3.08 | 0.28 | 0.12 |
| 1000 | 4.11 | 0.48 | 0.21 |
| 1250 | 5.14 | 0.73 | 0.32 |
| 1500 | 6.16 | 1.01 | 0.44 |
| 2000 | 8.21 | 1.72 | 0.74 |
| 2500 | 10.27 | 2.61 | 1.13 |

**12 in.**

| Gallons Per Minute | Velocity Feet Per Second | Friction Head Feet | Friction Loss Pounds Per Square Inch |
|---|---|---|---|
| 350 | 1.01 | 0.027 | 0.012 |
| 400 | 1.16 | 0.04 | 0.017 |
| 450 | 1.30 | 0.05 | 0.022 |
| 500 | 1.45 | 0.06 | 0.026 |
| 750 | 2.17 | 0.12 | 0.052 |
| 1000 | 2.89 | 0.20 | 0.087 |
| 1250 | 3.62 | 0.31 | 0.13 |
| 1500 | 4.34 | 0.43 | 0.19 |
| 2000 | 5.78 | 0.73 | 0.32 |
| 2500 | 7.23 | 1.11 | 0.49 |
| 3000 | 8.68 | 1.55 | 0.67 |
| 3500 | 10.12 | 2.07 | 0.90 |
| 4000 | 11.07 | 2.66 | 1.15 |

**14 in.**

| Gallons Per Minute | Velocity Feet Per Second | Friction Head Feet | Friction Loss Pounds Per Square Inch |
|---|---|---|---|
| 500 | 1.18 | 0.03 | 0.01 |
| 750 | 1.77 | 0.07 | 0.03 |
| 1000 | 2.37 | 0.12 | 0.05 |
| 1250 | 2.96 | 0.19 | 0.08 |
| 1500 | 3.56 | 0.27 | 0.12 |
| 2000 | 4.74 | 0.46 | 0.20 |
| 2500 | 5.93 | 0.70 | 0.30 |
| 3000 | 7.12 | 0.98 | 0.42 |
| 3500 | 8.30 | 1.30 | 0.56 |
| 4000 | 9.49 | 1.67 | 0.72 |
| 4500 | 10.68 | 2.08 | 0.90 |
| 5000 | 11.86 | 2.53 | 1.09 |
| 5500 | 13.05 | 3.02 | 1.31 |
| 6000 | 14.24 | 3.55 | 1.54 |
| 6500 | 15.42 | 4.11 | 1.78 |
| 7000 | 16.61 | 4.72 | 2.04 |
| 7500 | 17.79 | 5.36 | 2.32 |

**16 in.**

| Gallons Per Minute | Velocity Feet Per Second | Friction Head Feet | Friction Loss Pounds Per Square Inch |
|---|---|---|---|
| 500 | 0.91 | 0.02 | 0.01 |
| 750 | 1.36 | 0.04 | 0.02 |
| 1000 | 1.82 | 0.07 | 0.03 |
| 1250 | 2.27 | 0.10 | 0.04 |
| 1500 | 2.72 | 0.14 | 0.06 |
| 2000 | 3.63 | 0.24 | 0.10 |
| 2500 | 4.54 | 0.37 | 0.16 |
| 3000 | 5.45 | 0.51 | 0.22 |
| 3500 | 6.36 | 0.68 | 0.29 |
| 4000 | 7.26 | 0.87 | 0.38 |
| 4500 | 8.17 | 1.09 | 0.47 |
| 5000 | 9.08 | 1.32 | 0.57 |
| 5500 | 9.99 | 1.58 | 0.68 |
| 6000 | 10.90 | 1.85 | 0.80 |
| 6500 | 11.80 | 2.15 | 0.93 |
| 7000 | 12.71 | 2.46 | 1.06 |
| 7500 | 13.62 | 2.80 | 1.21 |
| 8000 | 14.53 | 3.15 | 1.37 |
| 8500 | 15.44 | 3.53 | 1.53 |
| 9000 | 16.35 | 3.92 | 1.69 |
| 9500 | 17.26 | 4.34 | 1.87 |
| 10000 | 18.16 | 4.77 | 2.06 |

# FRICTION LOSS AND FLOW VELOCITY FOR SCHEDULE 80 THERMOPLASTIC PIPE

(Friction head and friction loss are per 100 feet of pipe.)

CAUTION: Flow velocity should not exceed 5 feet per second. PVC and CPVC pipe cannot be used for compressed air service.

| Gallons Per Minute | ½ in. Velocity Feet Per Second | ½ in. Friction Head Feet | ½ in. Friction Loss Pounds Per Square Inch | 4 in. Velocity Feet Per Second | 4 in. Friction Head Feet | 4 in. Friction Loss Pounds Per Square Inch |
|---|---|---|---|---|---|---|
| 1 | 1.48 | 4.02 | 1.74 | | | |
| 2 | 2.95 | 8.03 | 3.48 | | | |
| 5 | 7.39 | 45.23 | 19.59 | | | |
| 7 | 10.34 | 83.07 | 35.97 | | | |
| 10 | | | | | | |
| 15 | | | | | | |
| 20 | | | | 0.57 | 0.04 | 0.017 |
| 25 | | | | 0.72 | 0.06 | 0.026 |
| 30 | | | | 0.86 | 0.08 | 0.035 |
| 35 | | | | 1.00 | 0.11 | 0.048 |
| 40 | | | | 1.15 | 0.14 | 0.061 |
| 45 | | | | 1.29 | 0.17 | 0.074 |
| 50 | | | | 1.43 | 0.21 | 0.091 |
| 60 | | | | 1.72 | 0.30 | 0.13 |
| 70 | | | | 2.01 | 0.39 | 0.17 |
| 75 | | | | 2.15 | 0.45 | 0.19 |
| 80 | | | | 2.29 | 0.50 | 0.22 |
| 90 | | | | 2.58 | 0.63 | 0.27 |
| 100 | | | | 2.87 | 0.76 | 0.33 |
| 125 | | | | 3.59 | 1.16 | 0.50 |
| 150 | | | | 4.30 | 1.61 | 0.70 |
| 175 | | | | 5.02 | 2.15 | 0.93 |
| 200 | | | | 5.73 | 2.75 | 1.19 |
| 250 | | | | 7.16 | 4.16 | 1.81 |
| 300 | | | | 8.60 | 5.83 | 2.52 |
| 350 | | | | 10.03 | 7.76 | 3.36 |
| 400 | | | | 11.47 | 9.93 | 4.30 |
| 450 | | | | | | |
| 500 | | | | | | |
| 750 | | | | | | |
| 1000 | | | | | | |
| 1250 | | | | | | |
| 1500 | | | | | | |
| 2000 | | | | | | |
| 2500 | | | | | | |
| 3000 | | | | | | |
| 3500 | | | | | | |
| 4000 | | | | | | |
| 4500 | | | | | | |
| 5000 | | | | | | |
| 5500 | | | | | | |
| 6000 | | | | | | |
| 6500 | | | | | | |
| 7000 | | | | | | |
| 7500 | | | | | | |
| 8000 | | | | | | |
| 8500 | | | | | | |
| 9000 | | | | | | |
| 9500 | | | | | | |
| 10000 | | | | | | |

| Gallons Per Minute | ¾ in. Velocity Feet Per Second | ¾ in. Friction Head Feet | ¾ in. Friction Loss Pounds Per Square Inch | 5 in. Velocity Feet Per Second | 5 in. Friction Head Feet | 5 in. Friction Loss Pounds Per Square Inch |
|---|---|---|---|---|---|---|
| 1 | 0.74 | 0.86 | 0.37 | | | |
| 2 | 1.57 | 1.72 | 0.74 | | | |
| 5 | 3.92 | 9.67 | 4.19 | | | |
| 7 | 5.49 | 17.76 | 7.69 | | | |
| 10 | 7.84 | 33.84 | 14.65 | | | |
| 15 | 11.76 | 71.70 | 31.05 | | | |
| 30 | | | | 0.54 | 0.03 | 0.013 |
| 35 | | | | 0.63 | 0.04 | 0.017 |
| 40 | | | | 0.72 | 0.04 | 0.017 |
| 45 | | | | 0.81 | 0.06 | 0.026 |
| 50 | | | | 0.90 | 0.07 | 0.030 |
| 60 | | | | 1.08 | 0.10 | 0.043 |
| 70 | | | | 1.26 | 0.13 | 0.056 |
| 75 | | | | 1.35 | 0.14 | 0.061 |
| 80 | | | | 1.44 | 0.16 | 0.069 |
| 90 | | | | 1.62 | 0.20 | 0.087 |
| 100 | | | | 1.80 | 0.24 | 0.10 |
| 125 | | | | 2.25 | 0.37 | 0.16 |
| 150 | | | | 2.70 | 0.52 | 0.23 |
| 175 | | | | 3.15 | 0.69 | 0.30 |
| 200 | | | | 3.60 | 0.88 | 0.38 |
| 250 | | | | 4.50 | 1.34 | 0.58 |
| 300 | | | | 5.40 | 1.87 | 0.81 |
| 350 | | | | 6.30 | 2.49 | 1.08 |
| 400 | | | | 7.19 | 3.19 | 1.38 |
| 450 | | | | 8.09 | 3.97 | 1.72 |
| 500 | | | | 8.99 | 4.82 | 2.09 |

| Gallons Per Minute | 1 in. Velocity Feet Per Second | 1 in. Friction Head Feet | 1 in. Friction Loss Pounds Per Square Inch | 6 in. Velocity Feet Per Second | 6 in. Friction Head Feet | 6 in. Friction Loss Pounds Per Square Inch |
|---|---|---|---|---|---|---|
| 2 | 0.94 | 0.88 | 0.38 | | | |
| 5 | 2.34 | 2.75 | 1.19 | | | |
| 7 | 3.28 | 5.04 | 2.19 | | | |
| 10 | 4.68 | 9.61 | 4.16 | | | |
| 15 | 7.01 | 20.36 | 8.82 | | | |
| 20 | 9.35 | 34.68 | 15.02 | | | |
| 25 | 11.69 | 52.43 | 22.70 | | | |
| 30 | 14.03 | 73.48 | 31.82 | | | |
| 50 | | | | 0.63 | 0.03 | 0.013 |
| 60 | | | | 0.75 | 0.04 | 0.017 |
| 70 | | | | 0.88 | 0.05 | 0.022 |
| 75 | | | | 0.94 | 0.06 | 0.026 |
| 80 | | | | 1.00 | 0.07 | 0.030 |
| 90 | | | | 1.13 | 0.08 | 0.035 |
| 100 | | | | 1.25 | 0.10 | 0.043 |
| 125 | | | | 1.57 | 0.16 | 0.068 |
| 150 | | | | 1.88 | 0.22 | 0.095 |
| 175 | | | | 2.20 | 0.29 | 0.12 |
| 200 | | | | 2.51 | 0.37 | 0.16 |
| 250 | | | | 3.14 | 0.56 | 0.24 |
| 300 | | | | 3.76 | 0.78 | 0.34 |
| 350 | | | | 4.39 | 1.04 | 0.45 |
| 400 | | | | 5.02 | 1.33 | 0.58 |
| 450 | | | | 5.64 | 1.65 | 0.71 |
| 500 | | | | 6.27 | 2.00 | 0.87 |
| 750 | | | | 9.40 | 4.25 | 1.84 |
| 1000 | | | | 12.54 | 7.23 | 3.13 |

| Gallons Per Minute | 1¼ in. Velocity Feet Per Second | 1¼ in. Friction Head Feet | 1¼ in. Friction Loss Pounds Per Square Inch | 8 in. Velocity Feet Per Second | 8 in. Friction Head Feet | 8 in. Friction Loss Pounds Per Square Inch |
|---|---|---|---|---|---|---|
| 2 | 0.52 | 0.21 | 0.09 | | | |
| 5 | 1.30 | 0.66 | 0.29 | | | |
| 7 | 1.82 | 1.21 | 0.53 | | | |
| 10 | 2.60 | 2.30 | 1.00 | | | |
| 15 | 3.90 | 4.87 | 2.11 | | | |
| 20 | 5.20 | 8.30 | 3.59 | | | |
| 25 | 6.50 | 12.55 | 5.43 | | | |
| 30 | 7.80 | 17.59 | 7.62 | | | |
| 35 | 9.10 | 23.40 | 10.13 | | | |
| 40 | 10.40 | 29.97 | 12.98 | | | |
| 45 | 11.70 | 37.27 | 16.14 | | | |
| 50 | 13.00 | 45.30 | 19.61 | | | |
| 125 | | | | 0.90 | 0.045 | 0.019 |
| 150 | | | | 1.07 | 0.05 | 0.022 |
| 175 | | | | 1.25 | 0.075 | 0.033 |
| 200 | | | | 1.43 | 0.09 | 0.039 |
| 250 | | | | 1.79 | 0.14 | 0.61 |
| 300 | | | | 2.14 | 0.20 | 0.087 |
| 350 | | | | 2.50 | 0.27 | 0.12 |
| 400 | | | | 2.86 | 0.34 | 0.15 |
| 450 | | | | 3.21 | 0.42 | 0.18 |
| 500 | | | | 3.57 | 0.51 | 0.22 |
| 750 | | | | 5.36 | 1.08 | 0.47 |
| 1000 | | | | 7.14 | 1.84 | 0.80 |
| 1250 | | | | 8.93 | 2.78 | 1.20 |
| 1500 | | | | 10.71 | 3.98 | 1.68 |

| Gallons Per Minute | 1½ in. Velocity Feet Per Second | 1½ in. Friction Head Feet | 1½ in. Friction Loss Pounds Per Square Inch | 10 in. Velocity Feet Per Second | 10 in. Friction Head Feet | 10 in. Friction Loss Pounds Per Square Inch |
|---|---|---|---|---|---|---|
| 2 | 0.38 | 0.10 | 0.041 | | | |
| 5 | 0.94 | 0.30 | 0.126 | | | |
| 7 | 1.32 | 0.55 | 0.24 | | | |
| 10 | 1.88 | 1.04 | 0.45 | | | |
| 15 | 2.81 | 2.20 | 0.95 | | | |
| 20 | 3.75 | 3.75 | 1.62 | | | |
| 25 | 4.69 | 5.67 | 2.46 | | | |
| 30 | 5.63 | 7.95 | 3.44 | | | |
| 35 | 6.57 | 10.58 | 4.58 | | | |
| 40 | 7.50 | 13.55 | 5.87 | | | |
| 45 | 8.44 | 16.85 | 7.30 | | | |
| 50 | 9.38 | 20.48 | 8.87 | | | |
| 60 | 11.26 | 28.70 | 12.43 | | | |
| 200 | | | | 0.90 | 0.036 | 0.015 |
| 250 | | | | 1.14 | 0.045 | 0.02 |
| 300 | | | | 1.36 | 0.07 | 0.03 |
| 350 | | | | 1.59 | 0.085 | 0.037 |
| 400 | | | | 1.81 | 0.11 | 0.048 |
| 450 | | | | 2.04 | 0.14 | 0.061 |
| 500 | | | | 2.27 | 0.17 | 0.074 |
| 750 | | | | 3.40 | 0.36 | 0.16 |
| 1000 | | | | 4.54 | 0.61 | 0.26 |
| 1250 | | | | 5.67 | 0.92 | 0.40 |
| 1500 | | | | 6.80 | 1.29 | 0.56 |
| 2000 | | | | 9.07 | 2.19 | 0.95 |
| 2500 | | | | 11.34 | 3.33 | 1.44 |

| Gallons Per Minute | 2 in. Velocity Feet Per Second | 2 in. Friction Head Feet | 2 in. Friction Loss Pounds Per Square Inch | 12 in. Velocity Feet Per Second | 12 in. Friction Head Feet | 12 in. Friction Loss Pounds Per Square Inch |
|---|---|---|---|---|---|---|
| 5 | 0.56 | 0.10 | 0.040 | | | |
| 7 | 0.78 | 0.15 | 0.065 | | | |
| 10 | 1.12 | 0.29 | 0.13 | | | |
| 15 | 1.68 | 0.62 | 0.27 | | | |
| 20 | 2.23 | 1.06 | 0.46 | | | |
| 25 | 2.79 | 1.60 | 0.69 | | | |
| 30 | 3.35 | 2.25 | 0.97 | | | |
| 35 | 3.91 | 2.99 | 1.29 | | | |
| 40 | 4.47 | 3.83 | 1.66 | | | |
| 45 | 5.03 | 4.76 | 2.07 | | | |
| 50 | 5.58 | 5.79 | 2.51 | | | |
| 60 | 6.70 | 8.12 | 3.52 | | | |
| 70 | 7.82 | 10.80 | 4.68 | | | |
| 75 | 8.38 | 12.27 | 5.31 | | | |
| 80 | 8.93 | 13.83 | 5.99 | | | |
| 90 | 10.05 | 17.20 | 7.45 | | | |
| 100 | 11.17 | 20.90 | 9.05 | | | |
| 350 | | | | 1.12 | 0.037 | 0.016 |
| 400 | | | | 1.28 | 0.05 | 0.022 |
| 450 | | | | 1.44 | 0.06 | 0.026 |
| 500 | | | | 1.60 | 0.07 | 0.030 |
| 750 | | | | 2.40 | 0.15 | 0.065 |
| 1000 | | | | 3.20 | 0.26 | 0.11 |
| 1250 | | | | 4.01 | 0.40 | 0.17 |
| 1500 | | | | 4.81 | 0.55 | 0.24 |
| 2000 | | | | 6.41 | 0.94 | 0.41 |
| 2500 | | | | 8.01 | 1.42 | 0.62 |
| 3000 | | | | 9.61 | 1.99 | 0.86 |
| 3500 | | | | 11.21 | 2.65 | 1.15 |
| 4000 | | | | 12.82 | 3.41 | 1.48 |

| Gallons Per Minute | 2½ in. Velocity Feet Per Second | 2½ in. Friction Head Feet | 2½ in. Friction Loss Pounds Per Square Inch | 14 in. Velocity Feet Per Second | 14 in. Friction Head Feet | 14 in. Friction Loss Pounds Per Square Inch |
|---|---|---|---|---|---|---|
| 5 | 0.39 | 0.05 | 0.022 | | | |
| 7 | 0.54 | 0.07 | 0.032 | | | |
| 10 | 0.78 | 0.12 | 0.052 | | | |
| 15 | 1.17 | 0.26 | 0.11 | | | |
| 20 | 1.56 | 0.44 | 0.19 | | | |
| 25 | 1.95 | 0.67 | 0.29 | | | |
| 30 | 2.34 | 0.94 | 0.41 | | | |
| 35 | 2.73 | 1.25 | 0.54 | | | |
| 40 | 3.12 | 1.60 | 0.69 | | | |
| 45 | 3.51 | 1.99 | 0.86 | | | |
| 50 | 3.90 | 2.42 | 1.05 | | | |
| 60 | 4.68 | 3.39 | 1.47 | | | |
| 70 | 5.46 | 4.51 | 1.95 | | | |
| 75 | 5.85 | 5.12 | 2.22 | | | |
| 80 | 6.24 | 5.77 | 2.50 | | | |
| 90 | 7.02 | 7.18 | 3.11 | | | |
| 100 | 7.80 | 8.72 | 3.78 | | | |
| 125 | 9.75 | 13.21 | 5.72 | | | |
| 150 | 11.70 | 18.48 | 8.00 | | | |
| 500 | | | | 1.31 | 0.04 | 0.02 |
| 750 | | | | 1.96 | 0.09 | 0.04 |
| 1000 | | | | 2.62 | 0.16 | 0.07 |
| 1250 | | | | 3.27 | 0.25 | 0.11 |
| 1500 | | | | 3.92 | 0.34 | 0.15 |
| 2000 | | | | 5.23 | 0.59 | 0.25 |
| 2500 | | | | 6.54 | 0.88 | 0.38 |
| 3000 | | | | 7.85 | 1.24 | 0.54 |
| 3500 | | | | 9.16 | 1.66 | 0.72 |
| 4000 | | | | 10.46 | 2.12 | 0.92 |
| 4500 | | | | 11.77 | 2.64 | 1.14 |
| 5000 | | | | 13.07 | 3.20 | 1.38 |
| 5500 | | | | 14.39 | 3.83 | 1.66 |
| 6000 | | | | 15.70 | 4.49 | 1.95 |
| 6500 | | | | 17.00 | 5.21 | 2.26 |
| 7000 | | | | 18.31 | 5.99 | 2.60 |

| Gallons Per Minute | 3 in. Velocity Feet Per Second | 3 in. Friction Head Feet | 3 in. Friction Loss Pounds Per Square Inch | 16 in. Velocity Feet Per Second | 16 in. Friction Head Feet | 16 in. Friction Loss Pounds Per Square Inch |
|---|---|---|---|---|---|---|
| 5 | 0.25 | 0.02 | 0.009 | | | |
| 7 | 0.35 | 0.028 | 0.012 | | | |
| 10 | 0.50 | 0.04 | 0.017 | | | |
| 15 | 0.75 | 0.09 | 0.039 | | | |
| 20 | 1.00 | 0.15 | 0.065 | | | |
| 25 | 1.25 | 0.22 | 0.095 | | | |
| 30 | 1.49 | 0.31 | 0.13 | | | |
| 35 | 1.74 | 0.42 | 0.18 | | | |
| 40 | 1.99 | 0.54 | 0.23 | | | |
| 45 | 2.24 | 0.67 | 0.29 | | | |
| 50 | 2.49 | 0.81 | 0.35 | | | |
| 60 | 2.99 | 1.14 | 0.49 | | | |
| 70 | 3.49 | 1.51 | 0.65 | | | |
| 75 | 3.74 | 1.72 | 0.74 | | | |
| 80 | 3.99 | 1.94 | 0.84 | | | |
| 90 | 4.48 | 2.41 | 1.04 | | | |
| 100 | 4.98 | 2.93 | 1.27 | | | |
| 125 | 6.23 | 4.43 | 1.92 | | | |
| 150 | 7.47 | 6.20 | 2.68 | | | |
| 175 | 8.72 | 8.26 | 3.58 | | | |
| 200 | 9.97 | 10.57 | 4.58 | | | |
| 250 | 12.46 | 16.00 | 6.93 | | | |
| 500 | | | | 0.99 | 0.02 | 0.01 |
| 750 | | | | 1.49 | 0.05 | 0.02 |
| 1000 | | | | 1.99 | 0.08 | 0.04 |
| 1250 | | | | 2.49 | 0.13 | 0.05 |
| 1500 | | | | 2.99 | 0.17 | 0.08 |
| 2000 | | | | 3.99 | 0.30 | 0.13 |
| 2500 | | | | 4.99 | 0.46 | 0.19 |
| 3000 | | | | 5.98 | 0.64 | 0.28 |
| 3500 | | | | 6.98 | 0.86 | 0.37 |
| 4000 | | | | 7.98 | 1.09 | 0.48 |
| 4500 | | | | 8.98 | 1.364 | 0.59 |
| 5000 | | | | 9.97 | 1.66 | 0.72 |
| 5500 | | | | 10.97 | 1.99 | 0.86 |
| 6000 | | | | 11.97 | 2.324 | 1.00 |
| 6500 | | | | 12.97 | 2.69 | 1.17 |
| 7000 | | | | 13.96 | 3.09 | 1.33 |
| 7500 | | | | 14.96 | 3.51 | 1.52 |
| 8000 | | | | 15.96 | 3.96 | 1.71 |
| 8500 | | | | 16.96 | 4.43 | 1.92 |
| 9000 | | | | 17.95 | 4.93 | 2.13 |

# FRICTION LOSS AND FLOW VELOCITY FOR SDR 26 THERMOPLASTIC PIPE

(Friction head and friction loss are per 100 feet of pipe.)

CAUTION: Flow velocity should not exceed 5 feet per second. PVC and CPVC pipe cannot be used for compressed air service.

**½ in.**

| Gallons Per Minute | Velocity Feet Per Second | Friction Head Feet | Friction Loss Pounds Per Square Inch |
|---|---|---|---|
| 1 | 0.84 | 1.00 | 0.43 |
| 2 | 1.67 | 2.00 | 0.86 |
| 5 | 4.17 | 11.25 | 4.87 |
| 7 | 5.84 | 20.66 | 8.95 |
| 10 | 8.34 | 39.34 | 17.03 |

**4 in.**

| Gallons Per Minute | Velocity Feet Per Second | Friction Head Feet | Friction Loss Pounds Per Square Inch |
|---|---|---|---|
| 20 | 0.48 | 0.02 | 0.009 |
| 25 | 0.60 | 0.04 | 0.017 |
| 30 | 0.72 | 0.05 | 0.022 |
| 35 | 0.84 | 0.07 | 0.030 |
| 40 | 0.96 | 0.09 | 0.039 |
| 45 | 1.08 | 0.11 | 0.048 |
| 50 | 1.20 | 0.14 | 0.061 |
| 60 | 1.44 | 0.19 | 0.082 |
| 70 | 1.67 | 0.25 | 0.11 |
| 75 | 1.79 | 0.29 | 0.13 |
| 80 | 1.91 | 0.32 | 0.14 |
| 90 | 2.15 | 0.40 | 0.17 |
| 100 | 2.39 | 0.49 | 0.21 |
| 125 | 2.99 | 0.74 | 0.33 |
| 150 | 3.59 | 1.04 | 0.45 |
| 175 | 4.19 | 1.39 | 0.60 |
| 200 | 4.79 | 1.77 | 0.77 |
| 250 | 5.98 | 2.68 | 1.16 |
| 300 | 7.18 | 3.75 | 1.62 |
| 350 | 8.38 | 5.00 | 2.17 |
| 400 | 9.57 | 6.39 | 2.77 |
| 450 | 10.77 | 7.95 | 3.44 |
| 500 | 11.96 | 9.66 | 4.18 |

**¾ in.**

| Gallons Per Minute | Velocity Feet Per Second | Friction Head Feet | Friction Loss Pounds Per Square Inch |
|---|---|---|---|
| 1 | 0.50 | 0.28 | 0.12 |
| 2 | 0.99 | 0.56 | 0.24 |
| 5 | 2.47 | 3.14 | 1.36 |
| 7 | 3.46 | 5.76 | 2.49 |
| 10 | 4.94 | 10.96 | 4.74 |
| 15 | 7.40 | 23.23 | 10.06 |
| 20 | 9.87 | 39.57 | 17.13 |

**5 in.**

| Gallons Per Minute | Velocity Feet Per Second | Friction Head Feet | Friction Loss Pounds Per Square Inch |
|---|---|---|---|
| 30 | 0.47 | 0.02 | 0.009 |
| 35 | 0.55 | 0.03 | 0.013 |
| 40 | 0.63 | 0.03 | 0.013 |
| 45 | 0.71 | 0.04 | 0.017 |
| 50 | 0.78 | 0.05 | 0.022 |
| 60 | 0.94 | 0.07 | 0.030 |
| 70 | 1.10 | 0.09 | 0.039 |
| 75 | 1.18 | 0.10 | 0.043 |
| 80 | 1.25 | 0.12 | 0.052 |
| 90 | 1.41 | 0.14 | 0.061 |
| 100 | 1.57 | 0.18 | 0.078 |
| 125 | 1.96 | 0.27 | 0.12 |
| 150 | 2.35 | 0.37 | 0.16 |
| 175 | 2.74 | 0.50 | 0.22 |
| 200 | 3.13 | 0.63 | 0.27 |
| 250 | 3.92 | 0.96 | 0.42 |
| 300 | 4.70 | 1.34 | 0.58 |
| 350 | 5.49 | 1.79 | 0.77 |
| 400 | 6.27 | 2.28 | 0.99 |
| 450 | 7.05 | 2.84 | 1.23 |
| 500 | 7.84 | 3.45 | 1.49 |
| 750 | 11.75 | 7.31 | 3.17 |

**1 in.**

| Gallons Per Minute | Velocity Feet Per Second | Friction Head Feet | Friction Loss Pounds Per Square Inch |
|---|---|---|---|
| 2 | 0.59 | 0.29 | 0.13 |
| 5 | 1.48 | 0.91 | 0.39 |
| 7 | 2.08 | 1.66 | 0.72 |
| 10 | 2.96 | 3.16 | 1.37 |
| 15 | 4.44 | 6.69 | 2.90 |
| 20 | 5.92 | 11.40 | 4.94 |
| 25 | 7.40 | 17.23 | 7.46 |
| 30 | 8.88 | 24.15 | 10.46 |
| 35 | 10.36 | 32.13 | 13.91 |

**6 in.**

| Gallons Per Minute | Velocity Feet Per Second | Friction Head Feet | Friction Loss Pounds Per Square Inch |
|---|---|---|---|
| 50 | 0.55 | 0.02 | 0.009 |
| 60 | 0.66 | 0.03 | 0.013 |
| 70 | 0.77 | 0.04 | 0.017 |
| 75 | 0.83 | 0.04 | 0.017 |
| 80 | 0.88 | 0.05 | 0.022 |
| 90 | 0.99 | 0.06 | 0.026 |
| 100 | 1.10 | 0.07 | 0.030 |
| 125 | 1.39 | 0.11 | 0.047 |
| 150 | 1.66 | 0.16 | 0.069 |
| 175 | 1.94 | 0.21 | 0.091 |
| 200 | 2.21 | 0.27 | 0.12 |
| 250 | 2.76 | 0.41 | 0.18 |
| 300 | 3.31 | 0.57 | 0.25 |
| 350 | 3.87 | 0.76 | 0.33 |
| 400 | 4.42 | 0.97 | 0.42 |
| 450 | 4.97 | 1.21 | 0.52 |
| 500 | 5.52 | 1.47 | 0.64 |
| 750 | 8.28 | 3.12 | 1.35 |
| 1000 | 11.05 | 5.31 | 2.30 |

**1¼ in.**

| Gallons Per Minute | Velocity Feet Per Second | Friction Head Feet | Friction Loss Pounds Per Square Inch |
|---|---|---|---|
| 2 | 0.36 | 0.085 | 0.037 |
| 5 | 0.90 | 0.27 | 0.117 |
| 7 | 1.25 | 0.49 | 0.21 |
| 10 | 1.79 | 0.92 | 0.40 |
| 15 | 2.68 | 1.96 | 0.85 |
| 20 | 3.58 | 3.34 | 1.45 |
| 25 | 4.47 | 5.04 | 2.18 |
| 30 | 5.36 | 7.07 | 3.06 |
| 35 | 6.26 | 9.41 | 4.07 |
| 40 | 7.15 | 12.05 | 5.22 |
| 45 | 8.04 | 14.98 | 6.49 |
| 50 | 8.94 | 18.21 | 7.88 |

**8 in.**

| Gallons Per Minute | Velocity Feet Per Second | Friction Head Feet | Friction Loss Pounds Per Square Inch |
|---|---|---|---|
| 100 | 0.66 | 0.03 | 0.012 |
| 125 | 0.83 | 0.037 | 0.015 |
| 150 | 0.98 | 0.04 | 0.017 |
| 175 | 1.14 | 0.06 | 0.026 |
| 200 | 1.30 | 0.07 | 0.030 |
| 250 | 1.63 | 0.11 | 0.048 |
| 300 | 1.95 | 0.16 | 0.069 |
| 350 | 2.28 | 0.21 | 0.091 |
| 400 | 2.61 | 0.27 | 0.12 |
| 450 | 2.93 | 0.33 | 0.14 |
| 500 | 3.26 | 0.41 | 0.18 |
| 750 | 4.89 | 0.86 | 0.37 |
| 1000 | 6.51 | 1.47 | 0.64 |
| 1250 | 8.15 | 2.23 | 0.96 |
| 1500 | 9.77 | 3.11 | 1.35 |
| 2000 | 13.03 | 5.30 | 2.29 |

**1½ in.**

| Gallons Per Minute | Velocity Feet Per Second | Friction Head Feet | Friction Loss Pounds Per Square Inch |
|---|---|---|---|
| 2 | 0.27 | 0.02 | 0.0087 |
| 5 | 0.68 | 0.14 | 0.059 |
| 7 | 0.96 | 0.25 | 0.104 |
| 10 | 1.36 | 0.47 | 0.20 |
| 15 | 2.04 | 1.00 | 0.43 |
| 20 | 2.72 | 1.71 | 0.74 |
| 25 | 3.40 | 2.59 | 1.12 |
| 30 | 4.08 | 3.63 | 1.57 |
| 35 | 4.76 | 4.83 | 2.09 |
| 40 | 5.44 | 6.18 | 2.68 |
| 45 | 6.12 | 7.69 | 3.33 |
| 50 | 6.80 | 9.34 | 4.04 |
| 60 | 8.16 | 13.10 | 5.67 |
| 70 | 9.52 | 17.42 | 7.54 |
| 75 | 10.19 | 19.80 | 8.57 |
| 80 | 10.87 | 22.31 | 9.66 |
| 90 | 12.23 | 27.75 | 12.02 |
| 100 | 13.59 | 33.73 | 14.61 |

**10 in.**

| Gallons Per Minute | Velocity Feet Per Second | Friction Head Feet | Friction Loss Pounds Per Square Inch |
|---|---|---|---|
| 200 | 0.83 | 0.027 | 0.012 |
| 250 | 1.05 | 0.04 | 0.017 |
| 300 | 1.26 | 0.05 | 0.022 |
| 350 | 1.47 | 0.075 | 0.033 |
| 400 | 1.68 | 0.09 | 0.039 |
| 450 | 1.89 | 0.11 | 0.048 |
| 500 | 2.10 | 0.14 | 0.061 |
| 750 | 3.14 | 0.29 | 0.13 |
| 1000 | 4.19 | 0.50 | 0.22 |
| 1250 | 5.27 | 0.76 | 0.33 |
| 1500 | 6.29 | 1.06 | 0.46 |
| 2000 | 8.38 | 1.81 | 0.78 |
| 2500 | 10.48 | 2.74 | 1.19 |
| 3000 | 12.58 | 3.84 | 1.66 |

**2 in.**

| Gallons Per Minute | Velocity Feet Per Second | Friction Head Feet | Friction Loss Pounds Per Square Inch |
|---|---|---|---|
| 2 | 0.17 | 0.01 | 0.004 |
| 5 | 0.44 | 0.045 | 0.020 |
| 7 | 0.61 | 0.08 | 0.035 |
| 10 | 0.87 | 0.16 | 0.069 |
| 15 | 1.30 | 0.33 | 0.14 |
| 20 | 1.73 | 0.57 | 0.25 |
| 25 | 2.16 | 0.86 | 0.37 |
| 30 | 2.60 | 1.21 | 0.52 |
| 35 | 3.03 | 1.61 | 0.70 |
| 40 | 3.46 | 2.06 | 0.89 |
| 45 | 3.90 | 2.56 | 1.11 |
| 50 | 4.33 | 3.11 | 1.35 |
| 60 | 5.19 | 4.36 | 1.89 |
| 70 | 6.06 | 5.80 | 2.51 |
| 75 | 6.49 | 6.60 | 2.86 |
| 80 | 6.92 | 7.43 | 3.22 |
| 90 | 7.79 | 9.25 | 4.01 |
| 100 | 8.66 | 11.24 | 4.87 |

**12 in.**

| Gallons Per Minute | Velocity Feet Per Second | Friction Head Feet | Friction Loss Pounds Per Square Inch |
|---|---|---|---|
| 350 | 1.04 | 0.04 | 0.017 |
| 400 | 1.19 | 0.04 | 0.017 |
| 450 | 1.34 | 0.05 | 0.022 |
| 500 | 1.49 | 0.06 | 0.026 |
| 750 | 2.23 | 0.13 | 0.056 |
| 1000 | 2.98 | 0.22 | 0.095 |
| 1250 | 3.73 | 0.34 | 0.15 |
| 1500 | 4.47 | 0.46 | 0.20 |
| 2000 | 5.96 | 0.79 | 0.34 |
| 2500 | 7.45 | 1.20 | 0.52 |
| 3000 | 8.94 | 1.67 | 0.72 |
| 3500 | 10.43 | 2.22 | 0.96 |
| 4000 | 11.92 | 2.86 | 1.24 |
| 4500 | 13.41 | 3.54 | 1.53 |

**2½ in.**

| Gallons Per Minute | Velocity Feet Per Second | Friction Head Feet | Friction Loss Pounds Per Square Inch |
|---|---|---|---|
| 5 | 0.30 | 0.025 | 0.011 |
| 7 | 0.42 | 0.035 | 0.015 |
| 10 | 0.59 | 0.06 | 0.026 |
| 15 | 0.88 | 0.13 | 0.056 |
| 20 | 1.18 | 0.22 | 0.095 |
| 25 | 1.47 | 0.34 | 0.15 |
| 30 | 1.77 | 0.47 | 0.20 |
| 35 | 2.06 | 0.63 | 0.27 |
| 40 | 2.35 | 0.81 | 0.35 |
| 45 | 2.65 | 1.00 | 0.43 |
| 50 | 2.94 | 1.22 | 0.53 |
| 60 | 3.53 | 1.71 | 0.74 |
| 70 | 4.12 | 2.27 | 0.98 |
| 75 | 4.41 | 2.58 | 1.12 |
| 80 | 4.71 | 2.91 | 1.26 |
| 90 | 5.30 | 3.62 | 1.57 |
| 100 | 5.89 | 4.39 | 1.90 |
| 125 | 7.36 | 6.65 | 2.88 |
| 150 | 8.83 | 9.31 | 4.03 |
| 175 | 10.31 | 12.40 | 5.37 |

**3 in.**

| Gallons Per Minute | Velocity Feet Per Second | Friction Head Feet | Friction Loss Pounds Per Square Inch |
|---|---|---|---|
| 5 | 0.20 | 0.01 | 0.0045 |
| 7 | 0.28 | 0.014 | 0.0063 |
| 10 | 0.40 | 0.02 | 0.009 |
| 15 | 0.59 | 0.05 | 0.022 |
| 20 | 0.79 | 0.09 | 0.039 |
| 25 | 0.99 | 0.13 | 0.056 |
| 30 | 1.19 | 0.18 | 0.078 |
| 35 | 1.39 | 0.24 | 0.10 |
| 40 | 1.59 | 0.31 | 0.13 |
| 45 | 1.78 | 0.38 | 0.16 |
| 50 | 1.98 | 0.47 | 0.20 |
| 60 | 2.38 | 0.65 | 0.28 |
| 70 | 2.78 | 0.87 | 0.38 |
| 75 | 2.97 | 0.99 | 0.43 |
| 80 | 3.17 | 1.11 | 0.48 |
| 90 | 3.57 | 1.38 | 0.60 |
| 100 | 3.97 | 1.68 | 0.73 |
| 125 | 4.96 | 2.54 | 1.10 |
| 150 | 5.95 | 3.56 | 1.54 |
| 175 | 6.94 | 4.74 | 2.05 |
| 200 | 7.93 | 6.07 | 2.63 |
| 250 | 9.92 | 9.18 | 3.98 |

# FRICTION LOSS AND FLOW VELOCITY FOR SDR 21 THERMOPLASTIC PIPE

(Friction head and friction loss are per 100 feet of pipe.)

CAUTION: Flow velocity should not exceed 5 feet per second. PVC and CPVC pipe cannot be used for compressed air service.

| Gallons Per Minute | Velocity Feet Per Second | Friction Head Feet | Friction Loss Pounds Per Square Inch | Velocity Feet Per Second | Friction Head Feet | Friction Loss Pounds Per Square Inch | Velocity Feet Per Second | Friction Head Feet | Friction Loss Pounds Per Square Inch |
|---|---|---|---|---|---|---|---|---|---|
| | **½ in.** | | | **¾ in.** | | | | | |
| 1 | 0.84 | 1.00 | 0.44 | 0.50 | 0.28 | 0.12 | **1 in.** | | |
| 2 | 1.67 | 2.00 | 0.87 | 0.99 | 0.56 | 0.24 | 0.60 | 0.30 | 0.13 |
| 5 | 4.17 | 11.25 | 4.87 | 2.47 | 3.14 | 1.36 | 1.50 | 0.93 | 0.41 |
| 7 | 5.84 | 20.66 | 8.95 | 3.46 | 5.76 | 2.49 | 2.09 | 1.70 | 0.74 |
| 10 | 8.34 | 39.34 | 17.03 | 4.94 | 10.96 | 4.75 | 2.99 | 3.24 | 1.40 |
| 15 | **4 in.** | | | 7.40 | 23.23 | 10.06 | 4.49 | 6.86 | 2.97 |
| 20 | 0.50 | 0.03 | 0.013 | 9.87 | 39.57 | 17.13 | 5.98 | 11.68 | 5.06 |
| 25 | 0.62 | 0.04 | 0.017 | **5 in.** | | | 7.48 | 17.66 | 7.65 |
| 30 | 0.75 | 0.06 | 0.026 | 0.49 | 0.02 | 0.009 | 8.97 | 24.76 | 10.72 |
| 35 | 0.87 | 0.08 | 0.035 | 0.57 | 0.03 | 0.013 | 10.47 | 32.94 | 14.26 |
| 40 | 1.00 | 0.10 | 0.043 | 0.65 | 0.04 | 0.017 | | | |
| 45 | 1.12 | 0.12 | 0.052 | 0.74 | 0.04 | 0.017 | **6 in.** | | |
| 50 | 1.25 | 0.15 | 0.065 | 0.82 | 0.05 | 0.022 | 0.58 | 0.02 | 0.009 |
| 60 | 1.50 | 0.21 | 0.091 | 0.98 | 0.08 | 0.035 | 0.69 | 0.03 | 0.013 |
| 70 | 1.75 | 0.28 | 0.12 | 1.14 | 0.10 | 0.043 | 0.81 | 0.04 | 0.017 |
| 75 | 1.87 | 0.32 | 0.14 | 1.23 | 0.11 | 0.048 | 0.86 | 0.05 | 0.022 |
| 80 | 2.00 | 0.36 | 0.16 | 1.31 | 0.13 | 0.056 | 0.92 | 0.05 | 0.022 |
| 90 | 2.25 | 0.45 | 0.19 | 1.47 | 0.16 | 0.069 | 1.04 | 0.07 | 0.030 |
| 100 | 2.50 | 0.54 | 0.23 | 1.63 | 0.19 | 0.082 | 1.15 | 0.08 | 0.035 |
| 125 | 3.13 | 0.82 | 0.36 | 2.04 | 0.30 | 0.13 | 1.44 | 0.125 | 0.054 |
| 150 | 3.75 | 1.15 | 0.50 | 2.45 | 0.41 | 0.18 | 1.73 | 0.18 | 0.078 |
| 175 | 4.37 | 1.54 | 0.67 | 2.86 | 0.55 | 0.24 | 2.02 | 0.24 | 0.103 |
| 200 | 4.99 | 1.96 | 0.85 | 3.27 | 0.70 | 0.30 | 2.31 | 0.30 | 0.13 |
| 250 | 6.24 | 2.97 | 1.29 | 4.09 | 1.06 | 0.46 | 2.89 | 0.46 | 0.20 |
| 300 | 7.49 | 4.16 | 1.80 | 4.90 | 1.48 | 0.64 | 3.46 | 0.63 | 0.27 |
| 350 | 8.74 | 5.54 | 2.40 | 5.72 | 1.98 | 0.86 | 4.04 | 0.85 | 0.37 |
| 400 | 9.99 | 7.09 | 3.07 | 6.54 | 2.53 | 1.10 | 4.61 | 1.08 | 0.47 |
| 450 | 11.24 | 8.82 | 3.82 | 7.35 | 3.14 | 1.36 | 5.19 | 1.34 | 0.58 |
| 500 | 12.48 | 10.72 | 4.64 | 8.17 | 3.82 | 1.65 | 5.76 | 1.63 | 0.71 |
| 750 | | | | 12.26 | 8.09 | 3.50 | 8.64 | 3.46 | 1.50 |
| 1000 | | | | | | | 11.53 | 5.89 | 2.55 |
| 1250 | | | | | | | | | |
| 1500 | | | | | | | | | |
| 2000 | | | | | | | | | |
| 2500 | | | | | | | | | |
| 3000 | | | | | | | | | |
| 3500 | | | | | | | | | |
| 4000 | | | | | | | | | |
| 4500 | | | | | | | | | |

| Gallons Per Minute | Velocity Feet Per Second | Friction Head Feet | Friction Loss Pounds Per Square Inch | Velocity Feet Per Second | Friction Head Feet | Friction Loss Pounds Per Square Inch | Velocity Feet Per Second | Friction Head Feet | Friction Loss Pounds Per Square Inch |
|---|---|---|---|---|---|---|---|---|---|
| 1 | **1¼ in.** | | | **1½ in.** | | | **2 in.** | | |
| 2 | 0.37 | 0.095 | 0.04 | 0.29 | 0.05 | 0.022 | 0.18 | 0.023 | 0.010 |
| 5 | 0.93 | 0.30 | 0.13 | 0.71 | 0.15 | 0.065 | 0.45 | 0.06 | 0.025 |
| 7 | 1.31 | 0.54 | 0.23 | 0.99 | 0.28 | 0.12 | 0.63 | 0.081 | 0.035 |
| 10 | 1.86 | 1.02 | 0.44 | 1.41 | 0.52 | 0.23 | 0.90 | 0.17 | 0.074 |
| 15 | 2.79 | 2.16 | 0.94 | 2.12 | 1.11 | 0.48 | 1.35 | 0.37 | 0.16 |
| 20 | 3.72 | 3.68 | 1.59 | 2.83 | 1.89 | 0.82 | 1.80 | 0.63 | 0.27 |
| 25 | 4.65 | 5.56 | 2.41 | 3.54 | 2.85 | 1.23 | 2.25 | 0.95 | 0.41 |
| 30 | 5.58 | 7.80 | 3.38 | 4.24 | 4.00 | 1.73 | 2.71 | 1.34 | 0.58 |
| 35 | 6.51 | 10.37 | 4.49 | 4.95 | 5.32 | 2.30 | 3.16 | 1.78 | 0.77 |
| 40 | 7.44 | 13.28 | 5.75 | 5.66 | 6.81 | 2.95 | 3.61 | 2.27 | 0.98 |
| 45 | 8.37 | 16.52 | 7.15 | 6.36 | 8.47 | 3.67 | 4.06 | 2.83 | 1.23 |
| 50 | 9.30 | 20.08 | 8.69 | 7.07 | 10.29 | 4.46 | 4.51 | 3.44 | 1.49 |
| 60 | 11.17 | 28.14 | 12.18 | 8.49 | 14.42 | 6.24 | 5.41 | 4.82 | 2.09 |
| 70 | | | | 9.90 | 19.19 | 8.31 | 6.31 | 6.41 | 2.78 |
| 75 | | | | 10.61 | 21.80 | 9.44 | 6.76 | 7.29 | 3.16 |
| 80 | | | | | | | 7.21 | 8.21 | 3.55 |
| 90 | **8 in.** | | | | | | 8.12 | 10.21 | 4.42 |
| 100 | 0.67 | 0.03 | 0.012 | | | | 9.02 | 12.41 | 5.37 |
| 125 | 0.85 | 0.037 | 0.015 | | | | | | |
| 150 | 1.02 | 0.05 | 0.022 | | | | | | |
| 175 | 1.19 | 0.065 | 0.028 | **10 in.** | | | | | |
| 200 | 1.36 | 0.08 | 0.035 | 0.86 | 0.027 | 0.012 | | | |
| 250 | 1.70 | 0.125 | 0.054 | 1.10 | 0.045 | 0.020 | | | |
| 300 | 2.04 | 0.18 | 0.078 | 1.31 | 0.06 | 0.026 | **12 in.** | | |
| 350 | 2.38 | 0.24 | 0.103 | 1.54 | 0.08 | 0.035 | 1.08 | 0.036 | 0.016 |
| 400 | 2.72 | 0.30 | 0.13 | 1.75 | 0.10 | 0.043 | 1.24 | 0.04 | 0.017 |
| 450 | 3.06 | 0.37 | 0.16 | 1.97 | 0.13 | 0.056 | 1.40 | 0.06 | 0.026 |
| 500 | 3.40 | 0.45 | 0.19 | 2.19 | 0.15 | 0.065 | 1.55 | 0.07 | 0.030 |
| 750 | 5.10 | 0.96 | 0.42 | 3.29 | 0.33 | 0.14 | 2.33 | 0.14 | 0.061 |
| 1000 | 6.80 | 1.63 | 0.64 | 4.38 | 0.56 | 0.24 | 3.11 | 0.24 | 0.10 |
| 1250 | 8.50 | 2.47 | 1.07 | 5.48 | 0.85 | 0.37 | 3.89 | 0.37 | 0.16 |
| 1500 | 10.19 | 3.45 | 1.49 | 6.57 | 1.18 | 0.51 | 4.66 | 0.51 | 0.22 |
| 2000 | 13.59 | 5.87 | 2.54 | 8.76 | 2.02 | 0.87 | 6.22 | 0.87 | 0.38 |
| 2500 | | | | 10.96 | 3.06 | 1.33 | 7.77 | 1.33 | 0.57 |
| 3000 | | | | 13.15 | 4.27 | 1.85 | 9.33 | 1.85 | 0.08 |
| 3500 | | | | | | | 10.88 | 2.47 | 1.07 |
| 4000 | | | | | | | 12.44 | 3.17 | 1.37 |
| 4500 | | | | | | | 13.99 | 3.93 | 1.70 |

| Gallons Per Minute | Velocity Feet Per Second | Friction Head Feet | Friction Loss Pounds Per Square Inch | Velocity Feet Per Second | Friction Head Feet | Friction Loss Pounds Per Square Inch |
|---|---|---|---|---|---|---|
| 1 | | | | | | |
| 2 | **2½ in.** | | | **3 in.** | | |
| 5 | 0.31 | 0.031 | 0.014 | 0.20 | 0.015 | 0.006 |
| 7 | 0.43 | 0.044 | 0.020 | 0.29 | 0.021 | 0.009 |
| 10 | 0.61 | 0.07 | 0.03 | 0.41 | 0.03 | 0.013 |
| 15 | 0.92 | 0.14 | 0.061 | 0.62 | 0.06 | 0.026 |
| 20 | 1.23 | 0.25 | 0.11 | 0.83 | 0.09 | 0.039 |
| 25 | 1.53 | 0.37 | 0.16 | 1.03 | 0.14 | 0.061 |
| 30 | 1.84 | 0.52 | 0.23 | 1.24 | 0.20 | 0.087 |
| 35 | 2.15 | 0.70 | 0.30 | 1.45 | 0.27 | 0.12 |
| 40 | 2.45 | 0.89 | 0.39 | 1.65 | 0.34 | 0.15 |
| 45 | 2.76 | 1.11 | 0.48 | 1.86 | 0.42 | 0.18 |
| 50 | 3.07 | 1.35 | 0.58 | 2.06 | 0.51 | 0.22 |
| 60 | 3.68 | 1.89 | 0.82 | 2.48 | 0.72 | 0.31 |
| 70 | 4.29 | 2.51 | 1.09 | 2.89 | 0.96 | 0.42 |
| 75 | 4.60 | 2.85 | 1.23 | 3.10 | 1.09 | 0.47 |
| 80 | 4.91 | 3.22 | 1.39 | 3.30 | 1.23 | 0.53 |
| 90 | 5.52 | 4.00 | 1.73 | 3.72 | 1.52 | 0.66 |
| 100 | 6.14 | 4.86 | 2.10 | 4.13 | 1.85 | 0.80 |
| 125 | 7.67 | 7.36 | 3.19 | 5.17 | 2.81 | 1.22 |
| 150 | 9.20 | 10.30 | 4.46 | 6.19 | 3.93 | 1.70 |
| 175 | 10.74 | 13.72 | 5.94 | 7.23 | 5.23 | 2.26 |
| 200 | | | | 8.26 | 6.69 | 2.90 |
| 250 | | | | 10.33 | 10.13 | 4.39 |
| 300 | | | | | | |
| 350 | | | | | | |
| 400 | | | | | | |
| 450 | | | | | | |
| 500 | | | | | | |
| 750 | | | | | | |
| 1000 | | | | | | |
| 1250 | | | | | | |
| 1500 | | | | | | |
| 2000 | | | | | | |
| 2500 | | | | | | |
| 3000 | | | | | | |
| 3500 | | | | | | |
| 4000 | | | | | | |
| 4500 | | | | | | |

## Water Hammer

Water hammer is a term used to describe the sudden increase in pressure created by quickly stopping, starting, or changing the direction of the flow of fluid in a piping system. Typical actions which cause water hammer are:

(1) Quickly closing a valve

(2) Quickly opening a valve

(3) Starting pumps with an empty discharge line

(4) A high speed wall of liquid (such as starting a pump) suddenly changes direction (such as going through a 90° elbow)

(5) Moving entrapped air through the system

The pressure increase generated must be added to the fluid pressure already existing in the piping system to determine the total pressure the system must withstand. If water hammer is not accounted for, the sudden pressure surge could be enough to burst the pipe, or break the fittings or valves.

Taking the following measures will help prevent problems:

(1) Keep fluid velocities under 5 feet per second.

(2) Use actuated valves with controlled opening and closing speeds.

(3) Instruct operators of manual valves on the proper opening and closing speeds.

(4) When starting a pump, partially close the valve in the discharge line to minimize the volume of liquid accelerating through the system. Fully open the valve after the line is completely filled.

(5) Use a check valve in the pipe line, near the pump, to keep the line full.

(6) Use air relief valves to control the amount of air that is admitted or exhausted throughout the piping system.

(7) Design the piping system so that the total pressure (operating plus water hammer surge) does not exceed the pressure rating of the lowest rated component in the system.

The nomograph shown on page 24 may be used to predict the pressure surge that will result from given service conditions. The chart may be used for any industrial liquid. Since the values given by the chart indicate only the pressure rise in the system, the value of the static pressure head must be added to the pressure rise to give the maximum pressures experienced in the system under the conditions involved.

## How To Use The Nomograph On The Following Page:

1. Liquid Velocity (feet/second), pipeline length (feet), and valve closing time (seconds) must be known.
2. Place a straight edge on the liquid velocity in pipe (line A) and the pipeline length (line D).
3. Mark intersection of straight edge with pivot line (line C).
4. Place straight edge on mark just placed on pivot line (line C) and on valve closing time for valve being used (line A).
5. The intersection of the straight edge with the pressure increase line (line B) is the liquid momentum surge pressure (water hammer).

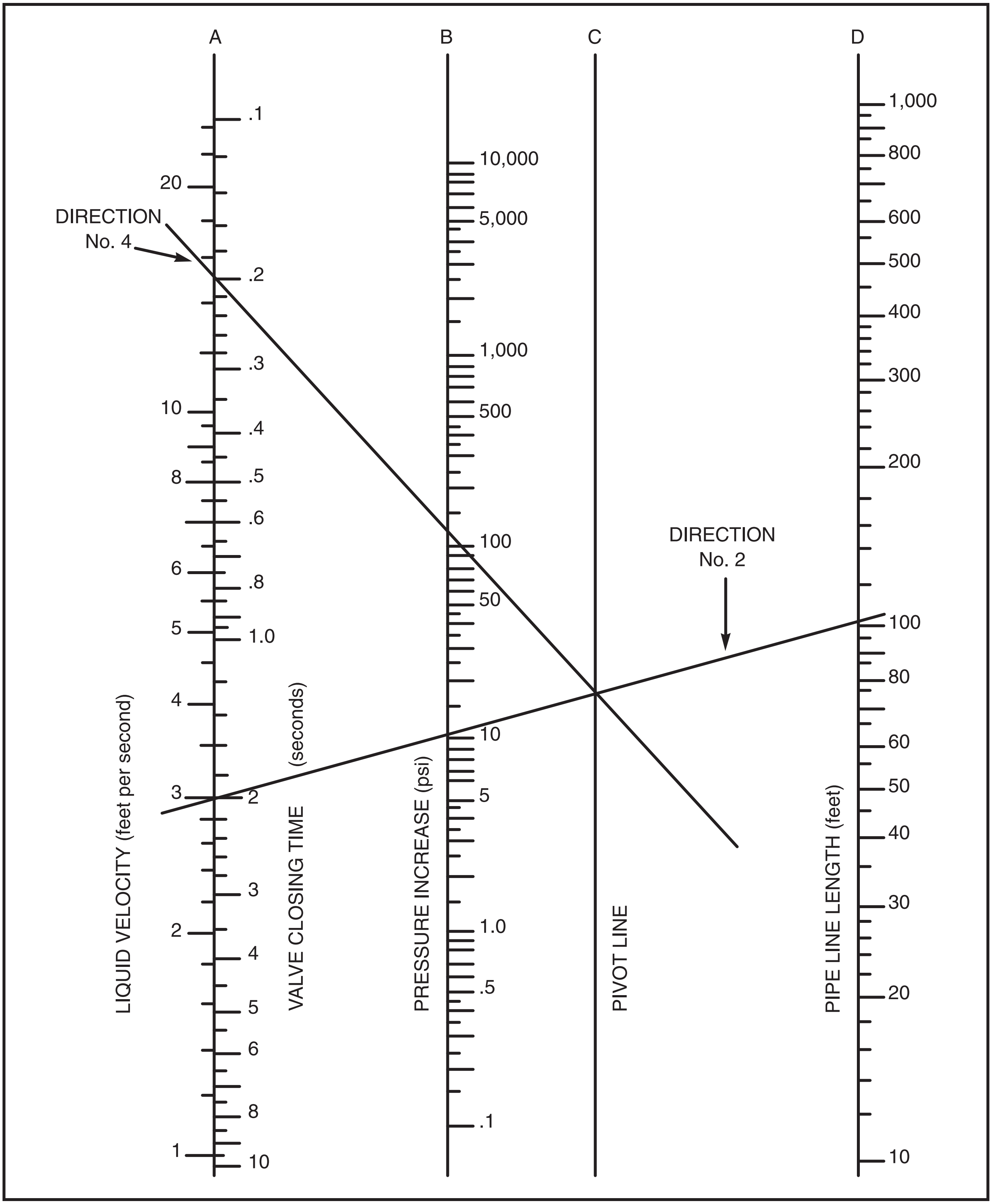
The liquid momentum surge pressure should be added to the operating line pressure to determine the system's maximum line pressure. The maximum line pressure is used to select the proper pipe schedule or wall thickness.

The nomograph is based on the formula

$$P = \frac{0.070VL}{T}$$

where P is increase in pressure due to momentum surge in psi, L is pipeline length in feet, V is liquid velocity in feet per second, and T is valve closing time in seconds.

## Water Hammer Nomograph



# FLUID FLOW PROPERTIES

## Entrapped Air

### Source

There are many potential sources for air in pipelines. Air may be introduced at the point where fluid enters the system or during initial filling of the system.

### Problem

Air in a piping system tends to accumulate at high points in the system. As the flowrate increases, the entrapped air is forced along the pipeline by the moving water. These pockets of air cause flow restrictions reducing the efficiency and performance of the system. Liquids are about 5 times more dense than air at 100 psi, so when a pocket of air reaches an outlet, it escapes rapidly and the fluid rushes to replace the void. Such pressure surges can easily exceed the strength of a piping system and it's components.

### Solution

Designers should be concerned about entrapped air, but the issue of entrapped air is very complex. The behavior of air in a piping system is not easy to analyze, but the effects can be devastating. Obviously, the best way to reduce problems would be to prevent air from entering the system. Systems should be filled slowly and air vented from the high points before the system is pressurized. Additionally, air relief valves should be installed at high points in the system to vent air that accumulates during service.

# WEATHERING

## UV Exposure

PVC pipe can suffer surface discoloration when exposed to ultraviolet (UV) radiation from sunlight. UV radiation affects PVC when energy from the sun causes excitation of the molecular bonds in the plastic. The resulting reaction occurs only on the exposed surface of the pipe and to the extremely shallow depths of .001 to .003 inches. The effect does not continue when exposure to sunlight is terminated.

A two-year study was undertaken to quantify the effects of UV radiation on the properties of PVC pipe (See Uni-Bell's UNI-TR-5). The study found that exposure to UV radiation results in a change in the pipe's surface color and a reduction in impact strength. Other properties such as tensile strength (pressure rating) and modulus of elasticity (pipe stiffness) are not adversely affected.

The presence of an opaque shield between the sun and the pipe prevents UV degradation. UV radiation will not penetrate thin shields such as paint coatings or wrappings. Burial of PVC pipe provides complete protection against UV attack.

The most common method used to protect above ground PVC pipe from the sun is painting with a latex (water base) paint. Preparation of the surface to be painted is very important. The pipe should be cleaned to remove moisture, dirt, and oil and wiped with a clean, dry cloth. Petroleum-based paints should not be used, since the presence of petroleum will prevent proper bonding of paint to pipe.

Reference Uni-Bell PVC Pipe Association 2001

# SUPPORT SPACING FOR PVC AND CORZAN CPVC PIPE

CHARLOTTE
PIPE AND FOUNDRY COMPANY®



Adequate support for any piping system is a matter of great importance. In practice, support spacings are a function of pipe size, operating temperatures, the location of heavy valves or fittings, and the mechanical properties of the pipe material.

To ensure the satisfactory operation of a PVC or CPVC piping system, the location and type of hangers should be carefully considered. The principles of design for steel piping systems are generally also applicable to PVC and CPVC piping systems, but with some notable areas where special consideration should be exercised.

(1) Concentrated loads (valves, flanges, etc,) should be supported directly so as to eliminate high stress concentrations. Should this be impractical, then the pipe must be supported immediately adjacent to the load.

(2) In systems where large fluctuations in temperature occur, allowance must be made for expansion and contraction of the piping system. Since changes in direction in the system are usually sufficient to allow expansion and contraction, hangers must be placed so as not to restrict this movement.

(3) Changes in direction should be supported as close as practical to the fitting to avoid introducing excessive torsional stresses into the system.

(4) Since PVC and CPVC pipe expand or contract approximately five times as much as steel, hangers should not restrict this movement. When using a clamp type hanger, the hanger should not force the pipe and fittings into position.

(5) Hangers should provide as much bearing surface as possible. To prevent damage to the pipe, file smooth any sharp edges or burrs on the hangers or supports.

(6) Valves should be braced against operating torque.

(7) PVC and CPVC lines must not be placed alongside steam or other high temperature pipe lines or other high temperature objects.

(8) Support spacing for horizontal piping systems is determined by the maximum operating temperatures the systems will encounter. The piping should be supported on uniform centers with supports that do not restrict the axial movement of the pipe. The chart below shows the recommended support spacing according to size, schedule, and operating temperatures. These spacings apply to continuous spans of uninsulated lines, with no concentrated loads, conveying liquids with specific gravities of up to 1.00.

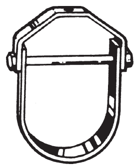
## SUPPORT SPACING (IN FEET)

| Nom. Pipe Size (in.) | PVC PIPE | | | | | | | | | | | | | | | CPVC PIPE | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PR 160 & 200 | | | | | Schedule 40 | | | | | Schedule 80 | | | | | Schedule 40 | | | | | | Schedule 80 | | | | | |
| | Temp. °F | | | | | Temp. °F | | | | | Temp. °F | | | | | Temp. °F | | | | | | Temp. °F | | | | | |
| | 60 | 80 | 100 | 120 | 140 | 60 | 80 | 100 | 120 | 140 | 60 | 80 | 100 | 120 | 140 | 60 | 80 | 100 | 120 | 140 | 180 | 60 | 80 | 100 | 120 | 140 | 180 |
| ½ | 3½ | 3½ | 3 | 2 | | 4½ | 4½ | 4 | 2½ | 2½ | 5 | 4½ | 4½ | 3 | 2½ | 5 | 5 | 4½ | 4½ | 4 | 2½ | 5½ | 5½ | 5 | 4½ | 4½ | 2½ |
| ¾ | 4 | 3½ | 3 | 2 | | 5 | 4½ | 4 | 2½ | 2½ | 5½ | 5 | 4½ | 3 | 2½ | 5½ | 5 | 5 | 4½ | 4 | 2½ | 5½ | 5½ | 5½ | 5 | 4½ | 2½ |
| 1 | 4 | 4 | 3½ | 2 | | 5½ | 5 | 4½ | 3 | 2½ | 6 | 5½ | 5 | 3½ | 3 | 6 | 5½ | 5½ | 5 | 4½ | 2½ | 6 | 6 | 6 | 5½ | 5 | 3 |
| 1¼ | 4 | 4 | 3½ | 2½ | | 5½ | 5½ | 5 | 3 | 3 | 6 | 6 | 5½ | 3½ | 3 | 6 | 5½ | 5½ | 5½ | 5 | 3 | 6½ | 6½ | 6 | 6 | 5½ | 3 |
| 1½ | 4½ | 4 | 4 | 2½ | | 6 | 5½ | 5 | 3½ | 3 | 6½ | 6 | 5½ | 3½ | 3½ | 6½ | 6½ | 6½ | 5½ | 5 | 3 | 7 | 7 | 6½ | 6 | 5½ | 3½ |
| 2 | 4½ | 4 | 4 | 3 | | 6 | 5½ | 5 | 3½ | 3 | 7 | 6½ | 6 | 4 | 3½ | 6½ | 6 | 6 | 5½ | 5 | 3 | 7 | 7 | 7 | 6½ | 6 | 3½ |
| 2½ | 5 | 5 | 4½ | 3 | | 7 | 6½ | 6 | 4 | 3½ | 7½ | 7½ | 6½ | 4½ | 4 | 7½ | 7 | 7 | 6½ | 6 | 3½ | 8 | 7½ | 7½ | 7½ | 6½ | 4 |
| 3 | 5½ | 5½ | 4½ | 3 | | 7 | 7 | 6 | 4 | 3½ | 8 | 7½ | 7 | 4½ | 4 | 8 | 7 | 7 | 7 | 6 | 3½ | 8 | 8 | 8 | 7½ | 7 | 4 |
| 4 | 6 | 5½ | 5 | 3½ | | 7½ | 7 | 6½ | 4½ | 4 | 9 | 8½ | 7½ | 5 | 4½ | 8½ | 7½ | 7½ | 7 | 6½ | 4 | 9 | 9 | 9 | 8½ | 7½ | 4½ |
| 6 | 6½ | 6½ | 5½ | 4 | | 8½ | 8 | 7½ | 5 | 4½ | 10 | 9½ | 9 | 6 | 5 | 9½ | 8½ | 8 | 7½ | 7 | 4½ | 10 | 10½ | 9½ | 9 | 8 | 5 |
| 8 | 7 | 6½ | 6 | 5 | | 9 | 8½ | 8 | 5 | 4½ | 11 | 10½ | 9½ | 6½ | 5½ | 9½ | 8½ | 8 | 7½ | 7 | 5 | 11 | 11 | 10½ | 10 | 9 | 5½ |
| 10 | | | | | | 10 | 9 | 8½ | 5½ | 5 | 12 | 11 | 10 | 7 | 6 | 10 | 9½ | 9 | 8 | 7½ | 5½ | 11½ | 11½ | 11 | 10½ | 9½ | 6 |
| 12 | | | | | | 11½ | 10½ | 9½ | 6½ | 5½ | 13 | 12 | 10½ | 7½ | 6½ | 10½ | 10½ | 10 | 9 | 8 | 6 | 12½ | 12½ | 12½ | 11 | 10½ | 6½ |
| 14 | | | | | | 12 | 11 | 10 | 7 | 6 | 13½ | 13 | 11 | 8 | 7 | | | | | | | | | | | | |
| 16 | | | | | | 12½ | 11½ | 10½ | 7½ | 6½ | 14 | 13½ | 11½ | 8½ | 7½ | | | | | | | | | | | | |

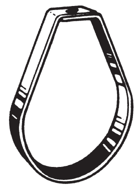
This data is based upon information provided by the raw material manufacturers. It should be used only as a reference and not as a guarantee of performance. Installations must comply with all local plumbing codes and regulations.

# RECOMMENDED PIPE HANGERS, CLAMPS, AND SUPPORTS

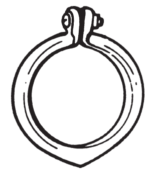




Clevis Hanger
1/2 to 30 in. pipe

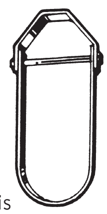


Band Hanger
1/2 to 8 in. pipe



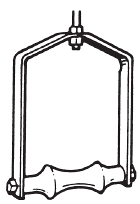
Split Ring Hanger
3/8 to 8 in. pipe

Split Ring Hanger
Adj. Swivel Ring
3/4 to 8 in. pipe

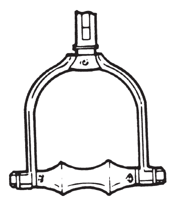


Adj. Clevis
For Insulated Lines
3/4 to 12 in. pipe

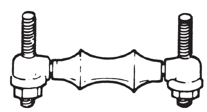
Adj. Swivel Ring
1/2 to 8 in. pipe



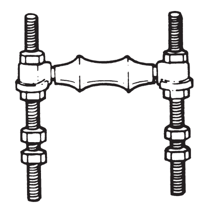
Roller Hanger
2 1/2 to 20 in. pipe



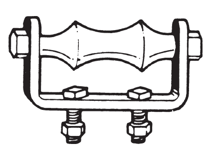
Adj. Swivel Roller Hanger
2 1/2 to 12 in. pipe



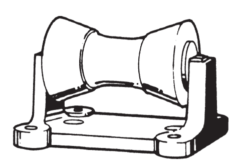
Single Pipe Roll
1 to 30 in. pipe



Adj. Pipe Roll Support
1 to 30 in. pipe

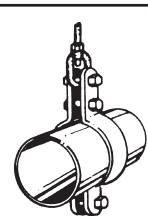


Roller Chair
2 to 12 in. pipe

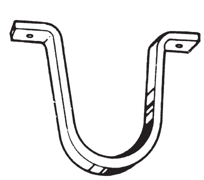


Pipe Roll Stand
2 to 42 in. pipe

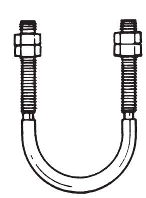
Pipe Clamp
1/2 to 24 in. pipe



Double Bolt Pipe Clamp
3/4 to 36 in. pipe



Anchor Strap
1/2 to 4 in. pipe



U Bolt
1/2 to 30 in. pipe

# EXPANSION AND CONTRACTION OF ABS, PVC, AND CPVC



ABS and PVC pipe, like other piping materials, undergo length changes as a result of temperature variations above and below the installation temperature. They expand and contract 4.5 to 5 times more than steel or iron pipe. The extent of the expansion or contraction is dependent upon the piping material's coefficient of linear expansion, the length of pipe between directional changes, and the temperature differential.

The coefficients of linear expansion (Y) for ABS, PVC, and CPVC (expressed in inches of expansion per 10°F temperature change per 100 feet of pipe) are as follows:

| **Material** | **Y (in./10°F/100 ft)** |
|---|---|
| ABS | 0.66 |
| PVC | 0.36 |
| CPVC | 0.408 |

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

$$\Delta L = \frac{Y\,(T_1 - T_2)}{10} \times \frac{L}{100}$$

$\Delta L$ = Dimensional change due to thermal expansion or contraction (in.)

$Y$ = Expansion coefficient (See table above.) (in./10°F/100 ft)

$(T_1 - T_2)$ = Temperature differential between the installation temperature and the maximum or minimum system temperature, whichever provides the greatest differential (°F).

$L$ = Length of pipe run between changes in direction (ft)

Example:
How much expansion can be expected in a 300 foot straight run of 2" diameter PVC pipe installed at 70°F and operating at 120°F?
Solution:

$$\Delta L = .360\ \frac{(120 - 70)}{10} \times \frac{300}{100} = .360 \times 5 \times 3 = 5.4 \text{ inches}$$

There are several ways to compensate for expansion and contraction. The most common methods are:

1. Expansion loops which consist of pipe and 90° elbows (See Figure 1)
2. Piston type expansion joints* (See Figure 2)
3. Flexible bends*
4. Bellows and rubber expansion joints*

*The manufacturers of these devices should be contacted to determine the suitability of their products for the specific application.

Expansion loops are a simple and convenient way to compensate for expansion and contraction when there is sufficient space for the loop in the piping system. A typical expansion loop design is shown below.

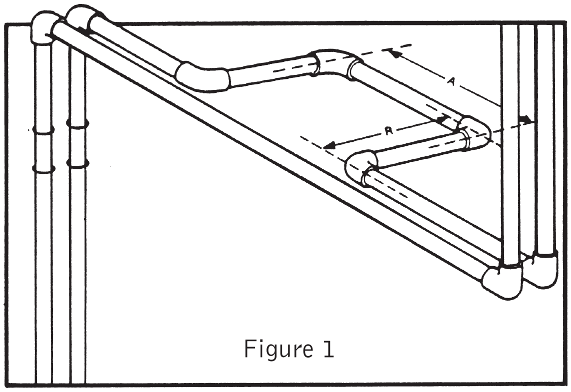



Figure 1

The length of leg "R" can be determined by using the following formula to ensure that it is long enough to absorb the expansion and contraction movement without damage. The length of leg "A" should be 1/2 the length of leg "R".

$R = 1.44\sqrt{D\,\Delta L}$

$R$ = Expansion loop leg length (ft)

$D$ = Nominal outside diameter of pipe (in.) (See table below.)

$\Delta L$ = Dimensional change due to thermal expansion or contraction (in.)

Example: How long should the expansion loop legs be to compensate for the expansion in a system that has 215 feet of 3" diameter PVC pipe installed at 75°F and operating at 135°F?

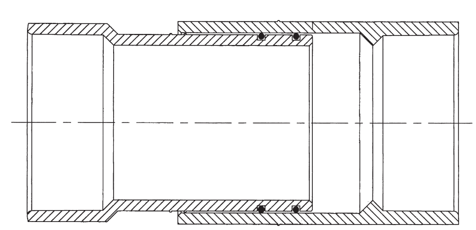
Solution: $R = 1.44\sqrt{3.500 \times 4.644} = 1.44\sqrt{16.254} = 5.80'$

$$A = \frac{5.80'}{2} = 2.90'$$

When installing the expansion loop, no rigid or restraining supports should be placed within the leg lengths of the loop. The loop should be installed as closely as possible to the mid-point between anchors. Piping support guides should restrict lateral movement and direct axial movement into the loop. Lastly, the pipe and fittings should be solvent cemented together, rather than using threaded connections.

Compensation for expansion and contraction in underground applications is normally achieved by snaking the pipe in the trench. Solvent cemented joints must be used.

Figure 2



Piston-type expansion joint illustrated.

ABS, PVC, and CPVC pipe and fittings can be installed underground. Since these piping systems are flexible systems, proper attention should be given to burial conditions. The stiffness of the piping system is affected by sidewall support, soil compaction, and the condition of the trench. Trench bottoms should be smooth and regular in either undisturbed soil or a layer of compacted backfill. Pipe must lie evenly on this surface throughout the entire length of its barrel. Excavation, bedding and backfill should be in accordance with the provisions of the local Plumbing Code having jurisdiction.

## Trenching

The following trenching and burial procedures should be used to protect the piping system.

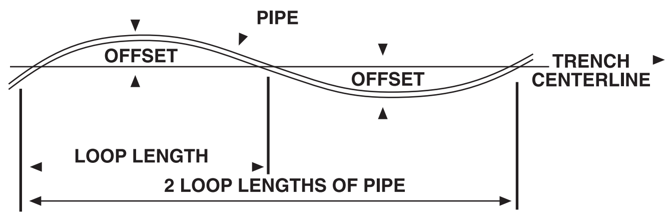
1. The trench should be excavated to ensure the sides will be stable under all working conditions.
2. The trench should be wide enough to provide adequate room for the following.
   A. Joining the pipe in the trench.
   B. Snaking the pipe from side to side to compensate for expansion and contraction.
   C. Filling and compacting the side fills.

   The space between the pipe and trench wall must be wider than the compaction equipment used in the compaction of the backfill. Minimum width shall be not less than the greater of either the pipe outside diameter plus 16 inches or the pipe outside diameter times 1.25 plus 12 inches. Trench width may be different if approved by the design engineer.
3. The trench bottom should be smooth, free of rocks and debris, continuous, and provide uniform support. If ledge rock, hardpan or large boulders are encountered, the trench bottom should be padded with bedding of compacted granular material to a thickness of at least 4 inches. Foundation bedding should be installed as required by the engineer.
4. Trench depth is determined by the pipe's service requirements. Plastic pipe should always be installed at least below the frost level. The minimum cover for lines subject to heavy overhead traffic is 24 inches.
5. A smooth, trench bottom is necessary to support the pipe over its entire length on firm stable material. Blocking should not be used to change pipe grade or to intermittently support pipe over low sections in the trench.

Compensation for expansion and contraction in underground applications is normally achieved by snaking the pipe in the trench. Solvent cemented joints must be used.

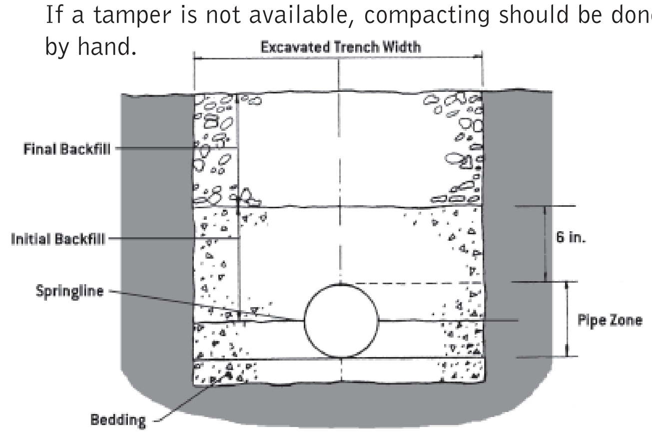
The following table shows recommended offsets and loop lengths for piping up to 2 1/2" nominal size.

| | 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 |




## Bedding and Backfilling

1. Even though sub-soil conditions vary widely from place to place, the pipe backfill should be stable and provide protection for the pipe.
2. The pipe should be surrounded with a granular material which is easily worked around the sides of the pipe. Backfilling should be performed in layers of 6 inch with each layer being sufficiently compacted to 85% to 95% compaction.
3. A mechanical tamper is recommended for compacting sand and gravel backfill which contain a significant proportion of fine grained material, such as silt and clay. If a tamper is not available, compacting should be done by hand.




4. The trench should be completely filled. The backfill should be placed and spread in fairly uniform layers to prevent any unfilled spaces or voids. Large rocks, stones, frozen clods, or other large debris should be removed. Heavy tampers or rolling equipment should only be used to consolidate only the final backfill.

Additional information is contained in ASTM D 2321 "Underground Installation of Thermoplastic pipe for sewers and other gravity-flow applications."

# Solvent Cementing PVC and CPVC Pipe and Fittings

## BASIC PRINCIPLES OF SOLVENT CEMENTING

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 tend to fuse together, in the loose part the cement will bond to both surfaces.

Penetrating and softening can be achieved by the use of both primer and cement. A suitable primer will usually penetrate and soften the surfaces more quickly than the cement alone. Additionally, the use of a primer can provide a safety factor for the installer, for he can know, under various temperature conditions, when he has achieved sufficient softening. For example, in cold weather more time and additional applications are required.

## PRIMERS AND CEMENTS

### Primer

It is recommended that a high quality primer be used to prepare the surfaces of pipe and fittings for solvent welding. Do not use water, rags, gasoline, or any other substitutes for cleaning PVC or CPVC surfaces. A chemical cleaner such as MEK may be used.

### Cement

Make sure the solvent cement used is suitable for the type and size of the pipes being installed. PVC cement must be used with PVC pipe and fittings. CPVC cement must be used with CPVC pipe and fittings. Also, cement with the proper viscosity for the type and size of pipe, must be used. Contact the supplier of the cement if there are any questions on the suitability of the cement for the intended application.

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 one year 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, useable condition. But such is not the case when gellation has taken place because of actual solvent loss; for example, when 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 and primers 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.

### Applicators

To properly apply the primer and 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.

**Rollers** — 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.

The chart below shows the recommended applicator sizes.

| Nominal Pipe Size (in.) | Applicator Type | | |
|---|---|---|---|
| | Dauber | Brush Width (in.) | Roller Length (in.) |
| 1/4 | A | 1/2 | NR |
| 3/8 | A | 1/2 | NR |
| 1/2 | A | 1/2 | NR |
| 3/4 | A | 1 | NR |
| 1 | A | 1 | NR |
| 1 1/4 | A | 1 | NR |
| 1 1/2 | A | 1 - 1 1/2 | NR |
| 2 | A | 1 - 1 1/2 | NR |
| 2 1/2 | NR | 1 1/2 - 2 | NR |
| 3 | NR | 1 1/2 - 2 1/2 | NR |
| 4 | NR | 2 - 3 | 3 |
| 5 | NR | 3 - 5 | 3 |
| 6 | NR | 3 - 5 | 3 |
| 8 | NR | 4 - 6 | 7 |
| 10 | NR | 6 - 8 | 7 |
| 12 | NR | 6 - 8 | 7 |
| 14 | NR | 7 - 8 | 7 |
| 16 | NR | 8+ | 8 |

A = Acceptable NR = Not Recommended

## MAKING THE JOINTS

### 1. Preparation

Before starting to make any joints, the pipe and fittings should be visually inspected for any damage or defects. The fittings should be exposed to the same temperature conditions as the pipe, for at least one hour prior to installation, so that the pipe and fittings are basically at the same temperature when joined.

### 2. Cutting

Cut pipe square using a miter box or a plastic pipe cutting tool which DOES NOT flare up diameter at end of pipe.

### 3. Deburring and Chamfering

Remove all burrs from end of pipe with a knife, file, or plastic pipe deburring tool. Chamfer (bevel) the end of the pipe 10°-15° as shown to the right.

### 4. Cleaning

Remove any dirt, moisture, or grease from pipe end and fitting sockets with a clean dry rag. A chemical cleaner must be used if the wiping fails to clean the surfaces.

### 5. Dry Fitting

Check dry fit of pipe and fitting by inserting pipe into fitting. With light pressure, pipe should easily go at least 1/3 of the way in. If it bottoms, it should be snug.

### 6. Priming

Using the correct applicator (as shown in chart), apply primer freely to fitting socket, keeping the surface and applicator wet until the surface has been softened. This will usually require 5-15 seconds. More time is needed for hard surfaces and in cold weather conditions. Redip the applicator in primer as required. When the surface is primed, remove any puddles of primer from the socket.

A second application in the socket is recommended if it has unusually hard surfaces. These hard surfaces are often found in belled-ends and in fittings made from pipe stock.

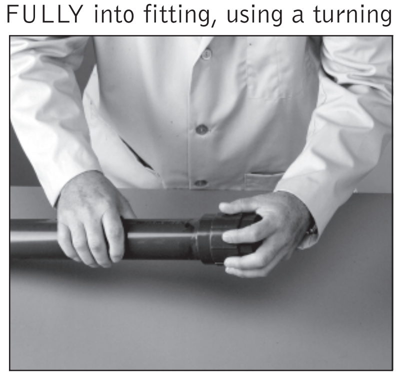
Apply the primer to the end of the pipe equal to the depth of the fitting socket. Application should be made in the same manner as was done on the fitting socket.

### 7. Cementing

While the surfaces of the pipe and fitting are still wet with primer, immediately apply a <u>full even layer</u> of cement to the pipe using the proper size applicator shown in chart) equal to the depth of the socket.

Apply a medium layer of cement to the fitting socket. Do not let the cement puddle. Also, when joining belled-end pipe, do not coat beyond the bell depth or allow the cement to run down the inside of the pipe.

Apply a second full even layer of cement to the pipe. Assemble parts QUICKLY! Parts must be assembled while cement is still fluid. If assembly is interrupted, recoat parts and assemble. Push pipe FULLY into fitting, using a turning motion, if possible, of 1/8 to 1/4 turn, until it bottoms. Hold them together for 15 - 30 seconds to offset tendency of pipe to move out of fittings. With a rag, wipe off excess bead of cement from juncture of pipe and fitting.



**Note:** 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.

# Joint Curing

The joint should not be disturbed until it has initially set. The chart below shows the recommended initial set times.

**Recommended Initial Set Times**

| Temperature Range | Pipe Sizes 1/2" to 1 1/4" | Pipe Sizes 1 1/2" to 3" | Pipe Sizes 4" to 8" | Pipe Sizes 10" to 16" |
|---|---|---|---|---|
| 60° - 100° F | 15 min | 30 min | 1 hr | 2 hr |
| 40° - 60° F | 1 hr | 2 hr | 4 hr | 8 hr |
| 0° - 40° F | 3 hr | 6 hr | 12 hr | 24 hr |

The joint should not be pressure tested until it has cured. The exact curing time varies with temperature, humidity, and pipe size. The following chart shows suggested curing times.

**Recommended Curing Time Before Pressure Testing**

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

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

The above data are based on laboratory tests and are intended as guidelines.
For more specific information, contact should be made with the cement manufacturer.

# Testing Pressure System

1. Prior to testing, safety precautions should be instituted to protect personnel and property in case of test failure.
2. Conduct pressure testing with water. DO NOT USE AIR OR OTHER GASES for pressure testing.
3. The piping system should be adequately anchored to limit movement. Water under pressure exerts thrust forces in piping systems. Thrust blocking should be provided at changes of direction, change in size and at dead ends.
4. The piping system should be slowly filled with water, taking care to prevent surge and air entrapment. The flow rate should not exceed 5 feet per second (see charts on pages 19 through 22).
5. All trapped air must be slowly released. Vents must be provided at all high points of the piping system. All valves and air relief mechanisms should be opened so that the air can be vented while the system is being filled. Trapped air is extremely dangerous and it must be slowly and completely vented prior to testing.
6. Once an installation is completed and cured the system should be filled with water and pressure tested in accordance with local code requirements. However, care must be taken to ensure the pressure does not exceed the working pressure of the lowest component in the system (valves, unions, flanges, threaded parts, etc.)
7. The pressure test should not exceed one hour. Any leaking joints or pipe must be cut out and replaced and the line recharged and retested using the same procedure.

Only Schedule 80 PVC and CPVC pipe can be safely threaded. Schedule 40 PVC and CPVC pipe and PVC SDR pipe should **not** be threaded.

Due to the reduction in wall thickness at the point of threading, the pressure rating of the pipe is reduced by 50%. Therefore, threaded connections are not recommended for high pressure applications.

## THREADING PROCEDURE

### 1. Cutting

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

### 2. Threading

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

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

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

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

It is recommended that a cutting lubricant, such as a soap and water solution or a water soluble machine oil, be used during the threading operation. Also, clearing the cuttings from the die is highly recommended.

Do not over-thread the pipe. The diagram and table on the following page show the ASTM F 1498 dimensions for American Standard Taper Pipe Threads. Periodically check the threads with a ring gauge to ensure that the threads are accurate. The tolerance is ± 1½ turns.

### 3. Installation

Brush the threads clean and wrap Teflon* thread tape around the entire length of the threads.[1] Start with the second full thread and wrap in the direction of the threads to prevent unraveling when the fitting is tightened onto the pipe. Overlap each wrap by one half the width of the tape.

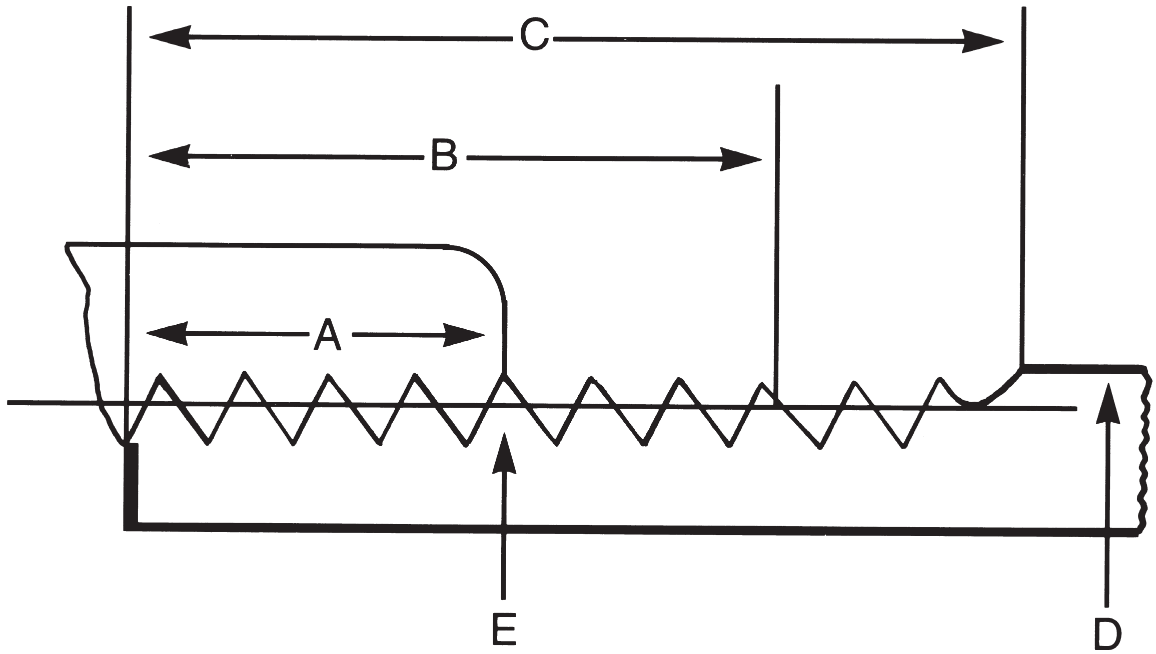
[1] Pipe joint compounds, pastes, or other thread lubricants are **not** recommended for use with PVC and CPVC pipe.

Thread the fitting onto the pipe and hand tighten. Further tighten the fitting (one to two turns past hand tight) by using a <u>strap wrench only</u>. Avoid over tighten-ing as this may cause thread or fit-ting damage.

When combining plastic and metallic threaded systems, it is recommended that plastic male threads be screwed into metallic female threads rather than metallic male threads into plastic female threads.

*Trademark of the E.I. DuPont Company

## Taper Pipe Thread Dimensions Diagram

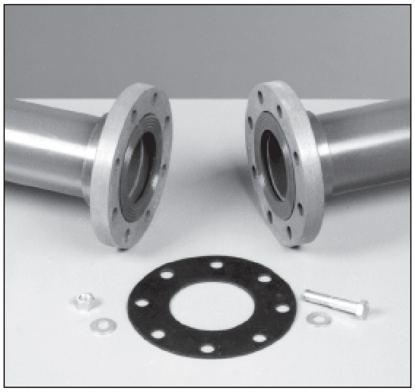



| PIPE | | THREADS | | | | | |
|---|---|---|---|---|---|---|---|
| Nominal Size In Inches | Outside Diameter In Inches (D) | Number of Threads Per Inch | Normal Engagement By Hand In Inches (A) | Length of Effective Thread In Inches (B) | Total Length: End of Pipe to Vanish Point In Inches (C) | Pitch Diameter at end of Internal Thread In Inches (E) | Maximum Depth of Thread In Inches |
| 1/4 | .540 | 18 | .228 | .4018 | .5946 | .49163 | .04444 |
| 3/8 | .675 | 18 | .240 | .4078 | .6006 | .62701 | .04444 |
| 1/2 | .840 | 14 | .320 | .5337 | .7815 | .77843 | .05714 |
| 3/4 | 1.050 | 14 | .339 | .5457 | .7935 | .98887 | .05714 |
| 1 | 1.315 | 11 1/2 | .400 | .6828 | .9845 | 1.23863 | .06957 |
| 1 1/4 | 1.660 | 11 1/2 | .420 | .7068 | 1.0085 | 1.58338 | .06957 |
| 1 1/2 | 1.900 | 11 1/2 | .420 | .7235 | 1.0252 | 1.82234 | .06957 |
| 2 | 2.375 | 11 1/2 | .436 | .7565 | 1.0582 | 2.29627 | .06957 |
| 2 1/2 | 2.875 | 8 | .682 | 1.1375 | 1.5712 | 2.76216 | .10000 |
| 3 | 3.500 | 8 | .766 | 1.2000 | 1.6337 | 3.38850 | .10000 |
| 4 | 4.500 | 8 | .844 | 1.3000 | 1.7337 | 4.38713 | .10000 |

# FLANGING
# PVC AND CPVC PIPE

CHARLOTTE PIPE AND FOUNDRY COMPANY®

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



5. Use a torque wrench to tighten the bolts to the torque values shown below.

## INSTALLATION

1. Join the flange to the pipe using the procedures shown in the solvent cementing or threading sections (pages 30-35).

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.

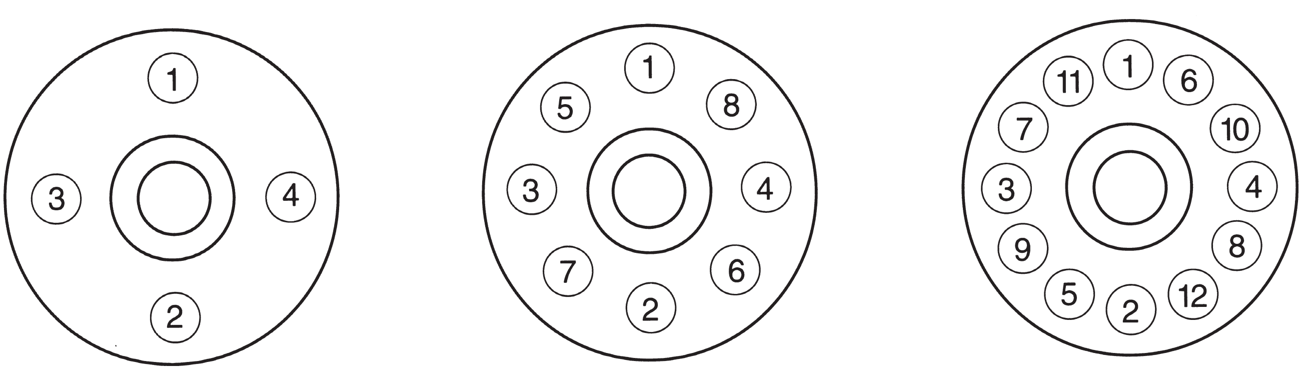
4. Sequentially tighten the bolts corresponding to the patterns shown below.

## RECOMMENDED TORQUE

| Pipe Size In Inches | No. Bolt Holes | Bolt Diameter | Recommended Torque ft/lbs |
|---|---|---|---|
| 1/2 | 4 | 1/2 | 10 - 15 |
| 3/4 | 4 | 1/2 | 10 - 15 |
| 1 | 4 | 1/2 | 10 - 15 |
| 1 1/4 | 4 | 1/2 | 10 - 15 |
| 1 1/2 | 4 | 1/2 | 10 - 15 |
| 2 | 4 | 5/8 | 20 - 30 |
| 2 1/2 | 4 | 5/8 | 20 - 30 |
| 3 | 4 | 5/8 | 20 - 30 |
| 4 | 8 | 5/8 | 20 - 30 |
| 6 | 8 | 3/4 | 33 - 50 |
| 8 | 8 | 3/4 | 33 - 50 |
| 10 | 12 | 7/8 | 53 - 75 |
| 12 | 12 | 7/8 | 53 - 75 |

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

## FLANGE BOLT TIGHTENING SEQUENCE



# CHEMICAL RESISTANCE

The following table gives the chemical resistance of ABS, PVC and CPVC thermoplastic piping materials and three commonly used seal materials. 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. **It 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.**

Number = Maximum Recommended Temp. (°F)** NR = Not Recommended • • = Incomplete Data

| Chemical Name | Pipe & Fitting Materials Recommended Max. Temp (°F) | | | Seal Materials Recommended Max. Temp. (°F) | | |
|---|---|---|---|---|---|---|
| | ABS | PVC | CPVC | Viton ® | EPDM | Neoprene |
| Acetaldehyde | NR | NR | NR | NR | 200 | NR |
| Acetamide | 120 | • • | • • | NR | 200 | NR |
| Acetate Solvent, Crude | NR | NR | NR | • • | • • | • • |
| Acetate Solvent, Pure | NR | NR | NR | • • | • • | • • |
| Acetic Acid, 10% | 120 | 140 | 180 | NR | 180 | NR |
| Acetic Acid, 20% | NR | 140 | NR | NR | 180 | NR |
| Acetic Acid, 50% | NR | 73 | NR | NR | 140 | NR |
| Acetic Acid, 80% | NR | 73 | NR | NR | 100 | NR |
| Acetic Acid, Glacial | NR | NR | NR | NR | 100 | NR |
| Acetic Anhydride | NR | NR | NR | NR | NR | 70 |
| Acetone | NR | NR | NR | NR | 130 | NR |
| Acetonitrile | NR | NR | NR | NR | NR | 70 |
| Acetophenone | NR | NR | NR | NR | 140 | NR |
| Acetyl Chloride | NR | NR | NR | 185 | NR | NR |
| Acetylene | 160§ | 140§ | 180§ | 200 | 200 | 70 |
| Acetyl Nitrile | NR | NR | NR | NR | NR | NR |
| Acrylic Acid | NR | NR | NR | • • | • • | • • |
| Acrylonitrile | NR | NR | NR | NR | NR | NR |
| Adipic Acid (Sat'd) | • • | 140 | 180 | 200 | 200 | 200 |
| Allyl Alcohol | NR | NR | NR | 100 | 70 | 70 |
| Allyl Chloride | NR | NR | NR | 70 | NR | • • |
| Alums | 160 | 140 | 180 | NR | 200 | 160 |
| Aluminum Acetate | 160 | • • | 180 | NR | 200 | NR |
| Aluminum Ammonium | • • | 140 | 180 | 200 | 200 | 160 |
| Aluminum Chloride | 160 | 140 | 180 | 200 | 200 | 160 |
| Aluminum Chrome | • • | 140 | 180 | 200 | 200 | 160 |
| Aluminum Fluoride | NR | 73 | 180 | 200 | 200 | 160 |
| Aluminum Hydroxide | 160 | 140 | 180 | 200 | 200 | 100 |
| Aluminum Nitrate | 160 | 140 | 180 | 100 | 200 | 100 |
| Aluminum Oxychloride | 160 | 140 | 180 | NR | • • | • • |
| Aluminum Potassium Sulfate | 160 | 140 | 180 | 200 | 200 | 160 |
| Aluminum Sulfate | 160 | 140 | 180 | 185 | 200 | 140 |
| Amines | NR | • • | NR | • • | • • | • • |
| Ammonia | 73 | 140 | NR | NR | 175 | 150 |
| Ammonia, Gas | 160§ | 140§ | NR | NR | 140 | 140 |
| Ammonia, Aqua, 10% | • • | 73 | NR | NR | 140 | • • |
| Ammonia, (25% Aqueous Solution) | 160 | NR | NR | NR | 140 | • • |
| Ammonia Hydroxide | 73 | 100 | NR | NR | 175 | 150 |
| Ammonia Liquid (Concentrated) | NR | NR | NR | NR | 140 | 70 |
| Ammonium Acetate | • • | 140 | 180 | 73 | 140 | 140 |

Acrylonitrile-Butadiene-Styrene Polyvinyl Chloride Type 1 Grade 1 Chlorinated Polyvinyl Chloride Type IV Grade 1
Flourocarbon Elastomer (Viton ® is a registered trademark of the DuPont Co.) Ethylene Propylene Diene Monomer
** Maximum recommended temperature, for chemical resistance, under normal conditions. § Non-pressure, vent-only, applications when chemical is in gas form.

Number = Maximum Recommended Temp. (°F)** NR = Not Recommended • • = Incomplete Data

| Chemical Name | Pipe & Fitting Materials Recommended Max. Temp (°F) | | | Seal Materials Recommended Max. Temp. (°F) | | |
|---|---|---|---|---|---|---|
| | ABS | PVC | CPVC | Viton ® | EPDM | Neoprene |
| Ammonium Benzoate | • • | • • | 180 | • • | • • | • • |
| Ammonium Bifluoride | • • | 140 | 180 | 200 | 200 | • • |
| Ammonium Bisulfide | 160 | 140 | 180 | • • | • • | • • |
| Ammonium Carbonate | 160 | 140 | 180 | 200 | 200 | 140 |
| Ammonium Chloride | 120 | 140 | 180 | 200 | 200 | 160 |
| Ammonium Citrate | 120 | • • | 180 | • • | • • | • • |
| Ammonium Dichromate | 120 | 73 | • • | • • | 70 | 100 |
| Ammonium Fluoride, 10% | 120 | 140 | 180 | • • | 200 | 100 |
| Ammonium Fluoride, 25% | 120 | 73 | 180 | • • | 140 | • • |
| Ammonium Hydroxide | 120 | 73 | NR | 70 | 200 | 150 |
| Ammonium Metaphosphate. | 120 | 140 | 180 | 200 | 200 | • • |
| Ammonium Nitrate | 120 | 140 | 180 | 100 | 200 | 160 |
| Ammonium Persulphate | 120 | 140 | 73 | • • | 200 | 70 |
| Ammonium Phospate | 120 | 140 | 73 | 185 | 200 | 140 |
| Ammonium Sulfamate | 120 | • • | 180 | • • | • • | • • |
| Ammonium Sulfate | 120 | 140 | 180 | 200 | 200 | 160 |
| Ammonium Sulfide | 120 | 73 | 180 | 200 | 200 | • • |
| Ammonium Thiocyanate | 120 | 140 | 180 | 185 | • • | 70 |
| Ammonium Tartrate | 120 | 140 | 180 | • • | • • | • • |
| Amyl Acetate | NR | NR | NR | NR | 70 | NR |
| Alcohol, Amyl | NR | NR | NR | 185 | 200 | 140 |
| Amyl Chloride | NR | NR | NR | 200 | NR | NR |
| Aniline | NR | NR | NR | NR | 140 | NR |
| Aniline Chlorohydrate | NR | NR | • • | • • | • • | • • |
| Aniline Hydrochloride | NR | NR | NR | 185 | • • | NR |
| Anthraquinone Sulfonic Acid | • • | 140 | • • | 200 | • • | • • |
| Antimony Trichloride | • • | 140 | 180 | 185 | 140 | 140 |
| Aqua Regia | NR | NR | 73 | 100 | NR | NR |
| Aromatic Hydrocarbons | NR | NR | NR | 73 | NR | NR |
| Argon | • • | • • | • • | 200 | 200 | 100 |
| Arsenic Acid | • • | 140 | 73 | 200 | 185 | NR |
| Aryl Sulfonic Acid | • • | 140 | • • | 185 | 140 | • • |
| Asphalt | NR | NR | NR | 180 | NR | NR |
| Barium Carbonate | 120 | 140 | 180 | 200 | 200 | 160 |
| Barium Chloride | 120 | 140 | 180 | 200 | 200 | 160 |
| Barium Hydroxide | 120 | 140 | 180 | 200 | 180 | 150 |
| Barium Nitrate | 120 | 73 | 180 | 200 | 200 | 160 |
| Barium Sulfate | 120 | 140 | 180 | 200 | 200 | 160 |
| Barium Sulfide | 120 | 140 | 180 | 200 | 140 | 160 |
| Beer | 120 | 140 | 180 | 200 | 200 | 140 |
| Beet Sugar Liquids | 120 | 140 | 180 | 185 | 200 | 160 |
| Benzaldehyde | NR | NR | NR | NR | 140 | NR |
| Benzalkonium Chloride | NR | NR | NR | • • | • • | • • |
| Benzene | NR | NR | NR | 150 | NR | NR |
| Benzene, Benzol | NR | NR | NR | 200 | 200 | • • |

Acrylonitrile-Butadiene-Styrene Polyvinyl Chloride Type 1 Grade 1 Chlorinated Polyvinyl Chloride Type IV Grade 1
Flourocarbon Elastomer (Viton ® is a registered trademark of the DuPont Co.) Ethylene Propylene Diene Monomer
** Maximum recommended temperature, for chemical resistance, under normal conditions. § Non-pressure, vent-only, applications when chemical is in gas form.

Number = Maximum Recommended Temp. (°F)** NR = Not Recommended • • = Incomplete Data

| Chemical Name | Pipe & Fitting Materials Recommended Max. Temp (°F) | | | Seal Materials Recommended Max. Temp. (°F) | | |
|---|---|---|---|---|---|---|
| | ABS | PVC | CPVC | Viton ® | EPDM | Neoprene |
| Benzene Sulfonic Acid | NR | NR | NR | 185 | NR | 100 |
| Benzoic Acid, (Sat'd) | 160 | 140 | 73 | • • | NR | 160 |
| Benzyl Chloride | NR | • • | NR | • • | • • | • • |
| Benzyl Alcohol | NR | NR | NR | 140 | NR | NR |
| Bismuth Carbonate | 160 | 140 | 180 | • • | • • | 70 |
| Black Liquor | 73 | 140 | 180 | 200 | 180 | 70 |
| Bleach, Industrial (15% $Cl_2$) | 73 | 140 | 180 | 185 | 70 | • • |
| Bleach, 12.5% Active $Cl_2$ | 73 | 140 | 180 | R | 140 | • • |
| Bleach, 5.5% Active $Cl_2$ | 73 | 140 | 180 | R | 140 | • • |
| Borax | 160 | 140 | 180 | 185 | 140 | 140 |
| Boric Acid | 160 | 140 | 180 | 185 | 140 | 140 |
| Breeders Pellets, Deriv. Fish | 160 | 140 | 180 | • • | • • | • • |
| Brine, Acid | 73 | 73 | 180 | 200 | 200 | 160 |
| Bromic Acid | 73 | 140 | 180 | 70 | 70 | • • |
| Bromine | NR | NR | NR | 70 | NR | NR |
| Bromine, Liquid | NR | NR | NR | 70 | NR | NR |
| Bromine, Vapor 25% | NR | 140 | • • | • • | NR | • • |
| Bromine, Water | NR | 73 | 73 | 185 | NR | NR |
| Bromine, Water, (Sat'd) | NR | 73 | 73 | • • | • • | • • |
| Bromobenzene | NR | NR | NR | 150 | NR | NR |
| Bromotoluene | NR | NR | NR | NR | NR | NR |
| Butadiene | NR | 140 | 73 | 185 | NR | 140 |
| Butane | NR | 140 | • • | 185 | NR | 70 |
| Butanol, Primary | NR | NR | NR | • • | • • | • • |
| Butanol, Secondary | NR | NR | NR | • • | • • | • • |
| Butyl Acetate | NR | NR | NR | NR | 140 | NR |
| Butyl Alcohol | 73 | 100 | NR | 75 | 200 | 140 |
| Butyl Carbitol | • • | • • | NR | • • | • • | • • |
| Butyl Cellosolve (2-butoxyethanol) | NR | 73 | NR | NR | 140 | • • |
| Butynediol | NR | 73 | • • | • • | • • | • • |
| Butylene | NR | 73 | • • | 100 | NR | NR |
| Butyl Phenol | NR | 73 | • • | • • | • • | NR |
| Butyl Pthalate | NR | NR | NR | 70 | • • | • • |
| Butyl Stearate | NR | 73 | 73 | 200 | NR | NR |
| Butyric Acid | NR | NR | NR | 70 | 140 | NR |
| Butyric Acid, Up to 1% | 73 | 73 | 180 | 73 | 140 | • • |
| Butyric Acid, Over 1% | NR | • • | NR | • • | • • | • • |
| Cadmium Acetate | • • | • • | 180 | • • | • • | • • |
| Cadmium Chloride | • • | • • | 180 | • • | • • | • • |
| Cadmium Cyanide | • • | 140 | 180 | • • | • • | 70 |
| Cadmium Sulfate | • • | • • | 180 | • • | • • | • • |
| Caffeine Citrate | • • | 73 | • • | • • | • • | • • |
| Calcium Acetate | NR | 73 | 180 | • • | R | • • |
| Calcium Bisulfide | NR | NR | 180 | 185 | • • | • • |
| Calcium Bisulfite | NR | 140 | 180 | 185 | NR | 70 |

Acrylonitrile-Butadiene-Styrene Polyvinyl Chloride Type 1 Grade 1 Chlorinated Polyvinyl Chloride Type IV Grade 1
Flourocarbon Elastomer (Viton ® is a registered trademark of the DuPont Co.) Ethylene Propylene Diene Monomer
** Maximum recommended temperature, for chemical resistance, under normal conditions. § Non-pressure, vent-only, applications when chemical is in gas form.

Number = Maximum Recommended Temp. (°F)** NR = Not Recommended • • = Incomplete Data

| Chemical Name | Pipe & Fitting Materials Recommended Max. Temp (°F) | | | Seal Materials Recommended Max. Temp. (°F) | | |
|---|---|---|---|---|---|---|
| | ABS | PVC | CPVC | Viton ® | EPDM | Neoprene |
| Calcium Carbonate | 160 | 140 | 180 | 200 | 200 | 70 |
| Calcium Chlorate | 160 | 140 | 180 | 185 | 140 | 70 |
| Calcium Chloride | 160 | 140 | 180 | 200 | 200 | 160 |
| Calcium Hydroxide | 160 | 140 | 180 | 200 | 200 | 70 |
| Calcium Hypochlorite | 160 | 140 | 180 | 185 | 70 | • • |
| Calcium Nitrate | 160 | 140 | 180 | 200 | 200 | 100 |
| Calcium Oxide | 160 | 140 | 180 | • • | 200 | 160 |
| Calcium Sulfate | 160 | 140 | 180 | 200 | 200 | 160 |
| Camphor Crystals | NR | 73 | • • | 200 | 200 | NR |
| Cane Sugar Liquors | 120 | 140 | 180 | 200 | 200 | 160 |
| Caprolactam | NR | • • | NR | • • | • • | • • |
| Caprolactone | NR | • • | NR | • • | • • | • • |
| Caprylic Acid | NR | • • | NR | • • | • • | • • |
| Carbitol™ | NR | NR | NR | 70 | 140 | 70 |
| Carbon Bisulfide | NR | NR | NR | • • | • • | • • |
| Carbon Dioxide, Wet | 160 | 140 | 180 | 200 | 200 | 160 |
| Carbon Dioxide, Dry | 160 | 140 | 180 | 200 | 200 | 160 |
| Carbon Disulfide | NR | NR | NR | 200 | NR | NR |
| Carbonic Acid | • • | 140 | 180 | 200 | 200 | 70 |
| Carbon Monoxide | 160 | 140 | 180 | 200 | 200 | 70 |
| Carbon Tetrachloride | NR | NR | NR | 185 | NR | NR |
| Castor Oil | NR | 140 | NR | • • | 140 | 100 |
| Caustic Potash | 160 | 140 | 180 | NR | 140 | 160 |
| Caustic Soda | 160 | 140 | 180 | NR | 70 | 100 |
| Cellosolve | NR | 73 | NR | NR | 140 | • • |
| Cellosolve Acetate | NR | • • | NR | NR | 140 | NR |
| Chloracetic Acid | 73 | 73 | 180 | NR | 73 | • • |
| Cloracetyl Chloride | NR | 73 | • • | • • | • • | • • |
| Chloral Hydrate | • • | 140 | 180 | NR | • • | 70 |
| Chloramine | NR | 73 | • • | • • | • • | 70 |
| Chloric Acid, 20% | • • | 140 | 180 | 140 | • • | 140 |
| Chlorinated Solvents | NR | NR | NR | • • | • • | • • |
| Chlorinated Water, Up to 3500 ppm | 160 | 140 | 180 | 185 | 100 | NR |
| Chlorinated Water, Above 3500 ppm | NR | NR | NR | 185 | NR | NR |
| Chlorine Gas, Dry | NR | NR | NR | 185 | NR | NR |
| Chlorine Gas, Wet | NR | NR | NR | 185 | NR | NR |
| Chlorine, Liquid | NR | NR | NR | 100 | NR | • • |
| Chlorine, trace in air | • • | • • | 180§ | • • | • • | • • |
| Chlorine Dioxide (sat'd aqueous sol.) | • • | • • | 180 | • • | • • | • • |
| Chlorine Water, (Sat'd) | • • | 140 | 180 | 200 | 73 | • • |
| Chlorobenzene | NR | NR | NR | 70 | NR | NR |
| Chlorobenzene Chloride | NR | NR | NR | 200 | • • | • • |
| Chloroform | NR | NR | NR | 70 | NR | NR |
| Chloropicrin | NR | NR | NR | • • | • • | • • |
| Chlorosulfonic Acid | • • | 73 | 73 | NR | NR | NR |

Acrylonitrile-Butadiene-Styrene Polyvinyl Chloride Type 1 Grade 1 Chlorinated Polyvinyl Chloride Type IV Grade 1
Flourocarbon Elastomer (Viton ® is a registered trademark of the DuPont Co.) Ethylene Propylene Diene Monomer
** Maximum recommended temperature, for chemical resistance, under normal conditions. § Non-pressure, vent-only, applications when chemical is in gas form.

# CHEMICAL RESISTANCE

Number = Maximum Recommended Temp. (°F)** NR = Not Recommended • • = Incomplete Data

| Chemical Name | Pipe & Fitting Materials Recommended Max. Temp (°F) | | | Seal Materials Recommended Max. Temp. (°F) | | |
|---|---|---|---|---|---|---|
| | ABS | PVC | CPVC | Viton ® | EPDM | Neoprene |
| Chlorox Bleach Solution, 5.5% $Cl_2$ | 73 | 140 | 180 | 200 | 140 | • • |
| Chromic Acid, 10% | 73 | 140 | 180 | 140 | 70 | NR |
| Chromic Acid, 30% | NR | 73 | 180 | 140 | NR | NR |
| Chromic Acid, 40% | NR | 73 | 180 | 140 | NR | NR |
| Chromic Acid, 50% | NR | 75 | 140 | 140 | NR | NR |
| Chromium Nitrate | • • | • • | 180 | • • | • • | • • |
| Chromium Potassium Nitrate | 73 | 73 | 73 | 200 | 140 | 160 |
| Citric Acid (Sat'd) | 160 | 140 | 180 | 200 | 200 | 140 |
| Citric Acid, 10% | 160 | 140 | 180 | • • | • • | • • |
| Citrus Oils | • • | • • | NR | • • | • • | • • |
| Coconut Oil | NR | 140 | NR | 185 | NR | 100 |
| Coke Oven Gas | NR | NR | NR | 185 | 70 | • • |
| Copper Acetate, (Sat'd) | 73 | 73 | 73 | 140 | 100 | 160 |
| Copper Carbonate | 120 | 140 | 180 | 185 | 200 | • • |
| Copper Chloride | 73 | 140 | 180 | 200 | 200 | 160 |
| Copper Cyanide | 73 | 140 | 180 | 185 | 200 | 160 |
| Copper Fluoride | 73 | 140 | 180 | 185 | 200 | 140 |
| Copper Nitrate | 120 | 140 | 180 | 200 | 200 | 160 |
| Copper Salts | 160 | 140 | 180 | • • | • • | • • |
| Copper Sulfate | 160 | 140 | 180 | 200 | 200 | 160 |
| Corn Oil | 73 | 140 | NR | 200 | NR | NR |
| Corn Syrup | 120 | 140 | 180 | 185 | • • | 100 |
| Cottonseed Oil | 120 | 140 | NR | 185 | NR | • • |
| Creosote | NR | NR | NR | 73 | NR | NR |
| Cresol | NR | NR | NR | 100 | NR | NR |
| Cresylic Acid, 50% | NR | 140 | NR | 185 | NR | NR |
| Crotonaldehyde | NR | NR | NR | NR | NR | 70 |
| Crude Oil | NR | 73 | 180 | 200 | NR | • • |
| Cumene | • • | • • | • • | 200 | NR | NR |
| Cupric Fluoride | 73 | 140 | 180 | • • | 200 | • • |
| Cupric Sulfate | 160 | 140 | 180 | 200 | 200 | 160 |
| Cuprous Chloride | 73 | 140 | 180 | 200 | 200 | 70 |
| Cyclohexane | NR | NR | NR | 185 | NR | NR |
| Cyclohexanol | NR | NR | NR | 185 | NR | NR |
| Cyclohexanone | NR | NR | NR | NR | 70 | NR |
| Decalin | NR | NR | NR | • • | • • | • • |
| D-Limonene | • • | • • | NR | • • | • • | • • |
| Desocyephedrine | • • | 73 | • • | • • | • • | • • |
| Detergents | 73 | 140 | NR | 200 | 200 | 160 |
| Detergent Solution, Heavy Duty | 73 | 140 | NR | 200 | 200 | 160 |
| Dextrine | • • | 140 | 180 | 200 | NR | • • |
| Dextrose | 120 | 140 | 180 | 200 | 140 | 160 |
| Diacetone Alcohol | NR | NR | NR | NR | 70 | NR |
| Diazo Salts | • • | 140 | 180 | • • | • • | • • |
| Dibutoxy Ethyl Phthalate | NR | NR | NR | 200 | 70 | NR |

Acrylonitrile-Butadiene-Styrene Polyvinyl Chloride Type 1 Grade 1 Chlorinated Polyvinyl Chloride Type IV Grade 1
Flourocarbon Elastomer (Viton ® is a registered trademark of the DuPont Co.) Ethylene Propylene Diene Monomer
** Maximum recommended temperature, for chemical resistance, under normal conditions. § Non-pressure, vent-only, applications when chemical is in gas form.

Number = Maximum Recommended Temp. (°F)** NR = Not Recommended • • = Incomplete Data

| Chemical Name | Pipe & Fitting Materials Recommended Max. Temp (°F) | | | Seal Materials Recommended Max. Temp. (°F) | | |
|---|---|---|---|---|---|---|
| | ABS | PVC | CPVC | Viton ® | EPDM | Neoprene |
| Dibutyl Ethyl Phthalate | NR | NR | NR | 200 | 70 | NR |
| Dibutyl Phthalate | NR | NR | NR | NR | 70 | NR |
| Dibutyl Sebacate | NR | NR | NR | NR | 70 | NR |
| Dichlorobenzene | NR | NR | NR | 150 | NR | NR |
| Dichloroethylene | NR | NR | NR | 185 | NR | NR |
| Diesel Fuels | NR | 73 | NR | 185 | NR | NR |
| Diethylamine | NR | NR | NR | NR | 70 | • • |
| Diethyl Cellosolve | NR | • • | NR | 200 | NR | 100 |
| Diethyl Ether | NR | NR | NR | NR | NR | • • |
| Diglycolic Acid | NR | 140 | • • | 70 | 70 | • • |
| Dill Oil | • • | • • | NR | • • | • • | • • |
| Dimethylamine | NR | 140 | NR | NR | 140 | NR |
| Dimethylformamide | NR | NR | NR | NR | NR | NR |
| Dimethyl Hydrazine | NR | NR | NR | NR | • • | • • |
| Dioctyl Phthalate (DEHP) | NR | NR | NR | 70 | 70 | NR |
| Dioxane | NR | NR | NR | NR | 70 | NR |
| Dioxane, 1.4 | NR | NR | NR | NR | 73 | • • |
| Disodium Phosphate | 120 | 140 | 180 | • • | 200 | • • |
| Distilled Water | 160 | 140 | 180 | 200 | 200 | 160 |
| Divinylbenzene | NR | NR | NR | 200 | NR | • • |
| Dursban TC | NR | • • | NR | • • | • • | • • |
| EDTA, Tetrasodium | • • | • • | 180 | • • | • • | • • |
| Epsom Salt | 120 | 140 | 180 | • • | 200 | • • |
| Epichlorohydrin | NR | NR | NR | • • | • • | • • |
| Esters | NR | NR | NR | • • | • • | • • |
| Ethanol, Up to 5% (Ethyl Alcohol) | NR | 140 | 180 | • • | • • | • • |
| Ethanol, Over 5% (Ethyl Alcohol) | NR | 140 | NR | • • | • • | • • |
| Ethanolamine | NR | NR | NR | • • | • • | • • |
| Ethers | NR | NR | NR | NR | • • | NR |
| Ethyl Acetate | NR | NR | NR | NR | 70 | NR |
| Ethyl Acetoacetate | NR | NR | NR | NR | 100 | • • |
| Ethyl Acrylate | NR | NR | NR | NR | 70 | NR |
| Ethyl Benzene | NR | NR | NR | 70 | NR | NR |
| Ethyl Chloride | NR | NR | NR | 140 | 70 | 70 |
| Ethyl Chloroacetate | NR | NR | NR | • • | • • | • • |
| Ethylene Bromide | NR | NR | NR | 70 | NR | NR |
| Ethylene Chloride | NR | NR | NR | 70 | • • | • • |
| Ethylene Chlorohydrin | NR | NR | NR | NR | 70 | 70 |
| Ethylene Diamine | NR | NR | NR | • • | 70 | 100 |
| Ethylene Dichloride | NR | NR | NR | 120 | NR | NR |
| Ethyl Ether | NR | NR | NR | NR | NR | NR |
| Ethylene Glycol, Up to 50% | 73 | 140 | 180 | 200 | 200 | 160 |
| Ethylene Glycol, Over 50% | 73 | 140 | NR | 200 | 200 | 160 |
| Ethylene Oxide | NR | NR | NR | NR | NR | NR |
| Fatty Acids | 160 | 140 | 73 | 185 | NR | 140 |

Acrylonitrile-Butadiene-Styrene Polyvinyl Chloride Type 1 Grade 1 Chlorinated Polyvinyl Chloride Type IV Grade 1
Flourocarbon Elastomer (Viton ® is a registered trademark of the DuPont Co.) Ethylene Propylene Diene Monomer
** Maximum recommended temperature, for chemical resistance, under normal conditions. § Non-pressure, vent-only, applications when chemical is in gas form.

# CHEMICAL RESISTANCE

Number = Maximum Recommended Temp. (°F)** NR = Not Recommended • • = Incomplete Data

| Chemical Name | Pipe & Fitting Materials Recommended Max. Temp (°F) | | | Seal Materials Recommended Max. Temp. (°F) | | |
|---|---|---|---|---|---|---|
| | ABS | PVC | CPVC | Viton ® | EPDM | Neoprene |
| Ferric Acetate | NR | 73 | 180 | • • | • • | • • |
| Ferric Chloride | 120 | 140 | 180 | 200 | 200 | 160 |
| Ferric Hydroxide | 160 | 140 | 180 | 180 | 180 | 100 |
| Ferric Nitrate | 160 | 140 | 180 | 200 | 200 | 160 |
| Ferric Sulfate | 160 | 140 | 180 | 185 | 200 | 140 |
| Ferrous Chloride | 160 | 140 | 180 | 200 | 200 | • • |
| Ferrous Hydroxide | 160 | 73 | 180 | 180 | 180 | • • |
| Ferrous Nitrate | 160 | 73 | 140 | 200 | 180 | 160 |
| Ferrous Sulfate | 160 | 140 | 180 | 200 | 200 | 160 |
| Fish Solubles | 160 | 140 | 180 | 70 | NR | • • |
| Fluorine Gas | NR | NR | NR | NR | NR | NR |
| Fluoboric Acid | • • | 140 | 73 | 140 | 140 | 160 |
| Fluorosilicic Acid, 30% | 73 | 140 | 73 | 200 | 140 | 100 |
| Formaldehyde, 35% | NR | 140 | NR | NR | 140 | 140 |
| Formic Acid, Up to 25% | • • | 73 | 180 | NR | 200 | 140 |
| Formic Acid, Anhydrous | • • | 73 | NR | NR | • • | 100 |
| Freon F- 11 | • • | 140§ | 73§ | 70 | NR | NR |
| Freon F-12 | • • | 140§ | 73§ | NR | NR | 130 |
| Freon F-21 | • • | NR | NR | NR | NR | NR |
| Freon F-22 | • • | NR | NR | NR | NR | 130 |
| Freon F-113 | • • | 140§ | • • | 130 | NR | 130 |
| Freon F-114 | • • | 140§ | • • | NR | NR | 70 |
| Fructose | 120 | 140 | 180 | 200 | 175 | 160 |
| Fruit Juices, Pulp | 73 | 140 | 180 | 200 | • • | • • |
| Furfural | NR | NR | NR | NR | 140 | 70 |
| Gallic Acid | • • | 140 | 73 | 185 | 70 | 70 |
| Gas, Manufactured | NR | 73§ | NR | • • | • • | • • |
| Gas, Natural | NR | 140§ | • • | 185 | NR | 140 |
| Gasoline, Leaded | NR | NR | NR | 100 | NR | 70 |
| Gasoline, Unleaded | NR | NR | NR | 100 | NR | • • |
| Gasoline, Sour | NR | NR | NR | 100 | NR | • • |
| Gasoline, Refined | NR | NR | NR | • • | • • | • • |
| Gelatin | 120 | 140 | 150 | 200 | 200 | 160 |
| Gin | NR | 140 | NR | • • | • • | • • |
| Glucose | 120 | 140 | 180 | 200 | 200 | 160 |
| Glycerine | 120 | 140 | 180 | 200 | 200 | 160 |
| Glycerine, Glycerol | 120 | 140 | 180 | 200 | 200 | • • |
| Glycolic Acid | • • | 140 | NR | NR | • • | 70 |
| Glycol Ethers | NR | 140 | NR | • • | • • | • • |
| Grape Sugar, Juice | 73 | 140 | 180 | 185 | 200 | 160 |
| Green Liquor | 160 | 140 | 180 | • • | 150 | 70 |
| Halocarbons Oils | NR | • • | NR | • • | • • | • • |
| Heptane | 73 | 140 | NR | 185 | NR | 70 |
| Hexane | NR | 73 | 73 | 70 | NR | 70 |
| Hexanol | NR | 100 | NR | 160 | NR | 70 |

Acrylonitrile-Butadiene-Styrene Polyvinyl Chloride Type 1 Grade 1 Chlorinated Polyvinyl Chloride Type IV Grade 1
Flourocarbon Elastomer (Viton ® is a registered trademark of the DuPont Co.) Ethylene Propylene Diene Monomer
** Maximum recommended temperature, for chemical resistance, under normal conditions. § Non-pressure, vent-only, applications when chemical is in gas form.

Number = Maximum Recommended Temp. (°F)** NR = Not Recommended • • = Incomplete Data

| Chemical Name | Pipe & Fitting Materials Recommended Max. Temp (°F) | | | Seal Materials Recommended Max. Temp. (°F) | | |
|---|---|---|---|---|---|---|
| | ABS | PVC | CPVC | Viton ® | EPDM | Neoprene |
| Hydraulic Oil | NR | 73 | • • | 200 | NR | 70 |
| Hydrazine | NR | NR | NR | NR | 70 | • • |
| Hydrobromic Acid, Dilute | 73 | 140 | 180 | R | 140 | • • |
| Hydrobromic Acid, 20% | 73 | 140 | 73 | 185 | 140 | 70 |
| Hydrobromic Acid, 50% | NR | 140 | 73 | 185 | 140 | 70 |
| Hydrochloric Acid, Dilute | 73 | 140 | 180 | NR | 150 | • • |
| Hydrochloric Acid, 18% | NR | 140 | 180 | NR | 150 | • • |
| Hydrochloric Acid, 20% | NR | 140 | 180 | NR | 150 | • • |
| Hydrochloric Acid Conc., 37% | NR | 140 | 180 | NR | 150 | • • |
| Hydrocyanic Acid, 10% | 160 | 140 | • • | 185 | 200 | • • |
| Hydrofluoric Acid, Dilute | NR | 73 | 73 | 150 | NR | 70 |
| Hydrofluoric Acid, Up to 3% | 73 | 73 | 73 | 150 | NR | 70 |
| Hydrofluoric Acid, 30% | NR | 73 | NR | 150 | NR | 70 |
| Hydrofluoric Acid, 40% | NR | 73 | NR | 100 | NR | NR |
| Hydrofluoric Acid, 50% | NR | 73 | NR | 75 | NR | NR |
| Hydrofluoric Acid, 100% | NR | NR | NR | NR | NR | NR |
| Hydrofluosilicic Acid, 50% | NR | 140 | 140 | 200 | 140 | • • |
| Hydrogen | 140§ | 140§ | 73§ | 200 | 200 | 160 |
| Hydrogen Cyanide | • • | 140 | • • | • • | • • | 70 |
| Hydrogen Fluoride | NR | NR | NR | NR | 70 | NR |
| Hydrogen Peroxide, Dilute | 73 | 140 | 73 | 200 | 140 | NR |
| Hydrogen Peroxide, 30% | NR | 140 | 73 | 200 | 140 | NR |
| Hydrogen Peroxide, 50% | NR | 140 | 73 | 185 | 100 | NR |
| Hydrogen Peroxide, 90% | NR | NR | NR | 100 | NR | NR |
| Hydrogen Phosphide | • • | 140 | • • | • • | 73 | • • |
| Hydrogen Sulfide, Dry | • • | 140 | 180 | 140 | 100 | NR |
| Hydrogen Sulfide, Aqeous Sol. | • • | 140 | 180 | 140 | 100 | NR |
| Hydroquinone | • • | 140 | • • | 185 | NR | NR |
| Hydroxylamine Sulfate | • • | 140 | • • | • • | 70 | 70 |
| Hypochlorous Acid | 73 | 140 | 140 | 70 | 70 | • • |
| Iodine | NR | NR | NR | 70 | 70 | NR |
| Iodine Solution, 10% | NR | NR | NR | 200 | 150 | • • |
| Iodine in Alcohol | NR | NR | NR | • • | • • | • • |
| Iron Salts | • • | • • | 180 | • • | • • | • • |
| Isopropanol | NR | 140 | NR | • • | • • | • • |
| Isopropyl Alcohol | NR | 140 | NR | 160 | 140 | 70 |
| Isopropyl Ether | NR | NR | NR | NR | NR | NR |
| Isooctane | NR | NR | NR | 185 | NR | 70 |
| Jet Fuel, JP-4 | NR | NR | NR | 200 | NR | NR |
| Jet Fuel, JP-5 | NR | NR | NR | 200 | NR | NR |
| Kerosene | NR | NR | NR | 200 | NR | 70 |
| Ketones | NR | NR | NR | NR | NR | NR |
| Kraft Liquor | 73 | 140 | 180 | 100 | • • | 70 |
| Lactic Acid, 25% | 73 | 140 | 180 | 70 | 70 | 140 |
| Lactic Acid, 80% | NR | 73 | 73 | 70 | 70 | • • |

Acrylonitrile-Butadiene-Styrene Polyvinyl Chloride Type 1 Grade 1 Chlorinated Polyvinyl Chloride Type IV Grade 1
Flourocarbon Elastomer (Viton ® is a registered trademark of the DuPont Co.) Ethylene Propylene Diene Monomer
** Maximum recommended temperature, for chemical resistance, under normal conditions. § Non-pressure, vent-only, applications when chemical is in gas form.

Number = Maximum Recommended Temp. (°F)** NR = Not Recommended • • = Incomplete Data

| Chemical Name | Pipe & Fitting Materials Recommended Max. Temp (°F) | | | Seal Materials Recommended Max. Temp. (°F) | | |
|---|---|---|---|---|---|---|
| | ABS | PVC | CPVC | Viton ® | EPDM | Neoprene |
| Lard Oil | 73 | 140 | NR | 185 | NR | 70 |
| Lauric Acid | • • | 140 | • • | 100 | • • | • • |
| Lauryl Chloride | • • | 140 | • • | 200 | 140 | • • |
| Lead Acetate | • • | 140 | 180 | NR | 200 | 160 |
| Lead Chloride | • • | 140 | 180 | 140 | NR | 70 |
| Lead Nitrate | • • | 140 | 180 | 200 | 175 | 140 |
| Lead Sulfate | • • | 140 | 180 | 200 | 200 | 140 |
| Lemon Oil | • • | • • | NR | 200 | • • | 100 |
| Ligroine | NR | NR | NR | 100 | • • | 70 |
| Lime Sulfur | • • | 140 | 180 | 185 | 200 | 100 |
| Limonene | • • | • • | NR | • • | • • | • • |
| Linoleic Acid | • • | 140 | 180 | 140 | 70 | • • |
| Linoleic Oil | • • | 140 | 180 | 70 | • • | • • |
| Linseed Oil | 73 | 140 | NR | 200 | 70 | 70 |
| Linseed Oil, Blue | 73 | 73 | NR | 200 | • • | • • |
| Liqueurs | NR | 140 | • • | • • | • • | 70 |
| Lithium Bromide (Brine) | • • | 140 | 180 | 200 | • • | • • |
| Lithium Chloride | • • | 140 | 180 | 140 | 100 | • • |
| Lithium Sulfate | • • | 140 | 180 | • • | • • | • • |
| Lubricating Oil, ASTM #1, #2, #3 | NR | 140 | 73 | 150 | NR | 70 |
| Lux Liquid | • • | NR | • • | • • | • • | • • |
| Lye Solutions | • • | 140 | 180 | • • | • • | • • |
| Machine Oil | NR | 140 | 180 | • • | NR | • • |
| Magnesium Carbonate | 120 | 140 | 180 | 200 | 170 | 140 |
| Magnesium Chloride | 120 | 140 | 180 | 170 | 170 | 160 |
| Magnesium Citrate | 120 | 140 | 180 | 200 | 175 | • • |
| Magnesium Fluoride | 120 | • • | 180 | 200 | 140 | • • |
| Magnesium Hydroxide | 120 | 140 | 180 | 200 | 200 | • • |
| Magnesium Nitrate | 120 | 140 | 180 | • • | 200 | • • |
| Magnesium Oxide | 120 | • • | 180 | • • | 140 | 160 |
| Magnesium Salts, Inorganic | 120 | • • | 180 | • • | • • | • • |
| Magnesium Sulfate | 120 | 140 | 180 | 200 | 175 | 160 |
| Maleic Acid | 160 | 140 | 180 | 200 | NR | 70 |
| Maleic Acid (Sat'd) | 160 | 140 | 180 | 200 | 70 | NR |
| Malic Acid | 160 | 140 | 180 | • • | • • | • • |
| Manganese Sulfate | 120 | 140 | 180 | 200 | 175 | 160 |
| Mercuric Acid | • • | • • | 180 | • • | • • | • • |
| Mercuric Chloride | • • | 140 | 140 | 185 | 200 | 140 |
| Mercuric Cyanide | • • | 140 | 180 | 70 | 70 | 70 |
| Mercuric Sulfate | • • | 140 | 180 | 70 | 70 | • • |
| Mercurous Nitrate | • • | 140 | 180 | 70 | 70 | NR |
| Mercury | • • | 140 | 180 | 185 | 200 | 140 |
| Methane | 160§ | 140§ | 180§ | 185 | NR | 70 |
| Methanol (Methyl Alcohol) | NR | 140 | NR | NR | 140 | 140 |
| Methoxyethyl Oleate | NR | 73 | • • | • • | • • | • • |

Acrylonitrile-Butadiene-Styrene Polyvinyl Chloride Type 1 Grade 1 Chlorinated Polyvinyl Chloride Type IV Grade 1
Flourocarbon Elastomer (Viton ® is a registered trademark of the DuPont Co.) Ethylene Propylene Diene Monomer
** Maximum recommended temperature, for chemical resistance, under normal conditions. § Non-pressure, vent-only, applications when chemical is in gas form.

Number = Maximum Recommended Temp. (°F)** NR = Not Recommended • • = Incomplete Data

| Chemical Name | Pipe & Fitting Materials Recommended Max. Temp (°F) | | | Seal Materials Recommended Max. Temp. (°F) | | |
|---|---|---|---|---|---|---|
| | ABS | PVC | CPVC | Viton ® | EPDM | Neoprene |
| Methyl Amine | NR | NR | NR | 100 | 70 | 70 |
| Methyl Bromide | NR | NR | NR | 185 | NR | NR |
| Methyl Cellosolve | NR | NR | NR | NR | 70 | 70 |
| Methyl Chloride | NR | NR | NR | 70 | NR | NR |
| Methyl Chloroform | NR | NR | NR | 70 | NR | NR |
| Methyl Ethyl Ketone | NR | NR | NR | NR | 70 | NR |
| Methyl Formate | NR | • • | NR | NR | 100 | 70 |
| Methyl Isobutyl Ketone | NR | NR | NR | NR | 70 | NR |
| Methyl Methacrylate | NR | NR | NR | NR | NR | NR |
| Methyl Sulfate | NR | 73 | 73 | • • | • • | • • |
| Methyl Sulfuric Acid | • • | 140 | 180 | • • | • • | • • |
| Methylene Bromide | NR | NR | NR | 70 | NR | NR |
| Methylene Chloride | NR | NR | NR | 73 | NR | NR |
| Methylene Chlorobromide | NR | NR | NR | NR | NR | NR |
| Methylene Iodine | NR | NR | NR | • • | 200 | • • |
| Methylisobutyl Carbinol | NR | NR | NR | 70 | 70 | 70 |
| Milk | 160 | 140 | 73 | 200 | 200 | 160 |
| Mineral Oil | 73 | 140 | 73 | 200 | NR | 70 |
| Molasses | 120 | 140 | 180 | 185 | 100 | 150 |
| Monochloroacetic Acid, 50% | 73 | 140 | 73 | 70 | NR | NR |
| Monoethanolamine | NR | NR | NR | 185 | 70 | NR |
| Motor Oil | 73 | 140 | 180 | 200 | NR | • • |
| Muriatic Acid, Up to 30% HCl | NR | 140 | 180 | • • | • • | • • |
| Naphtha | NR | NR | NR | 150 | NR | NR |
| Naphthalene | NR | NR | NR | 170 | NR | NR |
| n-Heptane | NR | NR | NR | • • | • • | • • |
| Natural Gas | NR | 140§ | • • | 185 | NR | 140 |
| Nickel Acetate | 73 | 73 | 180 | NR | 70 | • • |
| Nickel Chloride | 73 | 140 | 180 | 200 | 200 | 160 |
| Nickel Nitrate | 73 | 140 | 180 | 200 | 180 | • • |
| Nickel Sulfate | 73 | 140 | 180 | 200 | 200 | 160 |
| Nicotine | NR | 140 | • • | • • | • • | NR |
| Nicotinic Acid | NR | 140 | • • | • • | 70 | 140 |
| Nitric Acid, 10% | 73 | 140 | 140 | 185 | 70 | NR |
| Nitric Acid, 30% | NR | 140 | 120 | 160 | 70 | NR |
| Nitric Acid, 40% | NR | NR | 120 | 140 | NR | NR |
| Nitric Acid, 50% | NR | NR | 73 | 120 | NR | NR |
| Nitric Acid, 70% | NR | NR | 73 | 100 | NR | NR |
| Nitric Acid, 100% | NR | NR | NR | • • | • • | • • |
| Nitric Acid, Fuming | NR | NR | NR | NR | NR | NR |
| Nitrobenzene | NR | NR | NR | 70 | NR | • • |
| Nitroglycerine | NR | NR | NR | • • | • • | • • |
| Nitrous Acid, 10% | NR | 73 | • • | 100 | • • | • • |
| Nitrous Oxide | 73§ | 73§ | • • | 70 | • • | NR |
| Nitroglycol | NR | NR | • • | • • | • • | 70 |

Acrylonitrile-Butadiene-Styrene Polyvinyl Chloride Type 1 Grade 1 Chlorinated Polyvinyl Chloride Type IV Grade 1
Flourocarbon Elastomer (Viton ® is a registered trademark of the DuPont Co.) Ethylene Propylene Diene Monomer
** Maximum recommended temperature, for chemical resistance, under normal conditions. § Non-pressure, vent-only, applications when chemical is in gas form.

Number = Maximum Recommended Temp. (°F)** NR = Not Recommended • • = Incomplete Data

| Chemical Name | Pipe & Fitting Materials Recommended Max. Temp (°F) | | | Seal Materials Recommended Max. Temp. (°F) | | |
|---|---|---|---|---|---|---|
| | ABS | PVC | CPVC | Viton ® | EPDM | Neoprene |
| Nonionic Surfactants | 160 | 140 | NR | 200 | 200 | 160 |
| 1-Octanol | NR | • • | NR | • • | • • | • • |
| Ocenol | NR | • • | • • | • • | • • | • • |
| Oils and Fats | 73 | 140 | • • | • • | • • | • • |
| Oils, Edible | 73 | • • | NR | • • | • • | • • |
| Oils, Vegetable | 73 | • • | NR | 200 | NR | • • |
| Oils, Sour Crude | • • | • • | NR | • • | • • | • • |
| Oleic Acid | 160 | 140 | 180 | 185 | 70 | 70 |
| Oleum | NR | NR | NR | NR | NR | NR |
| Olive Oil | 73 | 140 | NR | 150 | • • | 140 |
| Oxalic Acid (Sat'd) | • • | 140 | 140 | 100 | 150 | 100 |
| Oxalic Acid, 20% | 73 | 140 | 180 | 100 | 150 | 100 |
| Oxalic Acid, 50% | • • | 140 | 73 | 100 | 150 | 100 |
| Oxygen | 160§ | 140§ | 180§ | 185 | 200 | 140 |
| Ozone | 160§ | 140§ | 180§ | 185 | 200 | NR |
| Ozonized Water | • • | • • | • • | • • | • • | • • |
| Palm Oil | • • | • • | • • | 70 | NR | • • |
| Palmitic Acid, 10% | 73 | 140 | 73 | 185 | 70 | NR |
| Palmitic Acid, 70% | NR | NR | 73 | 185 | • • | NR |
| Paraffin | 73 | 140 | • • | 200 | NR | 140 |
| Peanut Oil | • • | • • | • • | 150 | NR | • • |
| Pentachlorophenol | NR | NR | NR | 200 | NR | NR |
| Peracetic Acid, 40% | NR | NR | NR | • • | • • | • • |
| Perchloric Acid, 10% | NR | 73 | 73 | 70 | 70 | 70 |
| Perchloric Acid, 70% | NR | NR | NR | 185 | 70 | NR |
| Perphosphate | • • | 140 | 170 | 70 | 70 | • • |
| Petrolatum | • • | 140 | 180 | • • | • • | • • |
| Petroleum Oils, Sour | • • | 73 | 180 | 200 | NR | • • |
| Petroleum Oils, Refined | 73 | 140 | 180 | 200 | NR | • • |
| Phenol | NR | NR | NR | 200 | 70 | NR |
| Phenylhydrazine | NR | NR | NR | NR | NR | • • |
| Phenylhydrazine Hydrochloride | NR | NR | NR | • • | • • | • • |
| Phosgene, Liquid | NR | NR | NR | NR | 73 | • • |
| Phosgene, Gas | NR | NR | NR | NR | 73 | • • |
| Phosphoric Acid, 10% | 73 | 140 | 180 | 200 | 140 | 140 |
| Phosphoric Acid, 50% | 73 | 140 | 180 | 200 | 70 | 70 |
| Phosphoric Acid, 85% | 73 | 140 | 180 | 200 | 70 | NR |
| Phosphoric Anhydride | • • | 73 | 73 | • • | • • | • • |
| Phosphorous Pentoxide | • • | 73 | 180 | 200 | 200 | • • |
| Phosphorous, Red | NR | 70 | • • | • • | • • | • • |
| Phosphorus Trichloride | NR | NR | NR | • • | • • | NR |
| Phosphorous, Yellow | NR | 73 | • • | • • | • • | • • |
| Photographic Solutions | • • | 140 | 180 | 185 | • • | 100 |
| Phthalic Acid, 10% | 73 | 73 | • • | 140 | • • | NR |
| Picric Acid | NR | NR | NR | 140 | 140 | 70 |

Acrylonitrile-Butadiene-Styrene Polyvinyl Chloride Type 1 Grade 1 Chlorinated Polyvinyl Chloride Type IV Grade 1
Flourocarbon Elastomer (Viton ® is a registered trademark of the DuPont Co.) Ethylene Propylene Diene Monomer
** Maximum recommended temperature, for chemical resistance, under normal conditions. § Non-pressure, vent-only, applications when chemical is in gas form.

Number = Maximum Recommended Temp. (°F)** NR = Not Recommended • • = Incomplete Data

| Chemical Name | Pipe & Fitting Materials Recommended Max. Temp (°F) | | | Seal Materials Recommended Max. Temp. (°F) | | |
|---|---|---|---|---|---|---|
| | ABS | PVC | CPVC | Viton ® | EPDM | Neoprene |
| Pine Oil | NR | • • | NR | 70 | • • | NR |
| Plating Solutions, Brass | • • | 140 | 180 | 70 | 70 | 100 |
| Plating Solutions, Cadmium | • • | 140 | 180 | 70 | 70 | 100 |
| Plating Solutions, Chrome | • • | 140 | 180 | • • | • • | R |
| Plating Solutions, Copper | • • | 140 | 180 | 70 | 70 | R |
| Plating Solutions, Gold | • • | 140 | 180 | 70 | 70 | 125 |
| Plating Solutions, Indium | • • | • • | • • | • • | • • | • • |
| Plating Solutions, Lead | • • | 140 | 180 | 70 | 70 | 70 |
| Plating Solutions, Nickel | • • | 140 | 180 | 70 | 70 | • • |
| Plating Solutions, Rhodium | • • | 140 | 180 | 70 | • • | • • |
| Plating Solutions, Silver | • • | 140 | 180 | 70 | 70 | 70 |
| Plating Solutions, Tin | • • | 140 | 180 | 140 | 100 | • • |
| Plating Solutions, Zinc | • • | 140 | 180 | 70 | 70 | • • |
| Polyethylene Glycol | • • | • • | NR | • • | • • | • • |
| Polypropylene Glycol | • • | • • | NR | • • | • • | • • |
| Potash | 160 | 140 | 180 | 200 | 170 | 160 |
| Potassium Acetate | • • | • • | 180 | • • | • • | • • |
| Potassium Alum | • • | 140 | 180 | 200 | 200 | 160 |
| Potassium Aluminum Sulfate | • • | 140 | 180 | 200 | 200 | 160 |
| Potassium Amyl Xanthate | • • | 73 | • • | • • | • • | • • |
| Potassium Bicarbonate | 160 | 140 | 180 | 200 | 170 | 160 |
| Potassium Bichromate | 160 | 140 | 180 | 200 | 170 | • • |
| Potassium Bisulfate | • • | • • | • • | 200 | 170 | 140 |
| Potassium Borate | 160 | 140 | 180 | 200 | 200 | • • |
| Potassium Bromate | 160 | 140 | 180 | 200 | • • | 140 |
| Potassium Bromide | 160 | 140 | 180 | 200 | 170 | 160 |
| Potassium Carbonate | 160 | 140 | 180 | 200 | 170 | 160 |
| Potassium Chlorate | 160 | 140 | 180 | 140 | 140 | 100 |
| Potassium Chloride | 160 | 140 | 180 | 200 | 200 | 160 |
| Potassium Chromate | 160 | 140 | 180 | 200 | 170 | 70 |
| Potassium Cyanide | 160 | 140 | 180 | 185 | 140 | 160 |
| Potassium Dichromate | 160 | 140 | 180 | 200 | 170 | • • |
| Potassium Ethyl Xanthate | • • | 73 | • • | • • | • • | • • |
| Potassium Ferricyanide | 160 | 140 | 180 | 140 | 140 | 150 |
| Potassium Ferrocyanide | 160 | 140 | 180 | 140 | 140 | 150 |
| Potassium Fluoride | 160 | 140 | 180 | 200 | 140 | • • |
| Potassium Hydroxide | 160 | 140 | 180 | NR | 140 | 160 |
| Potassium Hydroxide, 50% | 160 | 140 | 180 | NR | 140 | 160 |
| Potassium Hypochlorite | • • | 73 | 180 | 70 | NR | • • |
| Potassium Iodide | • • | 73 | 180 | 180 | 140 | 160 |
| Potassium Nitrate | 160 | 140 | 180 | 200 | 200 | 140 |
| Potassium Perborate | 160 | 140 | 180 | • • | • • | 70 |
| Potassium Perchlorate, (Sat'd) | 160 | 140 | 180 | 150 | 140 | • • |
| Potassium Permanganate, 10% | 160 | 140 | 180 | 140 | 200 | 100 |
| Potassium Permanganate, 25% | 160 | NR | 180 | 140 | 140 | 100 |

Acrylonitrile-Butadiene-Styrene Polyvinyl Chloride Type 1 Grade 1 Chlorinated Polyvinyl Chloride Type IV Grade 1
Flourocarbon Elastomer (Viton ® is a registered trademark of the DuPont Co.) Ethylene Propylene Diene Monomer
** Maximum recommended temperature, for chemical resistance, under normal conditions. § Non-pressure, vent-only, applications when chemical is in gas form.

Number = Maximum Recommended Temp. (°F)** NR = Not Recommended • • = Incomplete Data

| Chemical Name | Pipe & Fitting Materials Recommended Max. Temp (°F) | | | Seal Materials Recommended Max. Temp. (°F) | | |
|---|---|---|---|---|---|---|
| | ABS | PVC | CPVC | Viton ® | EPDM | Neoprene |
| Potassium Persulphate, (Sat'd) | 73 | 140 | 180 | 200 | 200 | 140 |
| Potassium Phosphate | 73 | • • | 180 | • • | • • | • • |
| Potassium Sulfate | 73 | 140 | 180 | 200 | 200 | 140 |
| Potassium Sulfite | 73 | 140 | 180 | 200 | 200 | 140 |
| Potassium Tripolyphosphate | • • | • • | 180 | 100 | • • | 70 |
| Propane | 160§ | 140§ | 73§ | 70 | NR | 70 |
| Propanol, Up to 0.5% | NR | • • | 180 | • • | • • | • • |
| Propanol, Over 0.5% | NR | • • | NR | • • | • • | • • |
| Propargyl Alcohol | NR | 140 | NR | 140 | 140 | NR |
| Propionic Acid, Up to 2% | NR | • • | 180 | • • | • • | NR |
| Propionic Acid, Over 2% | NR | • • | NR | • • | • • | NR |
| Propyl Alcohol | NR | 140 | NR | • • | 140 | 140 |
| Propylene Dichloride | NR | NR | NR | 70 | NR | NR |
| Propylene Glycol, Up to 25% | 73 | 140 | 180 | 140 | 70 | 100 |
| Propylene Glycol, Up to 50% | 73 | 140 | NR | 140 | 70 | 100 |
| Propylene Oxide | NR | NR | NR | NR | 70 | NR |
| Pyridine | NR | NR | NR | NR | 70 | NR |
| Pyrogallicia Acid | • • | 73 | • • | • • | • • | 70 |
| Quaternary Ammonium Salts | • • | • • | NR | • • | • • | • • |
| Rayon Coagulating Bath | • • | 140 | NR | • • | • • | • • |
| Salicyclic Acid | • • | 140 | 180 | 185 | 200 | NR |
| Sea Water | 160 | 140 | 180 | • • | • • | • • |
| Selenic Acid | • • | 140 | • • | • • | • • | 70 |
| Silicic Acid | • • | 140 | • • | 200 | 140 | 140 |
| Silicone Oil | • • | 73 | 150 | 185 | 140 | 70 |
| Silver Chloride | 160 | • • | 180 | • • | • • | • • |
| Silver Cyanide | 160 | 140 | 180 | 140 | 140 | 70 |
| Silver Nitrate | 160 | 140 | 180 | 200 | 200 | 160 |
| Silver Sulfate | 160 | 140 | 180 | 200 | 170 | • • |
| Soaps | 160 | 140 | 180 | 200 | 200 | 140 |
| Sodium Acetate | 120 | 140 | 180 | NR | 170 | • • |
| Sodium Aluminate | 120 | • • | 180 | 200 | 200 | 140 |
| Sodium Alum | 120 | 140 | 180 | 200 | 170 | 140 |
| Sodium Arsenate | 120 | 140 | 180 | 200 | 140 | 70 |
| Sodium Benzoate | 120 | 140 | 180 | 200 | 200 | • • |
| Sodium Bicarbonate | 120 | 140 | 180 | 200 | 200 | 160 |
| Sodium Bichromate | 120 | 140 | 180 | 200 | 140 | 70 |
| Sodium Bisulfate | 120 | 140 | 180 | 200 | 200 | 140 |
| Sodium Bisulfite | 120 | 140 | 180 | 200 | 200 | 140 |
| Sodium Borate | 120 | 73 | 180 | 140 | 140 | 100 |
| Sodium Bromide | 120 | 140 | 180 | 200 | 200 | 70 |
| Sodium Carbonate | 120 | 140 | 180 | 200 | 140 | 140 |
| Sodium Chlorate | 120 | 73 | 180 | 100 | 140 | 140 |
| Sodium Chloride | 120 | 140 | 180 | 200 | 140 | 160 |
| Sodium Chlorite | 120 | NR | 180 | NR | NR | • • |

Acrylonitrile-Butadiene-Styrene Polyvinyl Chloride Type 1 Grade 1 Chlorinated Polyvinyl Chloride Type IV Grade 1
Flourocarbon Elastomer (Viton ® is a registered trademark of the DuPont Co.) Ethylene Propylene Diene Monomer
** Maximum recommended temperature, for chemical resistance, under normal conditions. § Non-pressure, vent-only, applications when chemical is in gas form.

CHARLOTTE PIPE AND FOUNDRY COMPANY®

Number = Maximum Recommended Temp. (°F)** NR = Not Recommended • • = Incomplete Data

| Chemical Name | Pipe & Fitting Materials Recommended Max. Temp (°F) | | | Seal Materials Recommended Max. Temp. (°F) | | |
|---|---|---|---|---|---|---|
| | ABS | PVC | CPVC | Viton ® | EPDM | Neoprene |
| Sodium Chromate | 120 | • • | 180 | 70 | 70 | 70 |
| Sodium Cyanide | 120 | 73 | 180 | 140 | 140 | 140 |
| Sodium Dichromate | 120 | 140 | 180 | 200 | 140 | NR |
| Sodium Ferricyanide | 120 | 140 | 180 | 140 | 140 | • • |
| Sodium Ferrocyanide | 120 | 140 | 180 | 140 | 140 | • • |
| Sodium Fluoride | 120 | 73 | 140 | 140 | 140 | 70 |
| Sodium Formate | • • | • • | 180 | • • | • • | • • |
| Sodium Hydroxide, 15% | 120 | 140 | 180 | NR | 180 | 160 |
| Sodium Hydroxide, 30% | 73 | 73 | 180 | NR | 140 | 160 |
| Sodium Hydroxide, 50% | 73 | 73 | 180 | NR | 140 | 160 |
| Sodium Hydroxide, 70% | NR | 73 | 180 | NR | 140 | 160 |
| Sodium Hypobromite | • • | • • | 180 | • • | • • | • • |
| Sodium Hypochlorite, 15% | 73 | 73† | 180† | 185 | 70 | NR |
| Sodium Hypochlorite (Sat'd) | NR | 73† | 180† | 140 | NR | NR |
| Sodium Iodide | • • | • • | 180 | • • | • • | 160 |
| Sodium Metaphosphate | 120 | 73 | 180 | 70 | 70 | • • |
| Sodium Nitrate | 120 | 140 | 180 | 200 | 200 | 140 |
| Sodium Nitrite | 120 | 140 | 180 | 200 | 170 | 140 |
| Sodium Palmitrate Solution, 5% | 120 | 140 | 180 | • • | • • | • • |
| Sodium Perborate | 120 | 140 | 180 | 70 | 70 | 70 |
| Sodium Perchlorate | 120 | 140 | 180 | • • | • • | • • |
| Sodium Peroxide | • • | 140 | • • | 185 | 140 | 70 |
| Sodium Phosphate, Alkaline | 73 | 140 | 180 | 200 | 170 | 140 |
| Sodium Phosphate, Acid | 73 | 140 | 180 | 200 | 170 | 140 |
| Sodium Phosphate, Neutral | 73 | 140 | 180 | 200 | 170 | 140 |
| Sodium Silicate | • • | • • | 180 | 200 | 200 | 140 |
| Sodium Sulfate | 73 | 140 | 180 | 200 | 140 | 140 |
| Sodium Sulfide | 73 | 140 | 180 | 200 | 140 | 140 |
| Sodium Sulfite | 73 | 140 | 180 | 200 | 140 | 140 |
| Sodium Thiosulfate | 73 | 140 | 180 | 200 | 200 | 160 |
| Sodium Tripolyphosphate | • • | • • | 180 | • • | • • | • • |
| Solicylaldehyde | NR | NR | • • | • • | • • | • • |
| Sour Crude Oil | NR | 140 | • • | 200 | NR | NR |
| Soybean Oil | • • | • • | NR | 200 | NR | 70 |
| Stannic Chloride | 120 | 140 | 180 | 200 | 100 | NR |
| Stannous Chloride | 120 | 140 | 180 | 200 | 70 | 160 |
| Stannous Sulfate | • • | • • | 180 | • • | • • | • • |
| Starch | 160 | 140 | 180 | 200 | 170 | 160 |
| Stearic Acid | • • | 140 | 73 | 100 | NR | 70 |
| Stoddard's Solvent | NR | NR | NR | 185 | NR | NR |
| Strontium Chloride | • • | • • | 180 | • • | • • | • • |
| Styrene | NR | • • | NR | 100 | NR | NR |
| Succinic Acid | • • | 140 | • • | 70 | 70 | • • |
| Sugar | 120 | • • | 180 | 200 | 140 | 140 |
| Sulfamic Acid | NR | NR | 180 | NR | NR | 70 |

Acrylonitrile-Butadiene-Styrene Polyvinyl Chloride Type 1 Grade 1 Chlorinated Polyvinyl Chloride Type IV Grade 1
Flourocarbon Elastomer (Viton ® is a registered trademark of the DuPont Co.) Ethylene Propylene Diene Monomer
** Maximum recommended temperature, for chemical resistance, under normal conditions. § Non-pressure, vent-only, applications when chemical is in gas form.
† Must use sodium hypochlorite resistant cement for making joints.

# CHEMICAL RESISTANCE

Number = Maximum Recommended Temp. (°F)** NR = Not Recommended • • = Incomplete Data

| Chemical Name | Pipe & Fitting Materials Recommended Max. Temp (°F) | | | Seal Materials Recommended Max. Temp. (°F) | | |
|---|---|---|---|---|---|---|
| | ABS | PVC | CPVC | Viton ® | EPDM | Neoprene |
| Sulfate Liquors | • • | • • | • • | 70 | 70 | • • |
| Sulfite Liquor | • • | • • | 180 | 140 | 140 | 70 |
| Sulfur | • • | 140 | 73 | 200 | • • | 70 |
| Sulfur Chloride | • • | • • | • • | 70 | NR | NR |
| Sulfur Dioxide, Dry | 73§ | 140§ | NR | 100 | 70 | NR |
| Sulfur Dioxide, Wet | 73§ | 73§ | NR | 140 | 140 | • • |
| Sulfur Trioxide | • • | 140 | 180 | 140 | 70 | NR |
| Sulfur Trioxide, Gas | 160§ | 140§ | • • | 140 | 70 | NR |
| Sulfuric Acid, 10% | 120 | 140 | 180 | 200 | 140 | 100 |
| Sulfuric Acid, 20% | 120 | 140 | 180 | 200 | 140 | 100 |
| Sulfuric Acid, 30% | NR | 140 | 180 | 200 | 140 | 100 |
| Sulfuric Acid, 50% | NR | 140 | 180 | 200 | 70 | NR |
| Sulfuric Acid, 60% | NR | 140 | 180 | 200 | NR | NR |
| Sulfuric Acid, 70% | NR | 140 | 180 | 200 | NR | NR |
| Sulfuric Acid, 80% | NR | 73 | 180 | 180 | NR | NR |
| Sulfuric Acid, 90% | NR | 73 | 73 | 160 | NR | NR |
| Sulfuric Acid, 94% | NR | NR | 73 | 160 | NR | NR |
| Sulfuric Acid, 98% | NR | NR | 73 | 160 | NR | NR |
| Sulfuric Acid, 100% | NR | • • | NR | 160 | NR | NR |
| Sulfurous Acid | NR | NR | 180 | 100 | 75 | NR |
| Surfactants, Nonionic | 160 | 140 | NR | 200 | 200 | 160 |
| Tall Oil | • • | 140 | 180 | 70 | NR | 70 |
| Tannic Acid, 10% | NR | 140 | 180 | 100 | 70 | 100 |
| Tannic Acid, 30% | NR | • • | 73 | • • | • • | • • |
| Tanning Liquors | 160 | 140 | 180 | 200 | • • | 70 |
| Tar | NR | NR | NR | 185 | NR | 70 |
| Tartaric Acid | 160 | 140 | 73 | 70 | NR | 70 |
| Terpenes | NR | • • | NR | • • | • • | • • |
| Tetraethyl Lead | NR | 73 | • • | 70 | NR | • • |
| Tetrahydrodurane | NR | NR | NR | • • | • • | • • |
| Tetrahydrofuran | NR | NR | NR | NR | NR | NR |
| Tetralin | NR | NR | NR | NR | NR | NR |
| Tetra Sodium Pyrophosphate | • • | 140 | 180 | • • | • • | • • |
| Texanol | • • | • • | NR | • • | • • | • • |
| Thionyl Chloride | NR | NR | NR | • • | • • | NR |
| Thread Cutting Oils | 73 | 73 | • • | 70 | NR | • • |
| Titanium Tetrachloride | NR | NR | NR | 185 | NR | NR |
| Toluene, Toluol | NR | NR | NR | 70 | NR | NR |
| Toluene-Kerosene, 25%-75% | NR | NR | NR | • • | • • | • • |
| Tomato Juice | 73 | 73 | 73 | 200 | 200 | 70 |
| Toxaphene-Xylene, 90%-100% | NR | NR | NR | • • | • • | • • |
| Transformer Oil | NR | 140 | • • | 140 | 140 | NR |
| Transformer Oil, DTE/30 | NR | • • | • • | • • | NR | NR |
| Tribute | • • | • • | NR | • • | • • | • • |
| Tributyl Phosphate | NR | NR | NR | NR | 70 | NR |

Acrylonitrile-Butadiene-Styrene Polyvinyl Chloride Type 1 Grade 1 Chlorinated Polyvinyl Chloride Type IV Grade 1
Flourocarbon Elastomer (Viton ® is a registered trademark of the DuPont Co.) Ethylene Propylene Diene Monomer
** Maximum recommended temperature, for chemical resistance, under normal conditions. § Non-pressure, vent-only, applications when chemical is in gas form.

Number = Maximum Recommended Temp. (°F)**     NR = Not Recommended     • • = Incomplete Data

| Chemical Name | Pipe & Fitting Materials Recommended Max. Temp (°F) | | | Seal Materials Recommended Max. Temp. (°F) | | |
|---|---|---|---|---|---|---|
| | ABS | PVC | CPVC | Viton ® | EPDM | Neoprene |
| Tributyl Citrate | NR | 73 | • • | • • | • • | • • |
| Trichloroacetic Acid | NR | 140 | • • | NR | 70 | 70 |
| Trichloroethane | NR | NR | NR | • • | • • | • • |
| Trichloroethylene | NR | NR | NR | 185 | NR | NR |
| Triethanolamine | NR | 73 | NR | NR | 70 | 70 |
| Triethylamine | NR | 140 | • • | 200 | • • | 70 |
| Trimethylpropane | NR | 73 | • • | • • | 180 | 160 |
| Trisodium Phosphate | 73 | 140 | 180 | 185 | 70 | 70 |
| Turpentine | NR | 140 | NR | 150 | NR | NR |
| Urea | 73 | 140 | 180 | 185 | 200 | 140 |
| Urine | 160 | 140 | 180 | 70 | 200 | 140 |
| Vaseline | NR | NR | NR | 70 | NR | 140 |
| Vegetable Oil | NR | NR | NR | 200 | NR | 70 |
| Vinegar | 73 | 140 | 180 | NR | 180 | 70 |
| Vinegar, White | 73 | 140 | 180 | 200 | 200 | • • |
| Vinyl Acetate | NR | NR | NR | NR | 70 | NR |
| Water | 160 | 140 | 180 | 200 | 200 | 160 |
| Water, Acid Mine | 160 | 140 | 180 | • • | 200 | 160 |
| Water, Deionized | NR | 140 | 180 | • • | 200 | 160 |
| Water, Demineralized | NR | 140 | 180 | 200 | 200 | 160 |
| Water, Distilled | NR | 140 | 180 | • • | 200 | 160 |
| Water, Potable | NR | 140 | 180 | • • | 200 | 160 |
| Water, Salt | 160 | 140 | 180 | • • | 200 | 160 |
| Water, Sea | 160 | 140 | 180 | • • | 200 | 160 |
| Water, Sewage | 160 | 140 | 180 | • • | 200 | • • |
| Water, Swimming Pool | NR | 73 | 180 | • • | • • | • • |
| WD 40 | NR | • • | NR | • • | • • | • • |
| Whiskey | NR | 140 | 180 | 140 | 200 | 140 |
| White Liquor | 73 | 140 | 180 | • • | • • | 140 |
| Wines | NR | 140 | 180 | 140 | 170 | 140 |
| Xylene | NR | NR | NR | 150 | NR | NR |
| Zinc Acetate | • • | 140 | 180 | 70 | 180 | 160 |
| Zinc Bromide | • • | 140 | 180 | • • | • • | • • |
| Zinc Carbonate | 120 | • • | 180 | • • | • • | • • |
| Zinc Chloride | 120 | 140 | 180 | 200 | 180 | 160 |
| Zinc Nitrate | 120 | 140 | 180 | 200 | 180 | • • |
| Zinc Phosphate | • • | • • | 180 | • • | • • | • • |
| Zinc Sulfate | • • | 140 | 180 | 200 | 180 | 140 |

Acrylonitrile-Butadiene-Styrene   Polyvinyl Chloride Type 1 Grade 1   Chlorinated Polyvinyl Chloride Type IV Grade 1
Flourocarbon Elastomer (Viton ® is a registered trademark of the DuPont Co.)   Ethylene Propylene Diene Monomer
** Maximum recommended temperature, for chemical resistance, under normal conditions. § Non-pressure, vent-only, applications when chemical is in gas form.

# PVC "SOLID WALL" SCHEDULE 40 DWV PIPE AND PVC DWV FITTINGS FACT SHEET

**System**

- PVC Schedule 40 Pipe and Fittings.

**Standards**

- ASTM D 1785 Schedule 40 PVC Plain End Pipe
- ASTM D 2665 Schedule 40 PVC DWV Fittings
- NSF Standard 14 Dimensional Standard
- NSF Standard 61 Health Effects

**Cell Class**

- 12454 PVC DWV Pipe and Fittings per ASTM D 1784
- **Maximum Working Temperature**
- 140 Degrees Fahrenheit

**Maximum Working Pressure**

- 0 (Zero) PSI
- PVC DWV is not a pressure rated piping system.
- Recommended test is 10 feet of hydrostatic (water) pressure, which is equal to 4.3 PSI.

**Joining Method**

- Solvent Weld Joints
- Solvent Cement must meet ASTM D 2564.
- Primer is required

**Cure Times**

- Cure times shown are sufficient to complete a test at 10 feet of hydrostatic pressure (4.3 pounds per square inch.) Full cure may take significantly longer.
- Cure times are a function of air temperature, fluid temperature, humidity, and pipe size. Increase the cure time for more demanding conditions.

**Threaded Joint**

- Threading PVC Schedule 40 pipe is not recommended.
- To be joined with taper threads manufactured in accordance with American National Standard Taper Pipe Threads per ANSI/ASME B1.20.1 and ASTM F 1498.
- Use Teflon tape. Begin with the second thread and wrap in the direction of the thread overlapping each wrap one half the width of the tape.
- Avoid over-tightening as this may cause damage to the thread or the fitting.

**Transition to Cast Iron Soil Pipe**

- Transition fittings to No Hub and Service are available and recommended.

**Thermal Expansion**

- .360 inches per 10 degree temperature change per 100 foot of pipe.

**Special Considerations**

- Do **NOT** air test.
- Consult chemical resistant chart for chemical compatibility.
- U.V. sensitivity. Do not install permanently in direct sunlight without painting with water-based latex paint, or covering with pipe insulation.

# PVC "SOLID WALL" SCHEDULE 40 DWV PIPE AND PVC DWV FITTINGS FACT SHEET

CHARLOTTE PIPE AND FOUNDRY COMPANY®



## System

**PVC Schedule 40 (Solid Wall) Pipe & Fittings.**

**Product Offering / Data**

| Size | Product | Available Lengths | OD | Nominal ID | Min. Wall | Weight Per 100 Ft. (lbs.) |
|---|---|---|---|---|---|---|
| 1¼" | Plain End IPS Pipe | 10' & 20' | 1.660 | 1.380 | 0.140 | 42.0 |
| 1½" | | 10' & 20' | 1.900 | 1.610 | 0.145 | 50.4 |
| 2" | | 10' & 20' | 2.375 | 2.067 | 0.154 | 67.6 |
| 2½" | | 20' | 2.875 | 2.469 | 0.203 | 107.0 |
| 3" | | 10' & 20' | 3.500 | 3.068 | 0.216 | 141.0 |
| 4" | | 10' & 20' | 4.500 | 4.026 | 0.237 | 200.0 |
| 5" | | 20' | 5.563 | 5.047 | 0.258 | 272.5 |
| 6" | | 10' & 20' | 6.625 | 6.065 | 0.280 | 352.0 |
| 8" | | 20' | 8.625 | 7.981 | 0.322 | 539.0 |
| 10" | | 20' | 10.750 | 10.020 | 0.365 | 755.0 |
| 12" | | 20' | 12.750 | 11.938 | 0.406 | 1001.0 |
| 14" | | 20' | 14.000 | 13.124 | 0.437 | 1180.1 |
| 16" | | 20' | 16.000 | 15.000 | 0.500 | 1543.1 |

## Minimum Cure Time to Test

| Size | 60° - 100°F | 40° - 60°F | 0° - 40°F |
|---|---|---|---|
| 1½" to 3" | 2 Hours | 4 Hours | 16 Hours |
| 4" to 8" | 6 Hours | 12 Hours | 48 Hours |
| 10" to 12" | 24 Hours | 40 Hours | 8 Days |

- Cure times shown are sufficient to complete a test at 10 feet of hydrostatic pressure (4.3 pounds per square inch.) Full cure may take significantly longer.

- Cure times are a function of air temperature, fluid temperature, humidity, and pipe size. Increase the cure time for more demanding conditions.

# PVC SCHEDULE 40 PIPE AND FITTINGS FACT SHEET

## System

- PVC Schedule 40 Pipe and Fittings.

## Standards

- ASTM D 1785 Schedule 40 PVC Plain End Pipe
- ASTM D 2665 Schedule 40 Dual Marked Pipe
- ASTM F 480 Schedule 40 Bell End Well Casing
- ASTM D 2466 Schedule 40 Fittings
- NSF Standard 14 Dimensional Standard
- NSF Standard 61 Health Effects

## Cell Class

- 12454 (Type 1, Grade 1) PVC 1120 per ASTM D 1784

## Maximum Working Temperature

- 140 Degrees Fahrenheit
- The De-rating factor must be used to determine the pressure rating for each pipe diameter for temperatures over 73°F.

## Maximum Working Pressure

- See pipe diameter chart.

## Joining Method

- Solvent Weld Joints
- Solvent Cement must meet ASTM D 2564.
- Primer is required

## Cure Times

- Cure times are a function of air temperature, water temperature, humidity, and pipe size. Increase the cure time for colder temperatures or higher humidity. See cure time chart on page 33.

## Threaded Joint

- Threading PVC Schedule 40 pipe is **not** recommended.
- To be joined with taper threads manufactured in accordance with American National Standard Taper Pipe Threads per ANSI/ASME B1.20.1 and ASTM F 1498.
- Use Teflon tape. Begin with the second thread and wrap in the direction of the thread overlapping each wrap one half the width of the tape.
- Avoid over-tightening as this may cause damage to the thread or the fitting.

## Mechanical Joints

- May be made with schedule 80 flanges or unions.
- May be roll grooved.

## Thermal Expansion

- .360 inches per 10 degree temperature change per 100 foot of pipe.

## Temperature De-rating Factor

| Temperature | De-Rating Factor | Temperature | De-Rating Factor |
|---|---|---|---|
| 73°F | 1.00 | 120°F | 0.40 |
| 80°F | 0.88 | 125°F | 0.35 |
| 90°F | 0.75 | 130°F | 0.30 |
| 100°F | 0.62 | 140°F | 0.22 |

Principle: As the fluid temperature increases, the pipe's ability to hold pressure decreases.

Method: To find the pressure rating at a required temperature, multiply the cold water (73°F) pressure rating by the de-rating factor.

Example: Solve for 2" PVC-40 at 100°F.
0.62 x 280 PSI = 173 PSI

## Special Considerations

- Do **NOT** air test.
- Consult chemical resistant chart for chemical compatibility.
- U.V. sensitivity. Do not install permanently in direct sunlight without painting with water-based latex paint, or covering with pipe insulation.

# PVC SCHEDULE 40 PIPE AND FITTINGS FACT SHEET

CHARLOTTE PIPE AND FOUNDRY COMPANY®



**System**

**PVC Schedule 40 Pipe.**

**Product Offering / Data**

| Size | Product | Available Lengths | OD | Nominal ID | Min. Wall | Bell Depth | Weight Per 100 Ft. (lbs.) | Max Work PSI 73°F (23°C) |
|---|---|---|---|---|---|---|---|---|
| 1/2" | Plain End IPS Pipe | 20' | 0.840 | 0.622 | 0.109 | | 15.700 | 600 |
| 3/4" | | 20' | 1.050 | 0.824 | 0.113 | | 21.000 | 480 |
| 1" | | 20' | 1.315 | 1.049 | 0.133 | | 31.000 | 450 |
| 1 1/4" | | 10' & 20' | 1.660 | 1.380 | 0.140 | | 42.000 | 370 |
| 1 1/2" | | 10' & 20' | 1.900 | 1.610 | 0.145 | | 50.400 | 330 |
| 2" | | 10' & 20' | 2.375 | 2.067 | 0.154 | | 67.600 | 280 |
| 2 1/2" | | 20' | 2.875 | 2.469 | 0.203 | | 107.000 | 300 |
| 3" | | 10' & 20' | 3.500 | 3.068 | 0.216 | | 141.000 | 260 |
| 4" | | 10' & 20' | 4.500 | 4.026 | 0.237 | | 200.000 | 220 |
| 5" | | 20' | 5.563 | 5.047 | 0.258 | | 272.500 | 190 |
| 6" | | 10' & 20' | 6.625 | 6.065 | 0.280 | | 352.000 | 180 |
| 8" | | 20' | 8.625 | 7.981 | 0.322 | | 539.000 | 160 |
| 10" | | 20' | 10.750 | 10.020 | 0.365 | | 755.000 | 140 |
| 12" | | 20' | 12.750 | 11.938 | 0.406 | | 1001.000 | 130 |
| 14" | | 20' | 14.000 | 13.124 | 0.437 | | 1180.100 | 130 |
| 16" | | 20' | 16.000 | 15.000 | 0.500 | | 1543.100 | 130 |
| | | | | | | | | |
| 1/2" | Bell End IPS Pipe | 20' | 0.840 | 0.622 | 0.109 | 2.00 | 15.700 | 600 |
| 3/4" | | 20' | 1.050 | 0.824 | 0.113 | 2.25 | 21.000 | 480 |
| 1" | | 20' | 1.315 | 1.049 | 0.133 | 2.50 | 31.000 | 450 |
| 1 1/4" | | 20' | 1.660 | 1.380 | 0.140 | 2.75 | 42.000 | 370 |
| 1 1/2" | | 20' | 1.900 | 1.610 | 0.145 | 3.00 | 50.400 | 330 |
| 2" | | 20' | 2.375 | 2.067 | 0.154 | 4.00 | 67.600 | 280 |
| 2 1/2" | | 20' | 2.875 | 2.469 | 0.203 | 4.00 | 107.000 | 300 |
| 3" | | 10' & 20' | 3.500 | 3.068 | 0.216 | 4.00 | 144.300 | 260 |
| 4" | | 10' & 20' | 4.500 | 4.026 | 0.237 | 5.00 | 205.900 | 220 |
| 6" | | 10' & 20' | 6.625 | 6.065 | 0.280 | 6.50 | 365.100 | 180 |
| 8" | | 20' | 8.625 | 7.981 | 0.322 | 7.00 | 558.800 | 160 |
| 10" | | 20' | 10.750 | 10.020 | 0.365 | 9.00 | 761.000 | 140 |
| 12" | | 20' | 12.750 | 11.938 | 0.406 | 10.00 | 1045.000 | 130 |
| 14" | | 20' | 14.000 | 13.124 | 0.437 | 10.00 | 1187.000 | 130 |
| 16" | | 20' | 16.000 | 15.000 | 0.500 | 10.00 | 1543.100 | 130 |
| | | | | | | | | |
| 2" | Bell End IPS Well Casing | 20' | 2.375 | 2.067 | 0.154 | 4.00 | 67.600 | 280 |
| 2 1/2" | | 20' | 2.875 | 2.469 | 0.203 | 4.00 | 107.000 | 300 |
| 3" | | 20' | 3.500 | 3.068 | 0.216 | 4.00 | 144.300 | 260 |
| 4" | | 20' | 4.500 | 4.026 | 0.237 | 5.00 | 205.900 | 220 |
| 6" | | 20' | 6.625 | 6.065 | 0.280 | 6.50 | 365.100 | 180 |
| 8" | | 20' | 8.625 | 7.981 | 0.322 | 7.00 | 558.800 | 160 |

**Note:** See separate sheet for ASTM F 480 & ASTM D 2241 Bell End Well Casing.

# PVC SCHEDULE 80 PIPE AND FITTINGS FACT SHEET



## System

- PVC Schedule 80 Pipe and Fittings.

## Standards

- ASTM D 1785 Schedule 80 PVC Plain End Pipe
- ASTM D 2464 and ASTM D 2467 PVC Schedule 80 Fittings
- NSF Standard 14 Dimensional Standard
- NSF Standard 61 Health Effects

## Cell Class

- 12454 (Type 1, Grade 1) PVC 1120 per ASTM D 1784

## Maximum Working Temperature

- 140 Degrees Fahrenheit
- The De-rating factor must be used to determine the pressure rating for each pipe diameter for temperatures over 73°F.

## Maximum Working Pressure

- See pipe diameter chart.

## Joining Method

- Solvent Weld Joints
- Solvent Cement must meet ASTM D 2564.
- Primer is required

## Cure Times

- Cure times are a function of air temperature, water temperature, humidity, and pipe size. Increase the cure time for colder temperatures or higher humidity. See cure chart on page 33.

## Threaded Joint

- 1/4" - 4" PVC Schedule 80 pipe can be safely threaded. Threading will result in 50% reduction in pressure capability.
- To be joined with taper threads manufactured in accordance with American National Standard Taper Pipe Threads per ANSI/ASME B1.20.1 and ASTM D 1498.
- Use Teflon tape. Begin with the second thread and wrap in the direction of the thread overlapping each wrap one half the width of the tape.
- Avoid over-tightening as this may cause damage to the thread or the fitting.

## Mechanical Joints

- May be made with schedule 80 flanges or unions.
- May be roll grooved.

## Temperature De-rating Factor - PVC

| Temperature | De-Rating Factor | Temperature | De-Rating Factor |
|---|---|---|---|
| 73°F | 1.00 | 120°F | 0.40 |
| 80°F | 0.88 | 125°F | 0.35 |
| 90°F | 0.75 | 130°F | 0.30 |
| 100°F | 0.62 | 140°F | 0.22 |

Principle: As the fluid temperature increases, the pipe's ability to hold pressure decreases.

Method: To find the pressure rating at a required temperature, multiply the cold water (73°F) pressure rating by the de-rating factor.

Example: Solve for 2" PVC-80 at 100°F.
0.62 x 400 PSI = 248 PSI

## Thermal Expansion

- .360 inches per 10 degree temperature change per 100 foot of pipe.

## Special Considerations

- Do **NOT** air test.
- Consult chemical resistant chart for chemical compatibility.
- U.V. sensitivity. Do not install permanently in direct sunlight without painting with water-based latex paint, or covering with pipe insulation.

# PVC SCHEDULE 80 PIPE AND FITTINGS FACT SHEET

CHARLOTTE PIPE AND FOUNDRY COMPANY®



## System

**PVC Schedule 80 Pipe.**

**Product Offering / Data**

| Size | Product | Available Lengths | OD | Nominal ID | Min. Wall | Bell Length | Weight Per 100 Ft. (lbs.) | Max Work PSI 73°F (23°C) |
|---|---|---|---|---|---|---|---|---|
| 1/4" | Plain End IPS Pipe (Gray) | 20' | 0.540 | 0.302 | 0.119 | | 10.0 | 1130 |
| 3/8" | | 20' | 0.675 | 0.423 | 0.126 | | 13.8 | 920 |
| 1/2" | | 20' | 0.840 | 0.546 | 0.147 | | 20.4 | 850 |
| 3/4" | | 20' | 1.050 | 0.742 | 0.154 | | 27.0 | 690 |
| 1" | | 20' | 1.315 | 0.957 | 0.179 | | 41.0 | 630 |
| 1 1/4" | | 20' | 1.660 | 1.278 | 0.191 | | 52.2 | 520 |
| 1 1/2" | | 20' | 1.900 | 1.500 | 0.200 | | 66.8 | 470 |
| 2" | | 20' | 2.375 | 1.939 | 0.218 | | 94.5 | 400 |
| 2 1/2" | | 20' | 2.875 | 2.323 | 0.276 | | 144.5 | 420 |
| 3" | | 20' | 3.500 | 2.900 | 0.300 | | 194.2 | 370 |
| 4" | | 20' | 4.500 | 3.826 | 0.337 | | 275.2 | 320 |
| 5" | | 20' | 5.563 | 4.813 | 0.375 | | 387.3 | 290 |
| 6" | | 20' | 6.625 | 5.761 | 0.432 | | 541.5 | 280 |
| 8" | | 20' | 8.625 | 7.625 | 0.500 | | 805.2 | 250 |
| 10" | | 20' | 10.750 | 9.564 | 0.593 | | 1200.0 | 230 |
| 12" | | 20' | 12.750 | 11.376 | 0.687 | | 1650.0 | 230 |
| 14" | | 20' | 14.000 | 12.500 | 0.750 | | 1930.0 | 220 |
| 16" | | 20' | 16.000 | 14.314 | 0.843 | | 2544.1 | 220 |
| | | | | | | | | |
| 1/2" | Bell End IPS Pipe (Gray) | 20' | 0.840 | 0.546 | 0.147 | 1.00 | 20.5 | 850 |
| 3/4" | | 20' | 1.050 | 0.742 | 0.154 | 1.25 | 27.5 | 690 |
| 1" | | 20' | 1.315 | 0.957 | 0.179 | 1.50 | 40.9 | 630 |
| 1 1/4" | | 20' | 1.660 | 1.278 | 0.191 | 1.75 | 55.7 | 520 |
| 1 1/2" | | 20' | 1.900 | 1.500 | 0.200 | 2.00 | 68.6 | 470 |
| 2" | | 20' | 2.375 | 1.939 | 0.218 | 2.25 | 94.9 | 400 |
| 2 1/2" | | 20' | 2.875 | 2.323 | 0.276 | 2.50 | 142.1 | 420 |
| 3" | | 20' | 3.500 | 2.900 | 0.300 | 3.25 | 193.8 | 370 |
| 4" | | 20' | 4.500 | 3.826 | 0.337 | 4.00 | 283.3 | 320 |
| 6" | | 20' | 6.625 | 5.761 | 0.432 | 6.00 | 541.1 | 280 |
| 8" | | 20' | 8.625 | 7.625 | 0.500 | 6.00 | 805.2 | 250 |
| 10" | | 20' | 10.750 | 9.564 | 0.593 | 7.50 | 1200.0 | 230 |
| 12" | | 20' | 12.750 | 11.376 | 0.687 | 8.50 | 1650.0 | 230 |
| 14" | | 20' | 14.000 | 12.500 | 0.750 | 9.00 | 2010.0 | 220 |
| 16" | | 20' | 16.000 | 14.314 | 0.843 | 9.00 | 2544.1 | 220 |

# CPVC SCHEDULE 40/80 PIPE AND FITTINGS FACT SHEET



**System**

- Corzan CPVC Schedule 40/80 Pipe and Fittings.

**Standards**

- ASTM F 441 Schedule 40/80 CPVC Plain End Pipe
- ASTM F 437 Schedule 80 Threaded Fittings
- ASTM F 439 Schedule 80 Fittings
- NSF Standard 14 Dimensional Standard
- NSF Standard 61 Health Effects

**Cell Class**

- 24448 or 23447 (Type IV, Grade 1) CPVC 4120 per ASTM D 1784

**Maximum Working Temperature**

- 200 Degrees Fahrenheit
- The De-rating factor must be used to determine the pressure rating for each pipe diameter for temperatures over 73°F.

**Maximum Working Pressure**

- See pipe diameter chart.

**Joining Method**

- Solvent Weld Joints
- Solvent Cement must meet ASTM F 493.
- Primer is required

**Minimum Cure Time to Test at 180 PSI**

| Size | 60° - 100°F | 40° - 60°F | 0° - 40°F |
|---|---|---|---|
| 1/2" to 1 1/4" | 1 Hour | 2 Hours | 8 Hours |
| 1 1/2" to 3" | 2 Hours | 4 Hours | 16 Hours |
| 4" to 8" | 6 Hours | 12 Hours | 48 Hours |
| 10" to 16" | 24 Hours | 40 Hours | 8 Days |

**Cure Times**

- Cure times are a function of air temperature, water temperature, humidity, and pipe size. Increase the cure time for more demanding conditions.

**Threaded Joint**

- 1/4″ - 4″ Schedule 80 pipe can be safely threaded. Threading will result in 50% reduction in pressure capability.
- To be joined with taper threads manufactured in accordance with American National Standard Taper Pipe Threads per ANSI/ASME B1.20.1 and ASTM D 1498.
- Use Teflon tape. Begin with the second thread and wrap in the direction of the thread overlapping each wrap one half the width of the tape.
- Avoid over-tightening as this may cause damage to the thread or the fitting.

**Mechanical Joints**

- May be made with schedule 80 flanges or unions.
- May be roll grooved.

**Temperature De-rating Factor - CPVC**

| Temperature | De-Rating Factor | Temperature | De-Rating Factor |
|---|---|---|---|
| 73°F | 1.00 | 130°F | 0.62 |
| 80°F | 1.00 | 140°F | 0.50 |
| 90°F | 0.91 | 160°F | 0.40 |
| 100°F | 0.82 | 180°F | 0.25 |
| 120°F | 0.65 | 200°F | 0.20 |
| 125°F | 0.66 | | |

Principle: As the fluid temperature increases, the pipe's ability to hold pressure decreases.
Method: To find the pressure rating at a required temperature, multiply the cold water (73°F) pressure rating by the de-rating factor.
Example: Solve for 2" CPVC-80 at 100°F.
0.82 x 400 PSI = 328 PSI

**Thermal Expansion**

- .408 inches per 10 degree temperature change per 100 foot of pipe.

**Special Considerations**

- Do **NOT** air test.
- Consult chemical resistant chart for chemical compatibility.
- U.V. sensitivity. Do not install permanently in direct sunlight without painting with water-based latex paint, or covering with pipe insulation.

# CORZAN® CPVC SCHEDULE 40/80 PIPE AND FITTINGS FACT SHEET

CHARLOTTE PIPE AND FOUNDRY COMPANY®



## System

**CPVC Schedule 40 & 80 Pipe.**

**Product Offering / Data**

| Size | Product | Available Lengths | OD | Nominal ID | Min. Wall | Weight Per 100 Ft. (lbs.) | Max Work PSI 73°F (23°C) |
|---|---|---|---|---|---|---|---|
| 1/4" | Sch. 80 Plain End IPS Pipe (Gray) | 20' | 0.540 | 0.302 | 0.119 | 10.9 | 1130 |
| 3/8" | | 20' | 0.675 | 0.423 | 0.126 | 15.0 | 920 |
| 1/2" | | 20' | 0.840 | 0.546 | 0.147 | 22.1 | 850 |
| 3/4" | | 20' | 1.050 | 0.742 | 0.154 | 30.0 | 690 |
| 1" | | 20' | 1.315 | 0.957 | 0.179 | 44.2 | 630 |
| 1 1/4" | | 20' | 1.660 | 1.278 | 0.191 | 61.0 | 520 |
| 1 1/2" | | 20' | 1.900 | 1.500 | 0.200 | 73.9 | 470 |
| 2" | | 20' | 2.375 | 1.939 | 0.218 | 102.2 | 400 |
| 2 1/2" | | 20' | 2.875 | 2.323 | 0.276 | 155.9 | 420 |
| 3" | | 20' | 3.500 | 2.900 | 0.300 | 208.6 | 370 |
| 4" | | 20' | 4.500 | 3.826 | 0.337 | 304.9 | 320 |
| 6" | | 20' | 6.625 | 5.761 | 0.432 | 581.5 | 280 |
| 8" | | 20' | 8.625 | 7.625 | 0.500 | 882.9 | 250 |
| 10" | | 20' | 10.750 | 9.564 | 0.593 | 1309.1 | 230 |
| 12" | | 20' | 12.750 | 11.376 | 0.687 | 1801.2 | 230 |
| | | | | | | | |
| 1/2" | Sch. 40 Plain End IPS Pipe (Gray) | 20' | 0.840 | 0.622 | 0.109 | 17.3 | 600 |
| 3/4" | | 20' | 1.050 | 0.824 | 0.113 | 23.0 | 480 |
| 1" | | 20' | 1.315 | 1.049 | 0.133 | 34.2 | 450 |
| 1 1/4" | | 20' | 1.660 | 1.380 | 0.140 | 46.3 | 370 |
| 1 1/2" | | 20' | 1.900 | 1.610 | 0.145 | 55.3 | 330 |
| 2" | | 20' | 2.375 | 2.067 | 0.154 | 74.3 | 280 |
| 2 1/2" | | 20' | 2.875 | 2.469 | 0.203 | 117.9 | 300 |
| 3" | | 20' | 3.500 | 3.068 | 0.216 | 154.2 | 260 |
| 4" | | 20' | 4.500 | 4.026 | 0.237 | 219.6 | 220 |
| 6" | | 20' | 6.625 | 6.065 | 0.280 | 386.1 | 180 |
| 8" | | 20' | 8.625 | 7.981 | 0.322 | 581.1 | 160 |
| 10" | | 20' | 10.750 | 10.020 | 0.365 | 823.8 | 140 |
| 12" | | 20' | 12.750 | 11.938 | 0.406 | 1089.2 | 130 |

# GLOSSARY

**ABRASION RESISTANCE—**The measure of a material's ability to withstand erosion when subjected to rubbing, scraping, wearing, scouring, etc., conditions.

**ACETAL PLASTICS—**A group of plastics made from resins which have been obtained by heating aldehydes or ketones with alcohols.

**ACIDS—**Normally a water-soluble compound containing hydrogen and other elements that are capable of reacting with a base to form a salt. They turn blue litmus paper red.

**ACRYLONITRILE-BUTADIENE-STYRENE (ABS) PLASTICS—**A group of plastics made from polymers with prescribed percentages of acrylonitrile, butadiene, and styrene.

**ADHESIVE—**A substance capable of holding materials together by surface attachment.

**AGING—**The effect on materials exposed to an environment for a period of time. Also, the act of exposing materials to an environment for a period of time.

**ALKALIES—**Compounds capable of neutralizing acids.

**ANTIOXIDANT—**A substance added to a plastic compound to retard degradation due to contact with air (oxygen).

**BEAM LOADING—**The process of applying a specified force (load) to a piece of pipe which is supported at two points. It is usually expressed in pounds per the distance between the centers of the supports.

**BELLED-END—**A term used to describe a pipe end which has been enlarged to have the same inside dimensions as a fitting socket. It acts as a coupling when joining pipe.

**BLISTER—**An undesirable air or gas filled bubble (bump) on the surface of a plastic part.

**BOND—**To attach by the use of an adhesive.

**BURST STRENGTH—**The amount of internal pressure a piece of pipe or a fitting will hold before breaking.

**CALENDERING—**A process for making thin sheets of plastic or rubber in which a heated plastic or rubber compound is squeezed between heavy rollers.

**CELLULOSE ACETATE—**A type of resin made from the reaction of acetic acid or acetic anhydride with a cellulose base (cotton and/or wood pulp).

**CEMENT (SOLVENT CEMENT)—**An adhesive used to bond plastics which is a "solution" of a plastic resin and a volatile solvent.

**CHEMICAL RESISTANCE—**The ability of a plastic to withstand the effects of chemicals at various concentrations and temperatures.

**COLD FLOW—**A change in the shape or the dimensions of a plastic part when subjected to a load (weight or pressure) at room temperature.

**COMPOUND—**The mixture of ingredients, consisting of a plastic resin and specified additives, used to manufacture a plastic part.

**CONDENSATION—**A chemical reaction involving the combination of molecules with the result being the elimination of a simple molecule, such as water, and the formation of a more complex compound of greater molecular weight.

**COPOLYMER—**The product formed by the simultaneous polymerization of two or more polymerizeable chemicals (monomers).

**CRAZING—**Small, fine cracks on or under the surface of a plastic.

**CREEP—**The dimensional change, beyond the initial elastic elongation caused by the application of a load, over a specified period of time. It is normally expressed in inches per inch per unit of time.

**CURE—**To change the properties of a polymer to a stable, usable, and final state by the use of chemical agents, heat, or radiation.

**DEFLECTION TEMPERATURE (HEAT DISTORTION)—**The temperature which will cause a plastic specimen to deflect a certain distance when a specified load is applied.

**DEGRADATION—**A deleterious change in the chemical structure, physical properties, or appearance of a plastic.

**DELAMINATION —**The separation of the layers of material in a laminate.

**DETERIORATION—**A permanent change in the physical properties of a plastic evidenced by impairment of these properties.

**DIELECTRIC STRENGTH—**The force required to drive an electric current through a specific thickness of a material.

**DIFFUSION—**The movement of gas or liquid particles or molecules in a body of fluid through or into a medium and away from the main body of fluid.

**DIMENSIONAL STABILITY—**The capability of a plastic part to maintain its original shape and dimensions under conditions of use.

**DRY-BLEND—**A dry compound prepared without fluxing or the addition of a solvent.

**ELASTICITY—**The property of a plastic which allows it to return to its original dimensions after deformation.

**ELASTIC LIMIT—**The load point at which a material will not return to its original shape and size after the load has been released.

**ELASTOMER—**A substance which when stretched to approximately twice its length, at room temperature, will quickly return to its original length when the stretching load is relieved.

**ELECTRICAL PROPERTIES—**The resistance of a plastic to the passage of electricity.

**ELONGATION—**The percentage of the original length which a material will deform, under tension, without failing.

**EMULSION—**A dispersion of one insoluble liquid into another insoluble liquid.

**ENVIRONMENTAL STRESS CRACKING**—Cracks which develop when a plastic part is subjected to incompatible chemicals and put under stress.

**ESTER**—The compound formed during the reaction between an alcohol and an acid.

**ETHYLENE PLASTICS**—Plastics based on polymers or copolymers of ethylene and other monomers in which ethylene is the greatest amount by weight.

**EXTRUSION**—The process used to continuously form a shape by forcing a heated or unheated plastic through a shaping orifice (die).

**FILLER**—A relatively inert material added to a plastic to modify its strength, permanence, working properties, other qualities, or to lower costs.

**FLEXURAL STRENGTH**—The measure of a material's ability to withstand a specified deformation under a beam load (bending) at 73°F. Normally expressed in PSI.

**FORMING**—A process in which the shape of plastic pieces such as sheets, rods, or tubes are changed to a desired configuration.

**FORMULATION**—The combination of ingredients used to make a finished plastic product. Also see compound.

**FUSE**—To join plastic parts by softening the material with heat or solvents.

**GATE**—The constriction in the flow channel between the runner and the mold cavity in an injection mold.

**GLASS TRANSITION**—The reversible change in an amorphous polymer from (or to) a viscous condition to (or from) a hard and relatively brittle one.

**GLASS TRANSITION TEMPERATURE**—The approx-imate midpoint of the temperature range over which the glass transition takes place.

**GUSSET**—A piece used to give additional size or strength to a plastic part at a particular location.

**HARDNESS**—The measure of a material's ability to resist indentation.

**HEAT RESISTANCE**—The ability of a material to withstand the effects of exposure to high temperatures.

**HOOP STRESS**—The circumferential stress imposed on a pipe wall when exposed to an internal pressure load. Usually expressed in PSI.

**IMPACT STRENGTH**—A measure of a plastic part's ability to withstand the effects of dropping and/or striking. There are two commonly used test methods, Notched Izod and Tup. Notched Izod uses a pendulum type machine to strike a notched specimen. Tup testing uses a falling weight (tup) to strike a pipe or fitting specimen.

**INJECTION MOLDING**—The process used to form a shape by forcing a heated plastic, in a fluid state and under pressure, into the cavity of a closed mold.

**ISO EQUATION**—The equation which shows the relation-ship between stress, pressure, and dimensions in pipe.

**JOINT**—The point where a pipe and fitting or two pieces of pipe are connected together.

**KETONES**—A group of compounds having two alkyl groups attached to a carbonyl (CO) group.

**LIGHT STABILITY**—A feature of a plastic which allows it to retain its original color and physical properties when exposed to sun or artificial light.

**LIGHT TRANSMISSION**—The amount of light which a plastic will allow to pass through.

**LONGITUDINAL STRESS**—A tensile or compressive force placed upon the long axis of a plastic part.

**LUBRICANT**—Any substance which reduces the friction between moving solid surfaces.

**MODULUS**—A term used to describe the load required to cause a specified percentage of elongation. It is usually expressed in PSI or kilos per square centimeter.

**MONOMER**—A low-molecular-weight substance whose molecules can react with other molecules to form a polymer.

**NON-FLAMMABLE**—Incapable of supporting combustion.

**NON -TOXIC**—Non-poisonous.

**NYLON PLASTICS**—Plastics based on resins composed principally of a long-chain synthetic polymeric amide which has recurring amide groups as an integral part of the main polymer chain.

**OLEFIN PLASTICS**—A group of plastics based on polymers made by the polymerization or copolymerization of olefins with other monomers, with the olefins being at least 50% of the weight. Polypropylene, polyethylene, and polybutylene are examples.

**ORGANIC CHEMICAL**—Any chemical which contains carbon.

**PHENOLIC PLASTICS**—A group of plastics based on resins made by the condensation of phenols with aldehydes.

**PLASTIC**—A material that contains as an essential ingredient one or more organic polymeric substances of large molecular weight, is solid in its finished state, and, at some stage in its manufacture or in its processing into finished articles, can be shaped by flow.

**PLASTICITY**—The property of plastics which allows them to be formed, without rupture, continuously and permanently by the application of a force which exceeds the yield value of the material.

**PLASTICIZER**—A substance incorporated in a plastic to increase its workability, flexibility, or distensibility.

**PLASTIC PIPE**—A hollow cylinder of a plastic material in which the wall thicknesses are usually small when compared to the diameter and in which the inside and outside walls are essentially concentric.

**POLYBUTYLENE PLASTICS**—Plastics based on polymers made with butene as essentially the sole monomer.

**POLYETHYLENE PLASTICS**—Plastics based on polymers made with ethylene as essentially the sole monomer.

**POLYMER**—A product formed by the chemical reaction of the addition of a large number of small molecules which have the ability to combine and reach high molecular weights.

**POLYMERIZATION**—A chemical reaction in which the molecules of monomers are linked together to form polymers.

**POLYOLEFIN PLASTICS**—Plastics based on polymers made with an olefin(s) as essentially the sole monomer(s).

**POLYPROPYLENE PLASTICS**—Plastics based on polymers made with propylene as essentially the sole monomer.

**POLYSTYRENE**—A polymer prepared by the polymerization of styrene as the sole monomer.

**POLYVINYL CHLORIDE PLASTICS**—Plastics obtained by the polymerization of vinyl chloride. The addition of various ingredients, such as stabilizers, colorants, lubricants, and fillers enhance the processability and performance.

**POROSITY**—A term describing a plastic part which has many visible voids.

**PRESSURE RATING**—The maximum pressure at which a plastic part can safely function without failing.

**QUICK BURST**—A term used to describe the amount of internal pressure required to burst a pipe or fitting when the pressure is built up over a 60-70 second interval of time.

**REINFORCED PLASTIC**—A plastic with high strength fillers imbedded in the composition, causing some mechanical properties to be superior to those of the base resin.

**RESIN**—A solid or pseudosolid organic material, often having a high molecular weight, which exhibits a tendency to flow when subjected to stress, usually has a softening or melting range, and usually fractures conchoidally.

**RUNNER**—The secondary feed channel in an injection mold that runs from the inner end of the sprue to the cavity gate. Also, the solidified piece of plastic which forms in the feed channel when the injection molded part cools.

**SAMPLE**—A small part or portion of a material or product intended to be representative of the whole.

**SCHEDULE**—A pipe sizing system for the outside diameter and wall thickness dimensions which was started by the iron pipe industry. Normally, as the diameter increases, the pressure rating decreases for any given schedule of pipe.

**SELF-EXTINGUISHING**—A term describing a plastic material which stops burning when the source of the burning is removed.

**SHRINK MARK**—A depression in the surface of a molded plastic part where it has retracted from the mold.

**SOFTENING POINT**—The temperature at which a plastic changes from rigid to soft.

**SOLVENT**—A medium into which a substance is dissolved.

**SOLVENT CEMENT**—An adhesive consisting of a plastic dissolved into a solvent and used to bond plastic surfaces.

**SOLVENT CEMENTING**—Using a solvent cement to make pipe joint.

**SPECIFIC GRAVITY**—The ratio of the mass of a material to the mass of an equal volume of water.

**SPRUE**—The primary feed channel that runs from the outer face of an injection mold to the runner or the gate.

**STABILIZER**—An ingredient added to a plastic compound to inhibit or retard undesirable changes in the material.

**STANDARD DIMENSION RATIO (SDR) PIPE**—A type of pipe in which the dimension ratios are constant for any given class. Unlike "schedule" pipe, as the diameter increases the pressure rating remains constant for any given class of pipe.

**STIFFNESS FACTOR**—A term describing the degree of flexibility in a piece of pipe when subjected to an external load.

**STRESS-CRACK**—An external or internal crack in a plastic caused by tensile stresses less than its short-time mechanical strength.

**SUSTAINED PRESSURE TEST**—A test in which a plastic part is subjected to a constant internal pressure load for 1000 hours.

**TEAR STRENGTH**—A measure of a material's ability to resist tearing.

**TENSILE STRENGTH**—The measure of a plastic's ability to resist a stretching force. It is normally expressed in the PSI required to rupture a test specimen.

**THERMAL CONDUCTIVITY**—A measure of a plastic's ability to conduct heat.

**THERMAL CONTRACTION**—The decrease in length of a plastic part due to a change in temperature.

**THERMAL EXPANSION**—The increase in length of a plastic part due to a change in temperature.

**THERMOPLASTICS**—A group of plastics which can repeatedly be softened by heating and hardened by cooling.

**THERMOSETTING PLASTICS**—A group of plastics which, having been cured by heat, chemicals, or other means, are substantially infusable and insoluble. They are permanently hardened.

**VINYL CHLORIDE PLASTICS**—Plastics based on polymers or copolymers of vinyl chloride with other monomers, with the vinyl chloride being the greatest amount by weight.

**VISCOSITY**—A term describing a material's resistance to flow.

**VOLATILE**—A property of liquids in which they pass away by evaporating.

**WELD LINE (KNIT LINE)**—A term used to describe a mark on a molded plastic part formed by the union of two or more streams of plastic flowing together.

**YIELD POINT**—The point at which a plastic material will not withstand a stretching force. It will continue to elongate with no increase in load after reaching that point.

CHARLOTTE PIPE AND FOUNDRY COMPANY®

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

## Metric Conversion

| Pipe Size (mm) | Pipe Size (in.) | Pipe Size (mm) | Pipe Size (in.) |
|---|---|---|---|
| 6mm | 1/8 in. | 90mm | 3 1/2 in. |
| 7mm | 3/16 in. | 100mm | 4 in. |
| 8mm | 1/4 in. | 125mm | 5 in. |
| 10mm | 3/8 in. | 150mm | 6 in. |
| 15mm | 1/2 in. | 200mm | 8 in. |
| 18mm | 5/8 in. | 250mm | 10 in. |
| 20mm | 3/4 in. | 300mm | 12 in. |
| 25mm | 1 in. | 350mm | 14 in. |
| 32mm | 1 1/4 in. | 400mm | 16 in. |
| 40mm | 1 1/2 in. | 450mm | 18 in. |
| 50mm | 2 in. | 500mm | 20 in. |
| 65mm | 2 1/2 in. | 600mm | 24 in. |
| 80mm | 3 in. | | |

# NOTES

# NOTES

CHARLOTTE
PIPE AND FOUNDRY COMPANY

# 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 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 local plumbing, fire and building code requirements.

3) The Products fail due to defects or deficiencies in design, engineering, or installation of the piping system of which they are a part.

4) 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.

5) The Products fail due to the freezing of water in the Products.

6) 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.

Any product proved to be defective in manufacture will be replaced F.O.B. point of original delivery, or credit issued, at the discretion of Charlotte Pipe. **Purchaser must obtain written permission and/or a return goods authorization** and instructions for return shipment to Charlotte Pipe of any product claimed defective, shipped in error or excess of inventory needs.

All 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: Warranty Department
P.O. Box 35430
Charlotte, North Carolina 28235

**Warning:** Charlotte Pipe products are not to be used with compressed air or gases. Charlotte Pipe **does not recommend** that piping systems that include its products be tested with compressed air or gases.

01/25/05

# CHARLOTTE
## PIPE AND FOUNDRY COMPANY

PO BOX 35430
CHARLOTTE
NORTH CAROLINA 28235
PHONE (704) 348-6450
(800) 438-6091
FAX (888) 577-3649
LITERATURE BY FAX (800) 745-9382
WWW.CHARLOTTEPIPE.COM

MADE IN U.S.A.

NSF®

Originally Published 1992