Chemtrol® Thermoplastic Flow Solutions

INDUSTRIAL PLASTIC PIPING
60
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Plastic Piping Handbook

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Ideas that flow.
Chemtrol®

PLASTIC PIPING HANDBOOK

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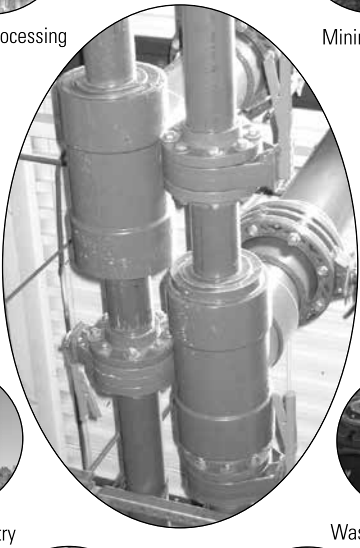


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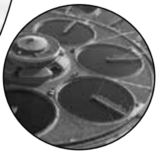
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FOREWARD

Growth in the use of plastic piping has been nothing less than spectacular. In 1947 sales of plastic piping in the United States amounted to less than $500,000; however, seven decades later sales have exceeded five billion dollars and show no signs of slowing down.

Plastic piping is employed for chemical and food processing, for natural gas distribution and supply, for shipboard installations, for municipal water treatment, for industrial and residential plumbing, and a host of other applications.

Despite the growing popularity of plastic piping, reliable, up-to-date and comprehensive information sometimes is difficult to obtain, and there is a genuine need for a handy reference expressly pertinent to the industry. This Chemtrol *Plastic Piping Handbook* represents an earnest effort to meet that need.

It contains summaries of the chemical and physical properties of frequently used plastic piping materials, item listings of Chemtrol® fittings and valves, make-up dimensions, recommended methods of joining plastic products, tips on fabrication and installation, and selected tables, graphs and charts of technical data required for practically every piping job.

The Advantages of Plastic Piping

A principal reason for the phenomenal growth of plastic piping is the unique combination of chemical resistance and physical properties it makes available at reasonable cost.

Plastic piping has outstanding resistance to nearly all acids, caustics, salt solutions and other corrosive liquids. It resists corrosion, rusting, scaling, or pitting...inside and outside. It also resists growth of bacteria, algae and fungi that could cause offensive odors or create serious sanitation problems.

Due to the smooth inner wall, plastic piping provides maximum flow rates, abrasion resistance at a low cost and minimum build-up of sludge and slime.

Because most plastics are non-conductive, plastic piping is not subject to galvanic or electrolytic corrosion, a major threat to mixed-metal piping systems. Plastic pipe can be buried in acid or alkaline wet or dry soil without painting or other special protective coatings.

Plastic pipe is tough and strong. Its tensile and burst strength is sufficient to handle operating pressures encountered in most moderate-service processes within the temperature capability specific for the particular material.

Plastic pipe weighs approximately one-half of one-sixth as much as metal pipe, which makes it easier to handle, join and install, especially in cramped quarters and on high rise construction jobs.

It can be fabricated by a variety of methods: solvent welding, fusion welding, threading and flanging. Each has special advantages for specific plastic materials and particular jobs.

Competitive, realistic pricing is a final reason that plastic piping often is used in place of expensive alloys and non-metallics. Plastic piping has been proven to out-perform these more costly materials on a dollar-for-dollar basis.

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Why Chemtrol Piping Components are Preferred

Proven dependability.

Chemtrol flow-control products are unsurpassed in performance and longevity. With 60 years of experience in industrial thermoplastics, Chemtrol offers dependable products that work in the most demanding environments.

Technical service and sales support.

Our technical specialists are some of the best in the business. As part of your team, they provide expert advice, solve problems, and assist you every step of the way.

Our distributors, sales professionals, and service representatives offer ideas, answer questions, and put their knowledge to work for you.

Innovative technology.

Great ideas flow from Chemtrol in PVC, CPVC, PP, and PVDF products for a wide range of flow-control applications.

Education and training.

We help you learn about the benefits of thermoplastics through excellent programs: classes and seminars specific to your industry, presented at our manufacturing facility, or product and application-specific seminars conducted in the field. Our high-quality product and technical manuals are available on request, and a full listing of Chemtrol products is provided on our web site, www.chemtrol.com

PVC

(Polyvinyl Chloride) PVC conforming to ASTM D1784, Classification 12454, formerly designated Type I, Grade 1, is the most frequently specified of all thermoplastic piping materials. It has been used successfully for more than 55 years in such diverse areas as chemical processing, industrial plating, chemical drainage, fresh and wastewater treatment, chilled and tower cooling water, deionized water manufacture and distribution, and irrigation sprinkler systems. PVC is characterized by high physical properties and resistance to chemical attack by strong acids and other oxidizers, alkalis, salt solutions, some organic chemical solutions, and many other chemicals. However, it is attacked by non-ionic surfactants, some vegetable oils (e.g., peanut), and many organic chemicals such as polar solvents (e.g., ketones), aromatics (i.e., benzene ring structure), and chlorinated hydrocarbons. The maximum service temperature of PVC is 140°F. With a design stress of 2,000 psi at 73°F, the long-term hydrostatic strength of PVC is as high as any of the major thermoplastic materials being used for solid piping systems. PVC is joined by solvent cementing, threading, or flanging.

CPVC (Corzan®)

(Chlorinated Polyvinyl Chloride) CPVC conforming to ASTM D1784, Classification 23447, is a resin created by the post-chlorination of a PVC polymer. The material's resistance to chemical attack is almost identical to that of PVC. And the physical properties of CPVC are very similar to those of PVC at 73°F, but the additional chlorine in the CPVC polymer extends its maximum service temperature to 210°F. For example, the design stress for CPVC is 2,000 psi at 73°F, identical to that of PVC. But its strength is only reduced to 500 psi at 180°F, as compared to 440 psi for PVC at 140°F. For more than 35 years, CPVC has proven to be an excellent material for hot corrosive liquids, hot and cold water distribution, and similar applications above the useful temperature range for PVC. CPVC may even be chosen over PVC in the 110°F to 140°F temperature range because its higher strength-at-temperature, requiring less frequent piping supports, can translate to a more favorable overall installed cost than PVC. CPVC is joined by solvent cementing, threading, or flanging.

PVDF (Kynar®)

(Polyvinylidene Fluoride) PVDF homopolymer conforming to ASTM D3222, Type I, Grade 2, is a tough, abrasion-resistant fluorocarbon material that has a design stress of 1,360 psi at 73°F and a maximum service temperature of 280°F. It has versatile chemical resistance to salts, strong acids, dilute bases, and many organic solvents, such as the aromatics (i.e., benzene ring structure), the aliphatics (i.e., paraffin, olefin, and acetylene hydrocarbons), and the chlorinated groups. And PVDF is ideally suited for handling wet or dry chlorine, bromine, and other halogens. However strong bases and some organic chemicals such as polar solvents (e.g., ketones) and esters attack it. No other solid thermoplastic piping material can approach the combined strength, working temperature, and chemical resistance characteristics of PVDF. It is joined by the thermo-sealing socket fusion process, threading, or flanging.

PVDF, absent of any color pigment, is transparent to ultraviolet light. So while PVDF is one of the few plastic materials that is not degraded by UV radiation, exposure of the fluid medium inside a piping system to direct sunlight can frequently adversely affect its stability. Therefore, all PVDF piping components that Chemtrol produces for general chemical service, contain an FDA-approved red pigment to mask the penetration of UV rays.

Natural Kynar® PVDF Type I (polymerized in emulsion) homopolymer is notably free of metallic ions and foreign organic compounds. And since the resin does not require processing or other external additives to aid manufacturing or long-term stability, the hard-polish surface of components will remain intact, so that piping systems will not release particulate to the fluid medium. Further, there will be no surface micropores to encourage biological growth. Natural Kynar® systems are intended for ultra high pure water and chemical services, such as electronics, pharmaceuticals, and processed foods and beverages.

Kynar® is a registered trademark of Arkema Inc.
Corzan® is a registered trademark of The Lubrizol Corporation.

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PP

(Polypropylene) PP as specified by ASTM D4101, is a member of the polyolefin family of pure hydrocarbon plastics. Although PP has half the strength of PVC and CPVC, with a design stress of 1,000 psi at 73°F, it may have the most versatile chemical resistance of the thermoplastic materials identified as the sentinels of industrial piping. Consider the fact that there are no known solvents for PP. As a result, it has been the material of choice for drainage of mixed industrial chemicals for over 40 years. As pressure piping, PP has no peers for concentrated acetic acid or hydroxides. It is also suitable for milder solutions of most acids, alkalis, salts, and many organic chemicals, including solvents. The nemeses for PP are strong oxidizers, such as the hypochlorites and higher concentrations of sulfuric, nitric, and hydrofluoric acids. They are Environmental Stress Cracking (ESC) agents for PP, meaning that time-to-failure is a function of the combined variables of concentration and temperature of the fluid and stress. Although PP is not recommended for some organic chemicals, such as polar and chlorinated solvents and the aromatics, the concern is permeation through rather than catastrophic damage of the molecular chain.

Black PP used in Chemtrol products is formulated with a minimum 2.5% carbon black. The plastic pipe industry recognizes PP formulated with this level of carbon black as suitable for long-term outdoor service.

Chem-Pure® Natural PP utilized to produce Chemtrol® piping products was selected because of its extremely low content of metals, organic compounds other than naturally pure propylene, and free ions. No pigments or other adulterants (natural) are added to the plastic resin. Chem-Pure® systems are intended for high purity chemicals or DI water. Chem-Pure systems are intended as an economic alternative to the ultra high purity PVDF systems typically found in the highly sophisticated electronic semi-conductor industry.

FKM

(Fluoroelastomer) FKM is compatible with a broad spectrum of chemicals. Because of this extensive chemical compatibility, spanning wide ranges of concentration and temperature, FKM has gained wide acceptance as a material of construction for valve o-rings and seats. These fluoroelastomers can be used in most applications involving mineral acids (with the exception of HCl), salt solutions, chlorinated hydrocarbons, and petroleum oils. FKM is not recommended for most strong alkali solutions.

EPDM

(Ethylene-propylene-diene monomer) EPDM is a terpolymer elastomer that has good abrasion and tear resistance and offers excellent chemical resistance to a variety of salt, acidic, and organic chemical solutions. It is the best material for most alkali solutions and hydrochloric acid, but is not recommended for applications involving petroleum oils or most strong acids.

PTFE

(Polytetrafluoroethylene) PTFE has outstanding resistance to chemical attack by most chemicals and solvents. PTFE has a temperature rating of -200°F to +500°F. It is a self-lubricating material used as a seat and/or bearing material in most Chemtrol® valves.

Chemical Resistance

While thermoplastic piping systems are useful in general water service because they are light-weight, easy to install, and cost-effective, they excel in corrosive environments, such as water and wastewater treatment, food and pharmaceuticals, chemical processing, mining, power plants, oil refineries and more. Choosing the proper material for corrosive fluids can be handled by consulting NIBCO's chemical resistance guide and understanding the effect that temperature will have upon plastic materials' strength.

Chemical resistance is the ability for a particular plastic material to maintain properties in contact with a chemical. To ensure comprehensive chemical compatibility, a piping system must take into consideration the chemical resistance of all system components, including, but not limited to, plastic components, solvent cements or thread pastes (if applicable), elastomeric seals, all valve components and lubricants. Testing under field conditions may be the best way to ensure selected materials will work in a particular application.

Standards

Many commercial, industrial, and governmental standards or specifications are available to assist the design engineer in specifying plastic piping systems. Standards most frequently referred to and most commonly called out in plastic piping specifications are ASTM Standards. These standards also often form the basis of other standards in existence. Below is a list and description of those standards most typically applied to industrial plastic piping.

ASTM D1784
(American Society for Testing and Materials)
This specification covers rigid PVC and CPVC compounds intended for general purpose use in extruded or molded formincluding pressure piping applications and nonpressure piping applicationscomposed of poly(vinyl chloride), chlorinated poly(vinyl chloride), or vinyl chloride copolymers containing at least 80% vinyl chloride, and the necessary compounding ingredients.

ASTM D1785 and F441
These standards cover the specification and quality of Schedule 40, 80, and 120 PVC (D1785) and CPVC (F441) pressure pipe. Outlined in these standards are dimensional specifications, burst, sustained, and maximum operating pressure requirements and test procedures for determining pipe quality with respect to workmanship and materials.

ASTM D2466
This standard covers Schedule 40 PVC threaded and socket pressure fittings. Stipulated in the standard are thread and socket specifications, by lengths, wall thickness, burst, material, quality, and identification requirements.

ASTM D2467 and F439
These standards cover Schedule 80 PVC (D2467) and CPVC (F439) Socket Type and Threaded Pressure Fittings. Dimensions, burst strength, resin compound stipulation, and scheme of product identification requirements are specified.

ASTM D2564 and F493
These standards set forth requirements for PVC (D2564) and CPVC (F493) Solvent Cement. The specification identifies the resin compound to be used and stipulates minimum resin content, solution viscosities, and physical performance qualities.

ASTM F656
This specification covers requirements for primers for use with poly (vinyl chloride) (PVC) pipe and fittings that are to be joined by PVC solvent cements meeting the requirements of Specification.

ASTM F1970
This specification covers special engineered fittings or appurtenances for use in PVC or CPVC systems. Flanges, unions, and valves not included in the scope of other ASTM specifications are specifically referenced. Minimum requirements are identified for testing materials, dimensions, marking, and in-plant quality control.

ASTM F1498
This specification adapts the General Purpose American Pipe Thread Specification, ASME B1.20.1, to taper pipe threads for use on plastic pipe and fittings with machined or molded threads. The standard covers dimensions and gaging of plastic tapered National Pipe Threads (NPT) for leak-tight joints, and it is now referenced in all ASTM Standards for plastic piping products.

ASTM D2855
This standard describes the procedure for making joints with PVC pipe and fittings by means of solvent cementing.

ASTM D4101 (Formerly D2146)
This specification covers polypropylene materials suitable for injection molding and extrusion. Polymers consist of homopolymer, copolymers, and elastomer compounded with or without the addition of impact modifiers (ethylene-propylene rubber, polyisobutylene rubber, and butyl rubber), colorants, stabilizers, lubricants, or reinforcements.

ASTM D1599
This standard covers the test method for establishing the short-term hydraulic failure pressure of thermoplastic pipe, tubing, and fitting under specific temperature, time, and method of loading conditions. These test techniques are normally used for quality control.

ASTM D1598
This test method covers the determination of the time-to-failure of both thermoplastic and reinforced thermosetting/resin pipe under constant internal pressure.

ASTM D2837
This standard describes the procedure for obtaining the Hydrostatic Design Basis for all known thermoplastic pipe materials and for any practical temperature and medium. This was achieved by evaluating stress rupture data, taken from tests conforming to ASTM D1598, for the subject material and involved specified treatment and analysis of data.

ASTM D2657
This standard covers the procedure for heat-fusion bonding of polyolefin materials.

ASTM D3222
This standard covers the polymerization method and physical properties of PVDF (polyvinylidene fluoride) Fluoroplastic Materials for molding and extrusion.

Organizations other than ASTM issue standards that are commonly encountered in industrial thermoplastic piping design. The most common standards are described below.

ASME B1.20.1 (was B2.1)
This specification details the dimensions and tolerance for tapered pipe threads. This standard is referenced in the ASTM standards for threaded fittings mentioned above. See Reference Data for details.

ASME B16.5
This specification sets forth standards for bolt holes, bolt circles, and overall dimensions for steel 150# flanges. See Reference Data for details.

NSF/ANSI 14
The physical, performance, and health effects requirements in this Standard apply to thermoplastic and thermoset plastic piping system components, including but not limited to pipes, fittings, valves, joining materials, gaskets, and appurtenances. The established physical, performance, and health effects requirements also apply to materials (resin or blended compounds) and ingredients used to manufacture plastic piping system components. This Standard provides definitions and requirements for materials, ingredients, products, quality assurance, marking, and record keeping.

Fittings and valves made from copper alloys containing more than 15% zinc by weight shall be resistant to dezincification and stress corrosion cracking (SCC) and shall meet the test requirements of this standard.

NSF/ANSI 61
This Standard establishes minimum health effects requirements for the chemical contaminants and impurities that are indirectly imparted to drinking water from products, components, and materials used in drinking water systems. This Standard does not establish performance, taste and odor, or microbial growth support requirements for drinking water system products, components, or materials.

This Standard is intended to cover specific materials or products that come into contact with: drinking water, drinking water treatment chemicals, or both. The focus of the Standard is evaluation of contaminants or impurities imparted indirectly to drinking water. The products and materials covered include, but are not limited to, process media (e.g., carbon, sand), protective materials (e.g., coatings, linings, liners), joining and sealing materials (e.g., solvent cements, welding materials, gaskets), pipes and related products (e.g., pipes, tanks, fittings), mechanical devices used in treatment/ transmission/distribution systems (e.g., valves, chlorinators, separation membranes, point-of-entry drinking water treatment systems), and mechanical plumbing devices (e.g., faucets, endpoint control valves).

Technical Service
Technical assistance regarding standards, applications, product performance, design, and installation tips is available from Technical Services Technical Information Hotline: (888) 446-4226 phone; (888) 336-4226 fax.

Physical Properties of Thermoplastic Piping Materials

ASTM Test Methods	Properties	Material: PVC 12454-B	CPVC 23447-B	PVDF	Polypropylene
General					
D792	Specific Gravity	1.38	1.50	1.76	.905
D570	Water Absorption % 24 Hrs. @ 73° F	.05	.05	.04	.02
Mechanical					
D638	Tensile Strength psi @ 73° F	7,300	7,200	6,000	4,600
D638	Modulus of Elasticity in Tension psi @ 73° F x 10^5	4.2	3.7	2.1	2.0
D790	Flexural Strength psi	14,500	15,600	9,700	7,000
D256	Izod Impact Strength @ 73° F (Notched)	1.1	2.0	3.8	.8
Thermal					
D696	Coefficient of Thermal Expansion in/in/° F x 10^{-5}	3.0	3.8	7.9	5.0
C177	Thermal Conductivity BTU/HR/Sq. Ft./° F/in	1.2	.95	.79	1.2
D648	Heat Distortion Temp. ° F @ 66 psi	NA	NA	284	195
D648	Heat Distortion Temp. ° F @ 264 psi	163	212	194	140
	Resistance to Heat ° F at Continuous Drainage	140	210	280	180
Flammability					
D2863	Limiting Oxygen Index (%)	43	60	44	17
E84	Flame Spread (%)	< 25	< 25	< 25	NA
E84	Smoke Generation	> 250	< 250	< 50	> 450
	Underwriters Lab Rating (Sub. 94)	94V-O	94V-O	94V-O	94HB

Polyvinyl Chloride (PVC)

Typical Applications		Chemical processing, industrial plating, chilled water distribution, chemical drainage, and irrigation systems
Joining Methods		Solvent cementing, threading, or flanging
Max. Service Temperature		140° F/60° C
Fittings	Schedule 80	Socket – 1/4" through 12" Threaded – 1/4" through 4"
Valves	Tru-Bloc®/True Union ball valves	1/2" through 6" socket, threaded, and flanged ends
	Tru-Bloc®/ True Union ball check valves	1/2" through 4" with socket, threaded, or flanged ends
	Butterfly valves	2" through 10" with EPDM seals 4" and 6" with EPDM or FKM liner
	3-Way valves	True Union 3-way/3-position or 3-way/2-position; 1/2" through 2" with socket or threaded ends
	Specialty valves	Angle and Y-Pattern: 1/4" through 1" threaded Needle and Chemcock®: 1/4" threaded
Pipe		

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Chlorinated Polyvinyl Chloride (Corzan® CPVC)

Typical Applications		Systems for hot corrosive liquids, hot and cold water distribution, chemical processing, industrial plating, deionized water lines, chemical drainage, waste water treatment systems, and similar applications above the temperature range of PVC
Joining Methods		Solvent cementing, threading, or flanging
Max. Service Temperature		210° F/99° C
Fittings	Schedule 80	Socket– 1/4" through 12" Threaded– 1/4" through 4"
Valves	Tru-Bloc®/True Union ball valves	1/2" through 6" socket, threaded, and flanged ends
	Tru-Bloc®/ True Union ball check valves	1/2" through 4" with socket, threaded, or flanged ends
	Butterfly valves	3" with EPDM or FKM liner
	3-Way valves	True Union 3-way/3-position or 3-way/2-position; 1/2" through 2" with socket or threaded ends
	Specialty valves	
Pipe		

Corzan® is a registered trademark of The Lubrizol Corporation.

Polypropylene (PP)

Typical Applications		**Black Polypropylene:** Clean chemical processes, hot corrosive liquids, industrial plating, waste treatment systems	**Natural Polypropylene:** Deionized water systems, clean chemical processes, pharmaceutical operations, food processing
Joining Methods		Socket heat fusion, threading, or flanging	
Max. Service Temperature		180° F/82° C	
Fittings	Schedule 80	IPS socket ends – 1/2" through 6" Threaded – 1/2" through 4"	IPS socket ends – 1/2" through 4" Threaded – 1/2" through 4"
Valves	Tru-Bloc®/True Union ball valves	1/2" through 4" with socket, threaded, or flanged ends	1/2" through 4" with socket or threaded ends
	Tru-Bloc®/ True Union ball check valves	1/2" through 2" with socket, threaded, or flanged ends	1/2" through 2" with socket or threaded ends
Pipe		Schedule 40 and 80 wall thicknesses	

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Polyvinylidene Fluoride (KYNAR® PVDF)

Typical Applications		**Red KYNAR®** PVDF, which protects fluid medium from UV exposure, is an excellent material for general industrial applications, especially outdoor installations	**Natural KYNAR®** (Unpigmented) PVDF is ideal for industries such as electronics, pharmaceuticals, and processed foods or beverages
Joining Methods		Socket heat fusion, threading, or flanging	
Max. Service Temperature		280° F/138° C	
Fittings	Schedule 80	IPS socket ends – 1/2" through 6" Threaded – 1/2" through 2"	
Valves	Tru-Bloc®/True Union ball valves	1/2" through 4" with socket, threaded, or flanged ends	
	Tru-Bloc®/ True Union ball check valves	1/2" through 4" with socket, threaded, or flanged ends	
Pipe		Schedule 80 wall thickness	

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True Union Ball Valves

The True Union feature, a Chemtrol introduction, an exclusive Chemtrol introduction, so revolutionized the industrial plastic valve industry that it has become the standard followed by all major manufacturers. The purpose of the design is to permit the valve cartridge, i.e., the body containing all operational components, to be easily lifted from the piping system for servicing/replacement when the union nuts are backed off. Easy repair/replacement, interchangeability, distribution availability, technical service, and reliable quality are the synergistic rationale many plants and original equipment manufacturers have embraced while standardizing on Chemtrol® True Union Ball and Check Valves.

The laying length of the body and the heavy-duty modified-acme threads in the union connections to the body have not changed in the four distinct models' 40-year history of the valve. This permits fouled valve replacement with a new body cartridge, which will fit the old union nuts. No change in piping length is required.

The distinctive orange handle indicates "open/close" and direction of flow at a distance. And molded-in arrows on top of the handle dictate rotational direction to personnel for easy operation within 90° stops. For applications requiring handle removal, the D-ring stem flats indicate "open/close" and a molded-in arrow on top of the stem indicates flow direction.

The Evolution of Chemtrol® Ball Valves

As a result of continuous testing and improvements since the inception of the True Union Ball Valve, three distinct model changes have occurred. The original True Union Model A design had a seat-carrier that slid into the smooth bore of the valve body, held in place by the external nut and end connector. Tightening the external nut adjusted the compression of the PTFE seat onto the ball.

The first major evolution to the True Union Ball Valve, Model B, introduced the Tru-Bloc concept, a functional safety feature. With this design a separate threaded retainer locked the seat-carrier into the body and prevented the seat-carrier from being extruded out of the valve body when the external nut was removed. This change is intended to prevent pressure on the other side of the valve from ejecting the internal components and fluid medium out of the open valve end and to further prevent possible injury to persons or property.

The Model C seat-carrier design was modified to include an external thread which mated into the valve body threads, eliminating the separate retainer. This modification also eliminated the adjustment of the seat-carrier by the external nut and end connector, resulting in a sealing envelope that was independent of external forces. An energized O-ring was added under the PTFE seat that provided automatic adjustment to compensate for seat wear. This design modification continued the Tru-Bloc feature, preventing the seat carrier from being extruded out of the valve body when the external valve nut was removed.

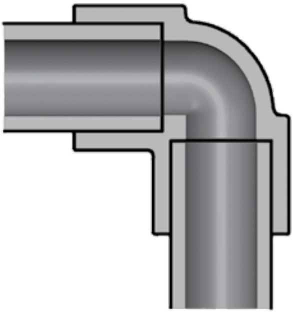
Manufactured in PVC and CPVC through 2", the current Model D ball valve's seat-carrier internal threads and the external union nut threads were strengthened to provide an increased pressure rating of 250 psi at 73°F and improved the pressure ratings at higher temperatures. The end connector design was modified to provide wrench flats. The union nut OD was changed to provide improved gripping for strap wrenches. The Model D design continued the sealing envelope that was independent of external forces with an energized O-ring under the PTFE seat that provided automatic adjustment to compensate for seat wear. The Tru-Bloc® feature was also retained.

Is a Fitting Just a Fitting?

Have you ever taken the time to look closely at the design of a Chemtrol® fitting? No, you say? A fitting is just a fitting? They are all the same? Well, perhaps you need to take a closer look at the difference between a Chemtrol fitting and those of many of our leading competitors.

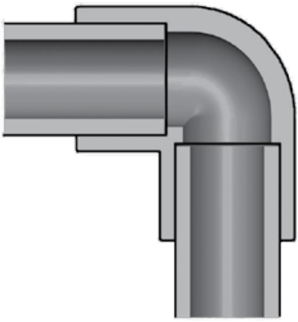
The stop of a Chemtrol fitting is designed to be the same thickness as the wall of the pipe going into it. This means that our fittings have a more streamlined design on the inside where it counts. No under cuts or over cuts exist that would interfere with the flow of the fluid through the fitting. This leads to less friction and turbulence as the fluid passes through the system.

Chemtrol's Design —
Streamlined on the inside where it really matters!



Chemtrol Fitting

Leading Competitor's Design —
Streamlined on the outside, but inside design creates turbulence.



Leading Competitor's Fitting

Now look at a competitor's. Many have reduced the thickness of their fittings causing a "stair step" when the pipe wall extends over the stop. This leads to more friction, turbulence and a less efficient system.

Some competitors have reduced the wall thickness of their fittings. Chemtrol has steadfastly resisted any trend that would compromise the quality of our fittings.

Now, we ask, is a fitting just a fitting?

Pressure Ratings of Chemtrol Products

The pressure carrying capability of any pipe at a given temperature is a function of the material strength from which the pipe is made and the geometry of the pipe as defined by its diameter and wall thickness. The following expression, commonly known as the ISO equation, is used in thermoplastic pipe specifications to relate these factors:

$$P = 2S / (D_o/t - 1)$$

where: P = *maximum pressure rating, psi*
S = *maximum hydraulic design stress (max. working strength), psi*
D_o = *average outside pipe diameter, in.*
t = *minimum wall thickness, in.*

The allowable design stress, which is the tensile stress in the hoop direction of the pipe, is derived for each material in accordance with ASTM D2837, Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials, at 73° F. The pressure ratings below were calculated from the basic Hydraulic Design Stress for each of the materials.

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Pipe and Fittings

In order to determine the pressure rating for a product system, first find the plastic material and schedule (wall thickness–see Dimensions and References components on page 10 for additional information) of pipe and fittings in the heading of the Maximum Non-Shock Operating Pressure table below. Then, locate the selected joining method in the subheading of the table and go down the column to the value across from a particular pipe size, listed in the far left column. This will be the maximum non-shock operating pressure at 73° F for the defined product system.

Maximum Non-Shock Operating Pressure (psi) at 73° F[1]

Nom. Pipe Size	Schedule 40 PVC & CPVC	Schedule 80 PVC & CPVC		Schedule 80 Polypropylene		Schedule 80 PVDF	
	Socket End	Socket End	Threaded End	Thermo-Seal Joint	Threaded End[3]	Thermo-Seal Joint	Threaded End
1/2	600	850	420	410	20	580	290
3/4	480	690	340	330	20	470	230
1	450	630	320	310	20	430	210
1 1/4	370	520	260	260	20	—	—
1 1/2	330	470	240	230	20	326	160
2	280	400	200	200	20	270	140
2 1/2	300	420	210	—	—	—	—
3	260	370	190	190	20	250	N.R.
4	220	320	160	160	20	220	N.R
6	180	280	N.R.	140	N.R.	190	N.R.
8	160	250[2]	N.R.	—	—	—	—
10	140	230	N.R.	—	—	—	—
12	130	230	N.R.	—	—	—	—

1 For more severe service, an additional correction factor may be required.
2 8" CPVC Tee, 90° ELL and 45° ELL rated at 1/2 of value shown.
3 Recommended for intermittent drainage pressure not exceeding 20 psi. Not available in natural polypropylene.
N.R. Not Recommended and NOT WARRANTED by manufacturer.

Valves, Unions, and Flanges

As with all other thermoplastic piping components, the maximum pressure rating for all Chemtrol® valves, unions and flanges, regardless of size, is related to temperature as per the chart below.

Maximum Non-Shock Operating Pressure (psi) vs. Temperature

Operating	Model D Ball Valve		All Other Valves, Unions & Flanges			
Temperature (°F)	PVC	CPVC	PVC	CPVC	PP	PVDF
70	250	250	150	150	150	150
80	250	250	150	150	150	150
90	225	250	150	150	150	150
100	200	240	150	150	150	150
110	180	220	135	140	140	150
120	165	190	125	130	130	150
130	140	180	110	120	118	150
140	130	170	50	110	105	150
150	N.R.	160	N.R.	100	93	140
160	N.R.	150	N.R.	90	80	133
170	N.R.	140	N.R.	80	70	125
180	N.R.	130	N.R.	70	50	115
200	N.R.	65	N.R.	50	N.R.	97
210	N.R.	30	N.R.	25	N.R.	85
220	N.R.	N.R.	N.R.	N.R.	N.R.	75
240	N.R.	N.R.	N.R.	N.R.	N.R.	55
260	N.R.	N.R.	N.R.	N.R.	N.R.	40
280	N.R.	N.R.	N.R.	N.R.	N.R.	25

N.R. Not Recommended and NOT WARRANTED by manufacturer.

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Temperature Ratings of Chemtrol Products

Since the strength of plastic pipe is sensitive to temperature, the identical test method is used to determine the material strength at elevated temperature levels. The correction factor for each temperature is the ratio of strength at that temperature level to the basic strength at 73° F. Because the hoop stress is directly proportional to the internal pressure, which created that pipe stress, the correction factors may be used for the temperature correction of pressure as well as stress. For pipe and fitting applications above 73° F, refer to the table below for the Temperature Correction Factors. To determine the maximum non-shock pressure rating at an elevated temperature, simply multiply the base pressure rating obtained from the table in the preceding column by the correction factor from the table below. The allowable pressure will be the same as the base pressure for all temperatures below 73° F.

Temperature Correction Factors

	Factors			
Operating Temperature (°F)	PVC	CPVC	PP	PVDF
70	1.00	1.00	1.00	1.00
80	0.90	0.96	0.97	0.95
90	0.75	0.92	0.91	0.87
100	0.62	0.85	0.85	0.80
110	0.50	0.77	0.80	0.75
115	0.45	0.74	0.77	0.71
120	0.40	0.70	0.75	0.68
125	0.35	0.66	0.71	0.66
130	0.30	0.62	0.68	0.62
140	0.22	0.55	0.65	0.58
150	N.R.	0.47	0.57	0.52
160	N.R.	0.40	0.50	0.49
170	N.R.	0.32	0.26	0.45
180	N.R.	0.25	*	0.42
200	N.R.	0.18	N.R.	0.36
210	N.R.	0.15	N.R.	0.33
240	N.R.	N.R.	N.R.	0.25
280	N.R.	N.R.	N.R.	0.18

* Recommended for intermittent drainage pressure not exceeding 20 psi.
N.R. Not Recommended and NOT WARRANTED by manufacturer.

Pressure Ratings of Chemtrol Products

Chemtrol Products in Vacuum or Collapse Loading Situations

Thermoplastic pipe is often used in applications where the pressure on the outside of the pipe exceeds the pressure inside. Suction or vacuum lines and buried pipe are examples of this type of service.

As a matter of practical application, gauges indicate the pressure differential above or below atmospheric pressure. However, scientists and engineers frequently express pressure on an absolute scale where zero equals a theoretically perfect vacuum and standard atmospheric pressure equals
14.6959 psi.

Vacuum Conversion Factors: See page 12 for additional head and metric factors.

Solvent cemented or thermo-sealed joints are particularly recommended for vacuum service. In PVC, CPVC, PP, or PVDF vacuum systems, mechanical devices such as valves and transition joints at equipment will generally represent a greater intrusion problem than the thermoplastic piping system will. Experience indicates that PVC vacuum systems can be evacuated to pressures as low as 5 microns with continuous pumping. However, when the system is shut off, the pressure will rise and stabilize around 10,000 microns or approximately 10 mm of Mercury at 73° F.

The following chart lists the allowable collapse loading for plastic pipe at 73° F. It shows how much greater the external pressure may be than the internal pressure. (Thus, a pipe with 100 psi internal pressure can withstand 100 psi more external pressure than a pipe with zero psi internal pressure.) For temperatures other than 73° F, multiply the values in the chart by the correction factors listed in the temperature correction table on the preceding page.

The chart also applies to a vacuum. The external pressure is generally atmospheric pressure, or 0.0 psig, while the internal pressure is normally identified as a vacuum or negative gauge pressure. However, this negative value will never exceed –14.7 psig. Therefore, if the allowable pressure listed in the chart (after temperature correction) is greater than the difference for internal-to-external pressure, the plastic system is viable.

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Maximum Collapse Pressure Rating, psi @73°F

Pipe Size	PVC Sch. 40	PVC Sch. 80	CPVC Sch. 80	PP Sch. 80	PVDF Sch. 80
1/2	450	575	575	230	391
3/4	285	499	499	200	339
1	245	469	469	188	319
1 1/4	160	340	340	136	—
1 1/2	120	270	270	108	183
2	75	190	190	76	129
2 1/2	100	220	220	—	—
3	70	155	155	62	105
4	45	115	115	46	78
6	25	80	80	32	54
8	16	50	50	—	—
10	12	43	—	—	—
12	9	39	—	—	—

Pressure Losses in a Piping System

Piping Calculations

As a fluid flows through a piping system, it will experience a head loss depending on, among other factors, fluid velocity, pipe wall smoothness and internal pipe surface area. The Tables on pages 15 and 16 give Friction Loss and Velocity data for Schedule 40 and Schedule 80 thermoplastic pipe based on the Williams and Hazen formula.

$$H = .2083 \left(\frac{100}{C}\right)^{1.852} x \left(\frac{q^{1.852}}{d^{4.8655}}\right)$$

Where: H = Friction Head Loss in Feet of Water/100 Feet of Pipe
C = Surface Roughness Constant (150 for all thermoplastic pipe)
q = Fluid Flow (gallons/min.)
d = Inside Diameter of Pipe

Fittings and valves, due to their more complex configurations, contribute significant friction losses in a piping system. A common method of expressing the losses experienced in fittings is to relate them to pipe in terms of equivalent pipe length. This is the length of pipe required to give the same friction loss as a fitting of the same size. The Table at the bottom of page 16 is a tabulation of the equivalent pipe length in feet for the various sizes of a number of common fittings. By using this Table and the Friction Loss Tables, the total friction loss in a plastic piping system can be calculated for any fluid velocity.

For example, suppose we wanted to determine the pressure loss across

Piping Calculations

a 2" Schedule 40, 90° elbow, at 75 gpm. From the lower table on page 16 we find the equivalent length of a 2" 90° elbow to be 5.5 feet of pipe. From the Schedule 40 Pipe Table on page 15 we find the friction loss to be 3.87 psi per 100 feet of pipe when the flow rate is 75 gpm. Therefore, the solution is as follows:

5.5 Feet/90° Elbow x 3.87 psi/100 Feet = 0.21 psi Pressure Drop/90° Elbow

which is the pressure drop across a 2" Schedule 40 elbow. But, what if it were a 2" Schedule 80 elbow, and we wanted to know the friction head loss? The solution is similar, except we look for the friction head in the Schedule 80 Pipe Table at the top of page 16 and find it to be 12.43 feet per 100 feet of pipe when the flow rate is 75 gpm. The solution follows:

5.5 Feet/90° Elbow x 12.43 Feet/100 Feet = 0.68 Feet Friction Head/90° Elbow

which is the friction head loss across a 2" Schedule 80 elbow.

Valve Calculations

As an aid to system design, fluid flow coefficients (Cv values) are shown for all Chemtrol valves. Cv is defined as the flow, in GPM, through a valve which will produce a pressure drop of 1.0 PSI when the medium is water at 60°F.

To determine the pressure drop for a given condition, the following formula may be used:

$$\triangle P = \frac{Q^2 \, S.G.}{Cv^2}$$

Where:

P = Pressure drop across the valve in psi
Q = Flow through the valve in gpm
S.G. = Specific gravity of the liquid (Water = 1.0)
Cv = Flow coefficient

The solution for an example problem follows. For Cv values for specific valves, refer to the product description page in the Chemtrol PVC & CPVC Guide.

EXAMPLE:
Find the pressure drop across a 1 ½" PVC ball check valve with a water flow rate of 50 gpm.

The Cv is 56, as shown in the *Chemtrol PVC & CPVC Guide.*

$$\triangle P = \frac{(50)^2 \times 1.0}{(56)^2}$$

$$\triangle P = \left(\frac{50}{56}\right)^2$$

$$\triangle P = .797 \text{ psi}$$

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Flow Capacity and Friction Loss for Schedule 40 Thermoplastic Pipe Per 100 Ft.

Gals. Per Minute	Velocity (Feet per Second)	Friction Head (Feet)	Friction Loss (PSI)	Velocity (Feet per Second)	Friction Head (Feet)	Friction Loss (PSI)	Velocity (Feet per Second)	Friction Head (Feet)	Friction Loss (PSI)	Velocity (Feet per Second)	Friction Head (Feet)	Friction Loss (PSI)	Velocity (Feet per Second)	Friction Head (Feet)	Friction Loss (PSI)	Velocity (Feet per Second)	Friction Head (Feet)	Friction Loss (PSI)	Velocity (Feet per Second)	Friction Head (Feet)	Friction Loss (PSI)	Velocity (Feet per Second)	Friction Head (Feet)	Friction Loss (PSI)
		1/4" Pipe																						
1/2	1.73	4.90	2.12		1/2" Pipe			3/4" Pipe																
3/4	2.59	10.38	4.50																					
1	3.45	17.68	7.66	1.13	1.16	.50	1.26	1.03	.45		1" Pipe			1 1/4" Pipe										
2	6.90	63.82	27.66	2.25	4.19	1.82	3.16	5.60	2.43								1 1/2" Pipe							
5	17.26	348.29	150.93	5.64	22.88	9.92	4.42	10.44	4.52	1.93	1.69	0.73	1.1	0.43	0.19									
7				7.89	42.66	18.49	6.32	20.21	8.76	2.70	3.14	1.36	1.55	0.81	0.35	1.13	0.38	0.16		2" Pipe			2 1/2" Pipe	
10				11.27	82.59	35.79	9.48	42.82	18.56	3.86	6.08	2.63	2.21	1.57	0.68	1.62	0.73	0.32						
15		3" Pipe		16.91	175.01	75.84	12.64	72.95	31.61	5.79	12.89	5.59	3.31	3.32	1.44	2.42	1.55	0.67	1.46	0.45	0.2	1.02	0.19	0.08
20							15.80	110.29	47.80	7.72	21.96	9.52	4.42	5.65	2.45	3.23	2.64	1.14	1.95	0.77	0.33	1.38	0.33	0.14
25	1.10	.17	.07							9.64	33.20	14.39	5.52	8.55	3.71	4.04	4	1.73	2.44	1.17	0.51	1.71	0.49	0.21
30	1.32	0.24	0.1		4" Pipe					11.57	46.54	20.17	6.63	11.98	5.19	4.85	5.6	2.43	2.92	1.64	0.71	2.05	0.69	0.3
35	1.54	.32	.14							13.50	61.91	26.83	7.73	15.94	6.91	5.65	7.45	3.23	3.41	2.18	0.94	2.39	0.92	0.4
40	1.77	.41	.18	1.02	.11	.05				15.43	79.28	34.36	8.83	20.41	8.84	6.46	9.54	4.13	3.9	2.79	1.21	2.73	1.18	0.51
45	1.99	.51	.22	1.15	.13	.06							9.94	25.39	11	7.27	11.87	5.14	4.39	3.47	1.5	3.07	1.46	0.63
50	2.21	.61	.26	1.28	.16	.07							11.04	30.86	13.37	8.08	14.43	6.25	4.87	4.22	1.83	3.42	1.78	0.77
60	2.65	.86	.37	1.53	.23	.10							13.25	43.25	18.74	9.69	20.22	8.76	5.85	5.92	2.57	4.1	2.49	1.08
70	3.09	1.15	.50	1.79	.30	.13							15.46	57.54	24.94	11.31	26.9	11.66	6.82	7.87	3.41	4.78	3.32	1.44
75	3.31	1.30	.56	1.92	.34	.15		6" Pipe								12.12	30.57	13.25	7.31	8.94	3.87	5.12	3.77	1.63
80	3.53	1.47	.64	2.04	.39	.17										12.93	34.45	14.93	7.8	10.08	4.37	5.47	4.25	1.84
90	3.97	1.82	.79	2.30	.48	.21	1.01	.07	.03							14.54	42.85	18.57	8.77	12.53	5.43	6.15	5.28	2.29
100	4.41	2.22	.96	2.56	.59	.26	1.12	.08	.03							16.16	52.08	22.57	9.75	15.23	6.6	6.83	6.42	2.78
125	5.52	3.35	1.45	3.19	.89	.39	1.40	.12	.05		8" Pipe								12.18	23.03	9.98	8.54	9.7	4.2
150	6.62	4.70	2.04	3.83	1.24	.54	1.68	.17	.07										14.62	32.28	13.99	10.25	13.6	5.89
175	7.72	6.25	2.71	4.47	1.65	.72	1.97	.22	.10	1.13	.06	0.03		10" Pipe					17.06	42.95	18.61	11.96	18.09	7.84
200	8.83	8.00	3.47	5.11	2.12	.92	2.25	.29	0.13	1.3	0.08	0.03										13.67	23.17	10.04
250	11.03	12.10	5.24	6.39	3.20	1.39	2.81	.43	0.19	1.62	0.11	0.05	1.03	0.04	0.02		12" Pipe					17.08	35.03	15.18
300	13.24	16.96	7.35	7.67	4.49	1.95	3.37	.61	0.26	1.94	0.16	0.07	1.23	0.05	0.02									
350	15.45	22.56	9.78	8.94	5.97	2.59	3.93	.81	0.35	2.27	0.21	0.09	1.44	0.07	0.03	1.01	0.03	0.01						
400				10.22	7.64	3.31	4.49	1.03	0.45	2.59	0.27	0.12	1.64	0.09	0.04	1.16	0.04	0.02						
450				11.50	9.51	4.12	5.05	1.29	0.56	2.91	0.34	0.15	1.85	0.11	0.04	1.3	0.05	0.02						
500				12.78	11.54	5.01	5.61	1.56	0.68	3.24	0.41	0.18	2.05	0.14	0.06	1.44	0.06	0.03						
750				19.17	24.49	10.61	8.42	3.31	1.43	4.86	0.87	0.38	3.08	0.29	0.13	2.17	0.12	0.05						
1000							11.23	5.64	2.44	6.48	1.48	0.64	4.1	0.49	0.21	2.89	0.21	0.09						
1250							14.04	8.53	3.7	8.09	2.24	0.97	5.13	0.74	0.32	3.61	0.31	0.13						
1500							16.84	11.96	5.18	9.71	3.13	1.36	6.16	1.03	0.45	4.33	0.44	0.19						
2000										12.95	5.34	2.31	8.21	1.76	0.76	5.78	0.75	0.33						
2500										16.19	8.07	3.5	10.26	2.66	1.15	7.22	1.13	0.49						
3000													12.31	3.73	1.62	8.67	1.58	0.68						
3500													14.36	4.96	2.15	10.11	2.11	0.92						
4000													16.42	6.36	2.87	11.56	2.71	1.17						

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Flow Capacity and Friction Loss for Schedule 80 Thermoplastic Pipe Per 100 Ft.

Gals. Per Minute	Velocity (Feet per Second)	Friction Head (Feet)	Friction Loss (PSI)	Velocity (Feet per Second)	Friction Head (Feet)	Friction Loss (PSI)	Velocity (Feet per Second)	Friction Head (Feet)	Friction Loss (PSI)	Velocity (Feet per Second)	Friction Head (Feet)	Friction Loss (PSI)	Velocity (Feet per Second)	Friction Head (Feet)	Friction Loss (PSI)	Velocity (Feet per Second)	Friction Head (Feet)	Friction Loss (PSI)	Velocity (Feet per Second)	Friction Head (Feet)	Friction Loss (PSI)	Velocity (Feet per Second)	Friction Head (Feet)	Friction Loss (PSI)
		1/4" Pipe																						
1/4	1.28	3.57	1.55		**1/2" Pipe**																			
1/2	2.57	12.88	5.58					**3/4" Pipe**																
3/4	3.85	27.29	11.83	1.11	1.31	.57					**1" Pipe**													
1	5.14	46.49	20.15	1.48	2.24	.97	.78	.48	.21					**1 1/4" Pipe**										
3	15.41	355.60	154.20	4.43	17.13	7.43	2.35	3.65	1.59	1.40	1.04	.45					**1 1/2" Pipe**							
5				7.38	44.12	19.12	3.92	9.45	4.10	2.33	9.45	1.16	1.30	.64	.28					**2" Pipe**				
7				10.33	82.27	35.65	5.48	17.62	7.64	3.26	4.98	2.16	1.82	1.20	.52	1.31	.54	.23					**2 1/2" Pipe**	
10		**3" Pipe**		14.76	159.26	69.02	7.84	34.11	14.78	4.66	9.65	4.18	2.59	2.32	1.01	1.87	1.05	.46	1.12	.30	.13			
15							11.75	72.27	31.32	6.99	20.44	8.86	3.89	4.91	2.13	2.81	2.23	.97	1.67	.63	.27	1.17	.26	.11
20	1.00	.15	.07				15.67	123.13	53.36	9.32	34.82	15.09	5.19	8.36	3.62	3.75	3.80	1.65	2.23	1.07	.46	1.56	.45	.20
25	1.24	.23	.10		**4" Pipe**					11.66	52.64	22.81	6.48	12.64	5.48	4.69	5.74	2.49	2.79	1.63	.71	1.92	.68	.29
30	1.49	.32	.14							13.99	78.78	31.97	7.78	17.71	7.67	5.62	8.04	3.48	3.35	2.28	.99	2.34	.95	.41
35	1.74	.43	.19	1.00	.11	.05				16.32	98.16	42.54	9.08	23.56	10.21	6.56	10.70	4.64	3.91	3.03	1.31	2.73	1.26	.55
40	1.99	.54	.23	1.14	.14	.06							10.37	30.17	13.07	7.50	13.71	5.94	4.46	3.88	1.68	3.12	1.62	.70
45	2.24	.68	.29	1.28	.17	.07							11.67	37.53	16.26	8.44	17.05	7.39	5.02	4.38	2.09	3.50	2.01	.87
50	2.49	.82	.36	1.42	.21	.09							12.97	45.62	19.77	9.37	20.72	8.98	5.58	5.87	2.54	3.89	2.45	1.06
60	2.99	1.15	.50	1.71	.30	.13							15.56	69.94	27.71	11.25	29.04	12.58	6.07	8.22	3.56	4.67	3.43	1.49
70	3.49	1.54	.67	1.99	.39	.17		**6" Pipe**								13.12	38.64	16.74	7.81	10.94	4.74	5.45	4.56	1.98
75	3.73	1.74	.75	2.14	.45	.20										14.06	43.90	19.02	8.37	12.43	5.39	5.84	5.18	2.24
80	3.98	1.97	.85	2.28	.51	.22	1.00	.07	.03							15.00	49.48	21.44	8.93	14.01	6.07	6.23	5.84	2.53
90	4.48	2.45	1.06	2.56	.63	.27	1.13	.63	.27							16.87	61.54	26.67	10.05	17.42	7.55	7.01	7.26	3.15
100	4.98	2.97	1.29	2.85	.76	.33	1.25	.10	.04		**8" Pipe**								11.16	21.18	9.18	7.79	8.83	3.83
125	6.22	4.49	1.95	3.56	1.16	.50	1.57	.16	.07										13.95	32.02	13.88	9.74	13.34	5.78
150	7.47	6.30	2.73	4.27	1.62	.70	1.88	.22	.10	1.07	.06	.03							16.74	44.88	19.45	11.68	18.70	8.10
175	8.71	8.38	3.63	4.99	2.16	.94	2.19	.29	.13	1.25	.07	.03		**10" Pipe**								13.63	24.88	10.78
200	9.96	10.73	4.65	5.70	2.76	1.20	2.51	.37	.16	1.43	.10	.04										15.58	31.86	13.81
250	12.45	16.22	7.03	7.12	4.17	1.81	3.13	.57	.25	1.78	.14	.06	1.13	.05	.02		**12" Pipe**							
300	14.94	22.74	9.85	8.55	5.85	2.54	3.76	.79	.34	2.14	.20	.09	1.36	.07	.03									
350	17.43	30.25	13.11	9.97	7.78	3.37	4.39	1.05	.46	2.50	.27	.12	1.59	.09	.04	1.12	.04	.02						
400				11.40	9.96	4.32	5.01	1.35	.59	2.85	.34	.15	1.81	.11	.05	1.28	.05	.02						
450				12.85	12.39	5.37	5.64	1.68	.73	3.21	.43	.19	2.04	.14	.06	1.44	.06	.03						
500				14.25	15.06	6.53	6.27	2.04	.88	3.57	.52	.23	2.27	.17	.07	1.60	.07	.03						
750				21.37	31.92	13.83	9.40	4.33	1.88	5.35	1.10	.48	3.40	.36	.16	2.40	.16	.07						
1000							12.53	7.37	3.19	7.14	1.87	.81	4.53	.62	.27	3.20	.27	.12						
1250							15.67	11.14	4.83	8.92	2.83	1.23	5.67	.94	.41	4.00	.40	.17						
1500										10.71	3.97	1.72	6.80	1.32	.57	4.81	.57	.25						
2000										14.27	6.76	2.93	9.07	2.24	.97	6.41	.96	.42						
2500										17.84	10.23	4.43	11.33	3.39	1.47	8.01	1.46	.63						
3000													13.60	4.74	2.06	9.45	1.96	.85						
3500													15.86	6.23	2.74	11.03	2.61	1.13						
4000																12.60	3.34	1.45						

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Hydraulic Shock

Hydraulic shock is the term used to describe the momentary pressure rise in a piping system which results when the liquid is started or stopped quickly. This pressure rise is caused by the momentum of the fluid; therefore, the pressure rise increases with the velocity of the liquid, the length of the system from the fluid source, or with an increase in the speed with which
it is started or stopped. Examples of situations where hydraulic shock can occur are valves which are opened or closed quickly or pumps which start with an empty discharge line. Hydraulic shock can even occur if a high-speed wall of liquid (as from a starting pump) hits a sudden change of direction in the piping, such as an elbow.

The pressure rise created by the hydraulic shock effect is added to whatever fluid pressure exists in the piping system and, although only momentary, this shock load can be enough to burst pipe and break fittings or valves.

Proper design when laying out a piping system will limit the possibility of hydraulic shock damage.

The following suggestions will help in avoiding problems:

1. In a plastic piping system, a fluid velocity not exceeding 5 ft./sec. will minimize hydraulic shock effects, even with quickly closing valves, such as solenoid valves. (Flow is normally expressed in GALLONS PER MINUTE—GPM. To determine the fluid velocity in any segment of piping the following formula may be used):

$$v = \frac{.4085\ GPM}{D_i^2}$$

Where: v = fluid velocity in feet per second
D_i = inside diameter
GPM = rate of flow in gallons per minute

See the Flow Capacity Tables on pages 15 and 16 for the fluid velocities resulting from specific flow rates in Schedule 40 and Schedule 80 pipes. The upper threshold rate of flow for any pipe may be determined by substituting 5 ft./sec. Fluid velocity in the above formula and solving for GPM.

Upper Threshold Rate of Flow (GPM) = $12.24\ D_i^2$

See the Pipe Reference Table on page 10 for the Upper Threshold Flow Rate in specific sizes of Schedule 80 Pipes.

2. Using actuated valves, which have a specific closing time, will eliminate the possibility of someone inadvertently slamming a valve open or closed too quickly. With air-to-air and air-to-spring actuators, it will probably be necessary to place a flow control valve in the air line to slow down the valve operation cycle, particularly on valve sizes greater than 1 1/2".

3. If possible, when starting a pump, partially close the valve in the discharge line to minimize the volume of liquid that is rapidly accelerating through the system. Once the pump is up to speed and the line completely full, the valve may be opened.

4. A check valve installed near a pump in the discharge line will keep the line full and help prevent excessive hydraulic shock during pump start-up. Before initial start-up the discharge line should be vented of all air. Air trapped in the piping will substantially reduce the capability of plastic pipe withstanding shock loading.

Shock Surge Wave

Providing all air is removed from an affected system, a formula based on theory may closely predict hydraulic shock effect.

$$p = v \left(\frac{SG - 1}{2} \quad C + C \right)$$

Where: p = maximum surge pressure, psi
v = fluid velocity in feet per second (see Table on pages 15 and 16 for flow/velocity conversion).
C = surge wave constant for water at 73° F.
*SG = specific gravity of liquid

* if SG is 1, then p = vC

EXAMPLE:
A 2" PVC Schedule 80 pipe carries a fluid with a specific gravity of 1.2 at a rate of 30 gpm and at a line pressure of 160 psi. What would the surge pressure be if a valve were suddenly closed?

From table below: c = 24.2

From upper table on page 16: v = 3.35

$$p = 3.35 \left(\frac{(1.2 - 1)}{2} \quad 24.2 + 24.2 \right)$$

$$p = (3.35)\,(26.6) = 90 \text{ psi}$$

Total line pressure = 90 + 160 = 250 psi

Schedule 80 2" PVC from the chart on page 13 has a pressure rating of 400 psi at room temperature. Therefore, 2" Schedule 80 PVC pipe is acceptable for this application.

Surge Wave Constant (C)

	PVC		CPVC		Polypropylene	PVDF
Pipe	Sch. 40	Sch. 80	Sch. 40	Sch. 80	Sch. 80	Sch. 80
1/4	31.3	34.7	33.2	37.3	—	—
3/8	29.3	32.7	31.0	34.7	—	—
1/2	28.7	31.7	30.3	33.7	25.9	28.3
3/4	26.3	29.8	27.8	31.6	23.1	25.2
1	25.7	29.2	27.0	30.7	21.7	24.0
1 1/4	23.2	27.0	24.5	28.6	19.8	—
1 1/2	22.0	25.8	23.2	27.3	18.8	20.6
2	20.2	24.2	21.3	25.3	17.3	19.0
2 1/2	21.1	24.7	22.2	26.0	—	—
3	19.5	23.2	20.6	24.5	16.6	18.3
4	17.8	21.8	18.8	22.9	15.4	17.0
6	15.7	20.2	16.8	21.3	14.2	15.8
8	14.8	18.8	15.8	19.8		
10	14.0	18.3	15.1	19.3		
12	13.7	18.0	14.7	19.2		
14	13.4	17.9	14.4	19.2		

CAUTION: The removal of all air from the system in order for the surge wave analysis method to be valid was pointed out at the beginning of this segment. However, this can be easier said than done. Over reliance on this method of analysis is not encouraged. Our experience suggests that the best approach to assure a successful installation is for the design to focus on strategic placements of air vents and the maintenance of fluid velocity near or below the threshold limit of 5 ft./sec.

Expansion and Thermal Contraction of Plastic Pipe

Calculating Dimensional Change

All materials undergo dimensional change as a result of temperature variation above or below the installation temperature. The extent of expansion or contraction is dependent upon the coefficient of linear expansion for the piping material. These coefficients are listed below for
the essential industrial plastic piping materials in the more conventional form of inches of dimensional change, per ° F of temperature change, per inch of length. They are also presented in a more convenient form to use. Namely, the units are inches of dimensional change, per 10° F temperature change, per 100 feet of pipe.

Expansion Coefficient

Material	C – in/in/° F x 10^{-5}	Y – in/10° F/100 ft.
PVC	3.0	.360
CPVC	3.8	.456
PP	5.0	.600
PVDF	7.9	.948

The formula for calculating thermally induced dimensional change, utilizing the convenient coefficient (Y), is dependent upon the temperature change to which the system may be exposed – between the installation temperature and the greater differential to maximum or minimum temperature – as well as, the length of pipe run between directional changes or anchors points. Also, a handy chart is presented at the bottom of this column, which approximates the dimensional change based on temperature change vs. pipe length.

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

$\triangle L$ = Dimensional change due to thermal expansion or contraction (in.)
Y = Expansion coefficient (See table above) (in/10°/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 1:

How much expansion can be expected in a 200 foot straight run of 3 inch PVC pipe that will be installed at 75° F when the piping system will be operated at a maximum of 120° F and a minimum of 40° F?

$$\triangle L = \frac{(120 - 75)}{10} \times \frac{200}{100} = .360 \times 4.50 \times 2.0 = 3.24 \text{ inches}$$

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Expansion or Contraction of PVC Pipe (in.)

Temp Change* △T°F	Length of Pipe to Closet Anchor Point (ft.)									
	10'	20'	30'	40'	50'	60'	70'	80'	90'	100'
10°	0.04	0.07	0.11	0.14	0.18	0.22	0.25	0.29	0.32	0.36
20°	0.07	0.14	0.22	0.29	0.36	0.43	0.50	0.58	0.65	0.72
30°	0.11	0.22	0.32	0.43	0.54	0.65	0.76	0.86	0.97	1.08
40°	0.14	0.29	0.43	0.58	0.72	0.86	1.00	1.15	1.30	1.44
50°	0.18	0.36	0.54	0.72	0.90	1.08	1.26	1.44	1.62	1.80
60°	0.22	0.43	0.65	0.86	1.08	1.30	1.51	1.73	1.94	2.16
70°	0.25	0.50	0.76	1.01	1.26	1.51	1.76	2.02	2.27	2.52
80°	0.29	0.58	0.86	1.15	1.44	1.73	2.02	2.30	2.59	2.88
90°	0.32	0.65	0.97	1.30	1.62	1.94	2.27	2.59	2.92	3.24
100°	0.36	0.72	1.08	1.44	1.80	2.16	2.52	2.88	3.24	3.60
110°	0.40	0.79	1.19	1.58	1.98	2.38	2.77	3.17	3.56	3.96
120°	0.43	0.86	1.30	1.73	2.16	2.59	3.02	3.46	3.89	4.32

* Temperature change (△T) from installation to the greater of maximum or minimum limits.

To determine the expansion or contraction for pipe of a material other than PVC, multiply the change in length given for PVC in the table above by 1.2667 for the change in CPVC, by 1.6667 for the change in PP, or by 2.6333 for the change in PVDF.

Calculating Stress

If movement resulting from thermal changes is restricted by the piping support system or the equipment to which it is attached, the resultant forces may damage the attached equipment or the pipe itself. Therefore, pipes should always be anchored independently at those attachments. If the piping system is rigidly held or restricted at both ends when no compensation has been made for thermally induced growth or shrinkage of the pipe, the resultant stress can be calculated with the following formula.

$S_t = EC\,(T_1\text{-}T_2)$

S_t = Stress (psi)
E = Modulus of Elasticity (psi) (See table below for specific values at various temperatures)
C = Coefficient of Expansion (in/in/ ° F x 10^5) (see physical property chart on page 8 for values)
$(T_1\text{-}T_2)$ = Temperature change (° F) between the installation temperature and the maximum or minimum system temperature, whichever provides the greatest differential.

Temperature vs. Modulus (x 10^5) psi

	73° F	90° F	100° F	140° F	180° F	210° F	250° F
PVC	4.20	3.75	3.60	2.70	N/A	N/A	N/A
CPVC	4.23	4.00	3.85	3.25	2.69	2.20	N/A
PP	1.79	1.25	1.15	.72	.50	N/A	N/A
PVDF	2.19	1.88	1.74	1.32	1.12	.81	.59

N/A - Not Applicable

The magnitude of the resulting longitudinal force can be determined by multiplying the thermally induced stress by the cross sectional area of the plastic pipe.

$F = S_t \times A$

F = FORCE (lbs)
S_t = STRESS (psi)
A = CROSS SECTIONAL AREA (in^2)

EXAMPLE 2:

What would be the amount of force developed in 2" Schedule 80 PVC pipe with the pipe rigidly held and restricted at both ends? Assume the temperature extremes are from 70° F to 100° F.

$S_t = EC\,(T_1 - T_2)$
$S_t = EC\,(100 - 70)$
$S_t = (3.60 \times 10^5) \times (3.0 \times 10^{-5})\,(30)$
$S_t = 324$ psi

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The Outside and Inside Diameters of the pipe are used for calculating the Cross Sectional Area (A) as follows: (See the Pipe Reference Table on page 10 for the pipe diameters and cross sectional area for specific sizes of schedule 80 Pipes.)

$$A = \pi/4\ (OD^2 - ID^2) = 3.1416/4\ (2.375^2 - 1.913^2) = 1.556\ \text{in.}^2$$

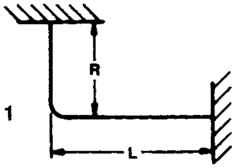
The force exerted by the 2" pipe, which has been restrained, is simply the compressive stress multiplied over the cross sectional area of that pipe.

$$F = S_t \times A$$
$$F = 324\ \text{psi} \times 1.556\ \text{in.}^2$$
$$F = 504\ \text{lbs.}$$

Managing Expansion/Contraction in System Design

Stresses and forces which result from thermal expansion and contraction can be reduced or eliminated by providing for flexibility in the piping system through frequent changes in direction or introduction of loops as graphically depicted on this page.

Fig. 1



Normally, piping systems are designed with sufficient directional changes, which provide inherent flexibility, to compensate for expansion and contraction. To determine if adequate flexibility exists in leg (R) (see Fig. 1) to accommodate the expected expansion and contraction in the adjacent leg (L) use the following formula:

$R = 2.877\sqrt{D \triangle L}$ SINGLE OFFSET FORMULA

Where: R = Length of opposite leg to be flexed (ft.)
D = Actual outside diameter of pipe (in.)
$\triangle$ L = Dimensional change in adjacent leg due to thermal expansion or contraction (in.)

Keep in mind the fact that both pipe legs will expand and contract. Therefore, the shortest leg must be selected for the adequacy test when analyzing inherent flexibility in naturally occurring offsets.

EXAMPLE 3:
What would the minimum length of a right angle leg need to be in order to compensate for the expansion if it were located at the unanchored end of the 200 ft. run of pipe in Example 1 from the previous page?

$R = 2.877\sqrt{3.500 \times 3.24} = 9.69$ ft.

Flexibility must be designed into a piping system, through the introduction of flexural offsets, in the following situations:
1. Where straight runs of pipe are long.
2. Where the ends of a straight run are restricted from movement.
3. Where the system is restrained at branches and/or turns.

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Several examples of methods for providing flexibility in these situations are graphically presented below. In each case, rigid supports or restraints should not be placed on a flexible leg of an expansion loop, offset or bend.

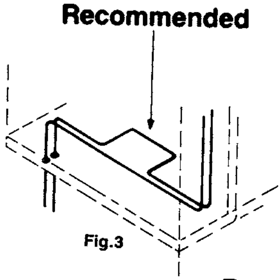

Fig.3

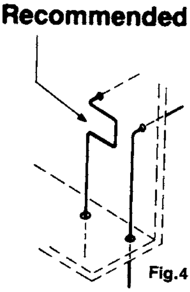

Fig.4

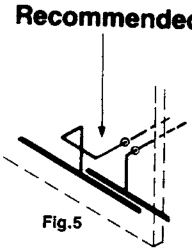

Fig.5

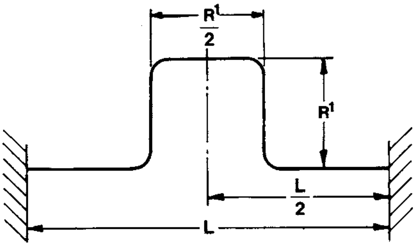

Fig. 2

An expansion loop (which is fabricated with 90° elbows and straight pipe as depicted in Fig. 2) is simply a double offset designed into an otherwise straight run of pipe. The length for each of the two loop legs (R'), required to accommodate the expected expansion and contraction in the pipe run (L), may be determined by modification of the SINGLE OFFSET FORMULA to produce a LOOP FORMULA, as shown below:

$R' = 2.041\sqrt{D \triangle L}$ LOOP FORMULA

EXAMPLE 4:
How long should the expansion loop legs be in order to compensate for the expansion in Example 1 from the previous page?

$R' = 2.041\sqrt{3.500 \times 3.24} = 6.87$ ft.

Minimum Cold Bending Radius
The formulae above for Single Offset and Loop bends of pipe, which are designed to accommodate expansion or contraction in the pipe, are derived from the fundamental equation for a cantilevered beam – in this case a pipe fixed at one end. A formula can be derived from the same equation for calculating the minimum cold bending radius for any thermoplastic pipe diameter.

Minimum Cold Bend Radius

$R_B = D_O\ (0.6999\ E/S_B - 0.5)$

Where: R_B = Minimum Cold Bend Radius (in.)
D_O = Outside Pipe Diameter (in.)
E * = Modulus of Elasticity @ Maximum Operating Temperature (psi)
S_B * = Maximum Allowable Bending Stress @ Maximum Operating Temperature (psi)

*The three formulae on this page provide for the maximum bend in pipe while the pipe operates at maximum long-term internal pressure, creating maximum allowable hydrostatic design stress (tensile stress in the hoop direction). Accordingly, the maximum allowable bending stress will be one-half the basic hydraulic design stress at 73° F with correction to the maximum operating temperature. See the table at the top of the second column on page 13. The modulus of elasticity, corrected for temperature may be found in the table in the second column of the preceding page.

EXAMPLE 5:
What would be the minimum cold radius bend, which the installer could place at the anchored end of the 200 ft. straight run of pipe in Examples 1 and 3, when the maximum operating temperature is 100° F instead of 140°?

R_B = 3.500 (0.6999 x 360,000/ 1/2 x 2000 x 0.62 – 0.5) =1,420.8 inches or 118.4 feet

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Pipe Support Spacing

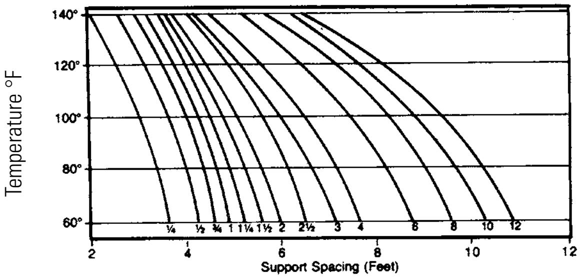
Correct supporting of a piping system is essential to prevent excessive bending stress and to limit pipe “sag” to an acceptable amount. Horizontal pipe should be supported on uniform centers, which are determined for pipe size, schedule, temperature, loading and material.

Point support must not be used for thermoplastic piping and, in general, the wider the bearing surface of the support the better. Supports should not be clamped in such a way that will restrain the axial movement of pipe that will normally occur due to thermal expansion and contraction. Concentrated loads in a piping system, such as valves must be separately supported.

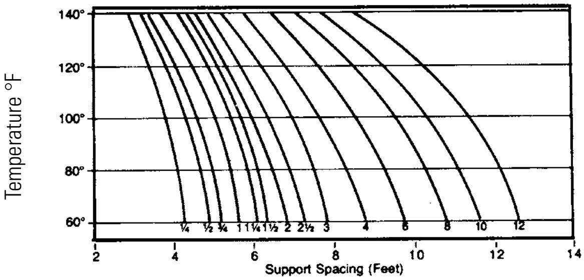
The graphs on this page give recommended support spacing for Chemtrol® thermoplastic piping materials at various temperatures. The data is based on fluids with a specific gravity of 1.0 and permits a sag of less than 0.1" between supports. For heavier fluids, the support spacing from the graphs should be multiplied by the correct factor in the table below.

Specific Gravity	1.0	1.1	1.2	1.4	1.6	2.0	2.5
Correction Factor	1.0	.98	.96	.93	.90	.85	.80

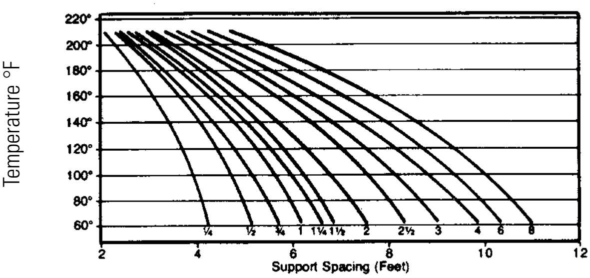
PVC Schedule 40



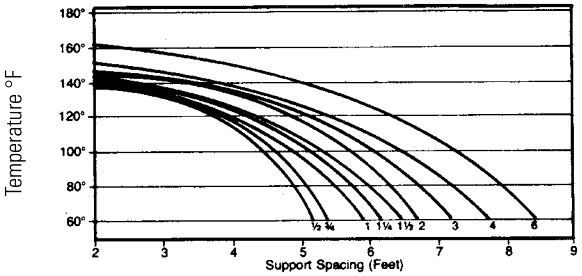
PVC Schedule 80



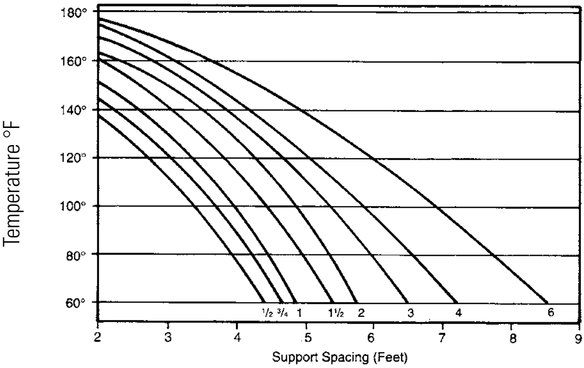
CPVC Schedule 80



Polypropylene Schedule 80



PVDF (KYNAR®) Schedule 80



The above data is for uninsulated lines. For insulated lines, reduce spans to 70% of graph values. For spans of less than 2 feet, continuous support should be used.

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Introduction

This chemical resistance guide has been compiled to assist the piping system designer in selecting chemical-resistant materials. The information given is intended as a guide only. Many conditions can affect the material choices. Careful consideration must be given to temperature, pressure and chemical concentrations before a final material can be selected by the system designer.

MATERIAL RATINGS FOR THERMOPLASTICS & ELASTOMERS

Temp. in °F =	Maximum temperature recommended under normal conditions
B to Temp. in °F =	Conditional resistance, consult NIBCO Technical Services: 888.446.4226
C =	Not recommended
Blank =	No data available, consult NIBCO Technical Services: 888.446.4226

Temperature maximums for thermoplastics, elastomers and metals should always fall within published temp/pressure ratings and manufacturer's recommendations for individual valves.

WARNING: THERMOPLASTICS ARE NOT RECOMMENDED FOR COMPRESSED AIR OR GAS SERVICE.*

This guide considers the resistance of the total valve assembly as well as the resistance of individual trim and fitting materials. The rating assigned to the valve body plus trim combinations is always that of the least resistant part. In the cases where the valve body is the least resistant, there may be conditions under which the rate of corrosion is slow enough and the mass of the body large enough to be usable for a period of time. Such use should always be determined by test before installation of the component in a piping system.

In the selection of a butterfly valve for use with a particular chemical, the liner, disc, and stem must be resistant. All three materials should carry a rating of “A.” The body of a properly functioning butterfly valve is isolated from the chemicals being handled and need not carry the same rating.

Chemical Resistance Guide for Valves & Fittings

CHEMICALS AND FORMULA	CONCENTRATION	PLASTICS MAX TEMPERATURE (°F)							SEAL MATERIALS MAX TEMPERATURE (°F)					
		ABS	CPVC	PP	PVC	PVDF	PEX	PPSU	PTFE	EPDM	NITRILE (Buna-N)	POLYCHLORO-PRENE	FKM	GRAPHITE
Acetaldehyde CH_3CHO	Conc.		C	140	C		C		350	B to 200	C	C	C	A
Acetamide CH_3CONH_2									200	B to 200	B to 180	B to 200	C	
Acetic Acid CH_3COOH	25%	C	180	180	140		140	B to 73	350	176	C	70	C	A
Acetic Acid CH_3COOH	50%					B to 140	B to 176		350	140	C	C	C	A
Acetic Acid CH_3COOH	85%	C	C	120	73		73		350	70	C	C	C	A
Acetic Acid CH_3COOH	Glacial	C	C	120	73	B to 104	B to 68		350					A
Acetic Anhydride $(CH_3CO)_2O$		C	C	73	C	C	73		350	C	C	B to 70	C	A
Acetone CH_3COCH_3		C	C	B	C	B	C	C	350	B to 300	C	C	C	A
Acetophenone $C_6H_5COCH_3$									350	B to 176	C	C	C	
Acetyl Chloride CH_3COCl		C	C		C	C			200	C	C	C	B	
Acetylene	Gas, 100%	73	C	73	C		73		250	B to 250	200	104	200	
Acrylonitrile $H_2C{=}CHCN$			C		C		140		350	104	C	C	C	A
Adipic Acid $COOH(CH_2)_4COOH$	Sat'd.		180	140	140	B to 176	140		350	140	B to 220	B to 160	176	
Allyl Alcohol $CH_2{=}CHCH_2OH$	96%		C	140	B to 73		C		250	B to 300	B to 180	B to 120	B to 70	
Allyl Chloride $CH_2{=}CHCH_2Cl$			C		C	140	C		350	C	B to 70	C	C	
Aluminum Acetate $Al(C_2H_4O_2)_3$	Sat'd.								350	176	C	C	C	

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CHEMICALS AND FORMULA	CONCENTRATION	PLASTICS MAX TEMPERATURE (°F)							SEAL MATERIALS MAX TEMPERATURE (°F)					
		ABS	CPVC	PP	PVC	PVDF	PEX	PPSU	PTFE	EPDM	NITRILE (Buna-N)	POLYCHLORO-PRENE	FKM	GRAPHITE
Aluminum Ammonium Sulfate (Alum) $AlNH_4(SO_4)_2 12H_2O$	Sat'd.		180	140	140		140		250	B to 200	B to 140	C	190	A
Aluminum Chloride (Aqueous) $AlCl_3$	Sat'd.	160	180	180	140	B to 212	140		250	176	B to 200	B to 200	176	A
Aluminum Fluoride AlF_3	Sat'd.	160	180	180	73	B to 212	140		250	B to 300	B to 200	B to 200	176	A
Aluminum Hydroxide $Al(OH)_3$	Sat'd.	160	180	180	140	B to 212	140		250	176	160	B to 180	176	
Aluminum Nitrate $Al(NO_3)_3 \bullet 9H_2O$	Sat'd.		180	180	140	B to 212	140		250	176	140	B to 200	B to 400	A
Aluminum Potassium Sulfate (Alum) $AlK(SO_4)_2 \bullet 12H_2O$	Sat'd.	160	180	140	140	B to 212	140		400	B to 200	B to 200	B to 200	248	A
Aluminum Sulfate (Alum) $Al_2(SO_4)_3$	Sat'd.	160	180	140	140	B to 212	140		250	B to 300	B to 300	B to 200	B to 390	A
Ammonia Gas NH_3	100%	C	C	140	140		140		400	140	B to 140	140	C	A
Ammonia Liquid NH_3	100%	160	C	140	C		140		400	212	70	B to 160	C	A
Ammonium Acetate CH_3COONH_4	Sat'd.	120	180	73	140	B to 212	140		400	140	140	140		
Ammonium Bifluoride NH_4HF_2	Sat'd.		180	180	140		140		400	140	B to 140	C	140	A
Ammonium Carbonate $(NH_4)_2CO_3$	Sat'd.		180	212	140	B to 248	140		400	176	B to 200	B to 200	212	
Ammonium Chloride NH_4Cl	Sat'd.	120	180	212	140	B to 212	140		400	300	B to 200	B to 212	250	A
Ammonium Fluoride NH_4F	10%	120	180	212	140	B to 212	140		400	300	B to 200	B to 100	140	A
Ammonium Fluoride NH_4F	25%	120	180	212	C		140		400	300	B to 120	B to 100	140	A

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		ABS	CPVC	PP	PVC	PVDF	PEX	PPSU	PTFE	EPDM	NITRILE (Buna-N)	POLYCHLORO-PRENE	FKM	GRAPHITE
Ammonium Hydroxide NH_4OH	10%	120	C	212	140		140		400	B to 300	200	200	B to 190	A
Ammonia Hydroxide NH_4OH	Sat'd.								400	B to 300	C	200	B to 190	A
Ammonium Nitrate NH_4NO_3	Sat'd.	120	180	212	140	B to 212	140		400	B to 300	200	200	176	A
Ammonium Persulphate $(NH_4)_2S_2O_8$			180	140	140	B to 212	140		200	B to 70	C	70	B to 140	
Ammonium Phosphate (Monobasic) $NH_4H_2PO_4$	All	120	180	212	140	B to 248	140		400	B to 200	200	B to 200	B to 180	A
Ammonium Sulfate $(NH_4)_2SO_4$		120	180	212	140	B to 212	140		400	300	200	200	176	A
Ammonium Sulfide $(NH_4)_2S$	Dilute	120	180	212	140		140		350	B to 300	B to 180	B to 160	B to 70	
Ammonium Thiocyanate NH_4SCN	50 - 60%	120	180	212	140	B to 212	73			B to 300	B to 180	B to 200	B to 190	
Amyl Acetate $CH_3COOC_5H_{11}$		C	C	C	C	B to 122	73		100	210	C	C	C	
Amyl Alcohol $C_5H_{11}OH$			C		C	B to 212	B to 140		400	B to 300	B to 180	B to 200	B to 212	A
n-Amyl Chloride $CH_3(CH_2)_3CH_2Cl$		C	C	C	C		C		400	C	C	C	200	
Aniline $C_6H_5NH_2$		C	C		C	B to 68	C		200	B to 140	C	C	B to 70	A
Aniline Hydrocloride $C_6H_5NH_2 \bullet HCl$	Sat'd.		C		C		140							C
Anthraquinone $C_{14}H_8O_2$			180		140		C						C	
Anthraquinone Sulfonic Acid $C_{14}H_7O_2 \bullet SO_3 \bullet H_2O$			180	73	140		C							
Antimony Trichloride $SbCl_3$	Sat'd.		180	140	140	B to 140	140			C	70	B to 70	70	A

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		ABS	CPVC	PP	PVC	PVDF	PEX	PPSU	PTFE	EPDM	NITRILE (Buna-N)	POLYCHLORO-PRENE	FKM	GRAPHITE
Aqua Regia (Nitrohydrochloric Acid)		C	B to 73	C	C	C	C		200	C	C	C	B to 190	C
Argon Ar	Dry								350	B to 400	250	B to 100	B to 500	
Arsenic Acid H_3AsO_4	80%		180	140	140	B to 248	140		400	B to 176	B to 200	B to 180	140	A
Asphalt			C	73	C		73		350	C	C	C	212	
Barium Carbonate $BaCO_3$	Sat'd.	120	180	140	140	B to 248	140		400	B to 300	140	B to 160	248	
Barium Chloride $BaCl_2 \bullet 2H_2O$	Sat'd.	120	180	140	140	B to 212	140		400	B to 300	B to 200	B to 160	B to 400	A
Barium Hydroxide $Ba(OH)_2$	Sat'd.	73	180	140	140				400	B to 300	B to 220	B to 200	248	
Barium Nitrate $Ba(NO_3)_2$	Sat'd.	73	180	140	73		140		250	176	140	B to 200	248	A
Barium Sulfate $BaSO_4$	Sat'd.	73	180	140	140	B to 212	140		400	B to 300	B to 200	B to 200	B to 380	A
Barium Sulfide BaS	Sat'd.	73	180	140	140				400	B to 310	B to 200	B to 200	B to 400	
Beer		120	180	180	140	B to 248	B to 140		300	120	B to 250	B to 140	B to 300	
Beet Sugar Liquors			180	180	140		73			B to 300	200	B to 180	B to 400	
Benzaldehyde C_6H_5CHO	10%	C	B to 73	73	B to 73		73			200	C	C	C	A
Benzene C_6H_6		C	C	C	C	C	B to 68	C	250	C	C	C	B to 140	A
Benzene Sulfonic Acid $C_6H_5SO_3H$	10%		180	180	140		B to 73			C	C	B to 100	200	
Benzoic Acid C_6H_5COOH		160	180	73	140				350	C	C	B to 150	176	
Benzyl Alcohol $C_6H_5CH_2OH$			C	120	C	B to 122	140		400	C	C	B to 70	B to 250	

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		ABS	CPVC	PP	PVC	PVDF	PEX	PPSU	PTFE	EPDM	NITRILE (Buna-N)	POLYCHLORO-PRENE	FKM	GRAPHITE
Bismuth Carbonate $(BiO)_2CO_3$			180	180	140		140			70	70	70	B to 200	
Black Liquor	Sat'd.		180	140	140		120		225	220	140	70	212	
Bleach (Sodium Hypochlorite)	12% Cl	73	185	120	140		73							
Blood									200	70	C	70	70	
Borax $Na_3B_4O_7 \bullet {}_{10}H_2O$	Sat'd.	160	180	212	140		140			300	B to 200	B to 200	200	
Boric Acid H_3BO_3	Sat'd.	160	180	212	140	B to 212	140			B to 300	B to 200	B to 200	185	A
Brine	Sat'd.		180	140	140		140		400	B	B	B	B	
Bromic Acid $HBrO_3$			180	C	140	B to 212	C			200	C	C	200	
Bromine Br_2	Liquid	73	C	C	C	B to 248	C		300	C	C	C	B to 350	C
Bromine Br_2	Gas, 25%		180	C	140		C		200	C	C	C	B to 180	C
Bromine Water	Sat'd.		180	C	140	B to 176	C		300	C	C	C	B to 210	C
Butadiene $H_2C{=}CHHC{=}CH_2$	50%		180	C	140		73		C	C	C	C	70	
Butane C_4H_{10}	50%		180	140	140		140	73	350	C	B to 250	B to 200	B to 400	
Butyl Acetate CH_3COOCH_2CH-${}_2CH_2CH_3$		C	C	C	C	C	C		175	C	C	C	C	
Butyl Alcohol $CH_3(CH_2)_2CH_2OH$			C	180	140		140		300	B to 250	B to 190	140	B to 390	A
Butyl Cellosolve			C		73				200	B to 300	C	C	C	A
n-Butyl Chloride C_4H_9Cl		C	C						400	C	C	C	70	
Butylene © $CH_3CH{=}CHCH_3$	Liquid			C	140		120		400	C	250	C	B to 400	

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		ABS	CPVC	PP	PVC	PVDF	PEX	PPSU	PTFE	EPDM	NITRILE (Buna-N)	POLYCHLORO-PRENE	FKM	GRAPHITE
Butyl Phthalate $C_{16}H_{22}O_4$			C	180		B to 140				250	C	C	C	
Butyl Stearate					73				250	C	C	C	B to 400	
Butyric Acid CH_3CH_2CH-$_2COOH$		C	C	180	73		73		300	C	C	C	C	
Calcium Bisulfide $Ca(HS)_2 \bullet {}_6H_2O$			73		C		140		200	200	B to 140	140	140	
Calcium Bisulfite $Ca(HSO_3)_2$			180	180	140		C		350	C	B to 200	B to 200	B to 400	
Calcium Carbonate $CaCO_3$			180	180	140	B to 248	140		350	B to 210	B	140	248	
Calcium Chlorate $Ca(ClO_3)_2 \bullet {}_2H_2O$			180	180	140	B to 248	140		350	B to 200	B to 200	B to 200	B to 190	140
Calcium Chloride $CaCl_2$		120	180	180	140	B to 248	B to 176		350	B to 212	B to 200	B to 200	300	A
Calcium Hydroxide $Ca(OH)_2$		160	180	180	140		140		250	210	B to 200	B to 220	212	
Calcium Hypochlorite $Ca(OCl)_2$	30%	160	180	140	140		140		200	B to 310	C	C	B to 400	90
Calcium Nitrate $Ca(NO_3)_2$			180	180	140		140		200	B to 300	B to 200	B to 200	B to 390	C
Calcium Oxide CaO			180		140		140			B	B to 200	B to 200	140	
Calcium Sulfate $CaSO_4$		100	180	180	140	B to 212	140		200	B to 300	B to 176	B to 70	B to 212	A
Camphor $C_{10}H_{16}O$		C		73	73		73		350	C	100	C	70	
Cane Sugar $C_{12}H_{22}O_{11}$			180	180	140		140		400					
Caprylic Acid $CH_3(CH_2)COOH$									350		C		B to 140	
Carbitol			C		73				200	B to 80	B to 80	C	C	

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		ABS	CPVC	PP	PVC	PVDF	PEX	PPSU	PTFE	EPDM	NITRILE (Buna-N)	POLYCHLORO-PRENE	FKM	GRAPHITE
Carbon Dioxide CO_2	Dry, 100%	160	180	140	140	B to 212	140		400	B to 250	200	B to 200	212	A
Carbon Dioxide CO_2	Wet	160	180	140	140		140		400	B to 250	140	C	212	A
Carbon Disulfide CS_2		C	C	C	C		B to 68		200	C	C	C	B to 400	A
Carbon Monoxide CO	Gas		180	180	140	B to 140	140		400	B to 300	160	140	B to 400	A
Carbon Tetrachlo-ride CCl_4		C	C	C	73	C	C	B to 73	350	C	C	C	B to 350	A
Carbonic Acid H_2CO_3	Sat'd.	185	180	140	140		140		350	B to 300	70	200	B to 400	A
Castor Oil			C	140	140		73		350		212	200	B to 400	550
Caustic Potash (Potassium Hydroxide) KOH	50%	160	180	180	140		140			200	B to 150	B to 70	B to 140	
Caustic Soda (Sodium Hydrox-ide) NaOH	40%	160	180	180	140		140			B to 200	212	B to 200	80	
Cellosolve			C	73	73		C		200		C		C	A
Cellosolve Acetate CH_3COOCH-$_2CH_2OC_2H_5$			C	73	73				300	C	C	C	C	
Chloral Hydrate $CCl_3CH(OH)_2$			180	C	140		120			B to 70	C	70	C	
Chloramine NH_2Cl	Dilute		C	73	73		73			70		B to 80	70	
Chloric Acid $HClO_3 \bullet 7H_2O$	10%		180	73	140		73		140	212	C	B to 120	B to 120	
Chloric Acid $HClO_3 \bullet 7H_2O$	20%		185	73	140		73		140	212	C	70	C	
Chlorine Dioxide ClO_2														

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		ABS	CPVC	PP	PVC	PVDF	PEX	PPSU	PTFE	EPDM	NITRILE (Buna-N)	POLYCHLORO-PRENE	FKM	GRAPHITE
Chlorine Gas (Moisture Content < 150 ppm)									400	C	C	C	B	A
Chlorine Gas (Moisture Content > 150 ppm)		C	C	C	C		C		400	C	C	C	C	
Chlorine	Liquid	C	C	C	C	200	C			C	C	C	B	
Chlorinated Water (< 3500 ppm)									400					73
Chlorinated Water (> 3500 ppm)									400					73
Chloroacetic Acid $CH_2ClCOOH$	50%	C	180	C	140		120		200	B to 175	C	C	C	
Chlorobenzene C_6H_5Cl	Dry	C	C	73	C		C	C	200	C	C	C	B to 400	A
Chloroform $CHCl_3$	Dry	C	C	C	C		C	C	200	C	C	C	B to 400	A
Chlorosulfonic Acid $ClSO_2OH$			73	C	73		C		200	C	C	C	C	
Chromic Acid H_2CrO_4	10%	73	180	140	140	B to 212	73		350	70	C	C	B to 400	C
Chromic Acid H_2CrO_4	30%	C	180	73	140	B to 212	73		350	70	C	C	B to 400	C
Chromic Acid H_2CrO_4	50%	C	C	73	C	B to 212	73		200	C	C	C	B to 400	C
Citric Acid $C_6H_8O_7$	Sat'd.	160	180	140	140	B to 248	140		200					A
Coconut Oil			C	73	140	B to 248	73		400	C	250	C	B to 390	
Coffee			180	140	140		140			B to 140	140	140	B to 200	
Coke Oven Gas				73	140		140		400	C	C	C	B to 390	

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		ABS	CPVC	PP	PVC	PVDF	PEX	PPSU	PTFE	EPDM	NITRILE (Buna-N)	POLYCHLORO-PRENE	FKM	GRAPHITE
Copper Acetate $Cu(C_2H_3O_2)_2•H_2O$	Sat'd.		73	73	73				350	B to 300	C	C	C	
Copper Carbonate $CuCO_3$	Sat'd.		180		140		140		350	B to 210	C	70	B to 190	
Copper Chloride $CuCl_2$	Sat'd.	73	180	140	140		140		350	B to 212	176	B to 210	B to 400	A
Copper Cyanide CuCN			180		140	B to 212	140		350	B to 300			B to 390	
Copper Fluoride $CuF_2•2H_2O$	2%		180	73	140		140			B to 250	80	140	B to 190	A
Copper Nitrate $Cu(NO_3)_2•3H_2O$	30%		180	140	140					B to 210	B to 230	B to 200	212	A
Copper Sulfate $CuSO_4•5H_2O$	Sat'd.	120	180	120	140	B to 212	140			B to 300	B to 212	200	B to 212	A
Corn Oil			C	73	140		120		400	C	250	C	B to 400	
Corn Syrup			185	140	140		140			200	200	C	212	
Cottonseed Oil		120	C	140	140		B to 140		400	B to 70	200	C	B to 400	
Creosote			C	73	C		140		350	C	B to 220	C	B to 400	
Cresol $CH_3C_6H_4OH$	90%	C	C	B to 73	C	B to 68	73		200		C	C	B	
Cresylic Acid	50%		180		140		C		200	C	C	C	140	
Crude Oil			C	140	140	B to 212	C		400	C	B to 250	C	B to 300	
Cuprlc Sulfate $CuSO_4•5H_2O$	Sat'd.	100	180	73	140				250					A
Cuprous Chloride CuCl	Sat'd.	70	180		140		140		350					A
Cyclohexane C_6H_{12}		73	C	C	C	B to 248	C		300	C	250	C	B to 400	
Cyclohexanol $C_6H_{11}OH$		C	C	140	C	B to 104	73		250	C	B to 70	B to 70	B to 400	

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		ABS	CPVC	PP	PVC	PVDF	PEX	PPSU	PTFE	EPDM	NITRILE (Buna-N)	POLYCHLORO-PRENE	FKM	GRAPHITE
Cyclohexanone $C_6H_{10}O$	Liquid	C	C	73	C	C	C	C	200	C	C	C	C	
Detergents (Heavy Duty)			C	180	140		B to 140							
Dextrin (Starch Gum)	Sat'd.		180	140	140		140		200	176	B to 180	B to 200	212	
Dextrose $C_6H_{12}O_6$			180	140	140		140		400	200	200	200	B to 400	
Diacetone Alcohol $CH_3COCH_2C(CH_3)_2OH$			C	120	C				350	B to 300	C	C	C	
Dibutoxy-ethyl Phthalate $C_{20}H_{30}O_6$			C		C									
Dibutyl Phthalate $C_6H_4(COOC_4H_9)_2$		C	C	73	C		73		350	B to 250	C	C	C	
Dibutyl Sebacate $C_4H_9OCO(CH_2)_8OCOC_4H_9$				73	73		73		350	C	C	C	C	
Dichlorobenzene $C_6H_4Cl_2$		C	C	C	C		C			C	C	C	B	
Dichloroethylene $C_2H_4Cl_2$			C	C	C		C		350	C	C	C	200	
Diesel Fuels			C	140	140	B to 212	73		350	C	B	C	C	
Diethylamine $C_4H_{10}NH$		C	C		C	C	C		200	70	C	70	C	A
Diethyl Cellosolve $C_6H_{14}O_2$														
Diethyl Ether $C_4H_{10}O$		C	C	73	73		C	B to 73		C	C	C	C	A
Diglycolic Acid $O(CH_2COOH)_2$	Sat'd.		180	140	140		140		250	B to 300	200	B to 200	C	
Dimethylamine $(CH_3)_2NH$				73	140	C	73			B to 140	C	C	C	
Dimethyl Formamide $HCON(CH_3)_2$		C	C	180	C		120	C	250	B to 122	C	C	C	

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		ABS	CPVC	PP	PVC	PVDF	PEX	PPSU	PTFE	EPDM	NITRILE (Buna-N)	POLYCHLORO-PRENE	FKM	GRAPHITE
Dioctyl Phthalate $C_6H_4(COOC_8H_{17})_2$		C	C	C	C		73		200	C	C	C	C	
Dioxane $C_4H_8O_2$			C	C	C		140			B to 160	C	C	C	A
Diphenyl Oxide $(C_6H_5)_2O$	Sat'd.						73			C	C	C	B to 310	
Disodium Phosphate Na_2HPO_4			180	140	140		140		400	B to 210	70	80	90	A
Dow Therm A $C_{12}H_{10} \bullet C_{12}H_{10}O$					C				212	C	C	C	B to 350	A
Ether ROR		C	C	C	C		73			C	C	C	C	
Ethyl Acetate $CH_3COOCH_2CH_3$		C	C	C	C		73	C	200	B to 158	C	C	C	
Ethyl Acrylate $CH_2{=}CHCOOC_2H_5$			C		C				350	C	C	C	C	
Ethyl Alcohol (Ethanol) C_2H_5OH			C	140	140		140	73	300	200	B to 200	158	C	A
Ethyl Benzene $C_6H_5C_2H_5$				C	C				350	C	C	C	70	
Ethyl Chloride C_2H_5Cl	Dry		C	C	C		C		350	140	200	C	B to 400	A
Ethylene Bromide $BrCH_2CH_2Br$	Dry		C		C				350					
Ethylene Chloride (Vinyl Chloride) CH_2CHCl	Dry	C	C	C	C		C		350	C	C	C	200	
Ethylene Chlorohydrin $ClCH_2CH_2OH$			C	73	C				200	C	C	C	70	A
Ethylene Diamine $NH_2CH_2CH_2NH_2$		C		73	C		140			B to 300	80	B to 90	C	
Ethylene Dichloride $C_2H_4Cl_2$	Dry	C	C	C	C		C		350	C	C	C	B to 400	A
Ethylene Glycol $OHCH_2CH_2OH$		73	C	212	140	B to 212		B to 220	400	250	250	250	B to 250	A

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CHEMICALS AND FORMULA	CONCENTRATION	PLASTICS MAX TEMPERATURE (°F)							SEAL MATERIALS MAX TEMPERATURE (°F)					
		ABS	CPVC	PP	PVC	PVDF	PEX	PPSU	PTFE	EPDM	NITRILE (Buna-N)	POLYCHLORO-PRENE	FKM	GRAPHITE
Ethylene Oxide CH_2CH_2O			C	C	C		73		400	C	C	C	C	
Ethyl Formate										C	C	C	B to 400	
Fatty Acids R-COOH		160	73	120	140		120		400	C	B to 250	C	250	A
Ferric Chloride (Aqueous) $FeCl_3$	Sat'd.	120	180	140	140	B to 212	140		400	B to 300	B to 200	160	176	A
Ferric Hydroxide $Fe(OH)_3$	Sat'd.	160	180	140	140		140		400	B to 210	B to 176	B to 200	B to 200	
Ferric Nitrate $Fe(NO_3)_3 \cdot 9H_2O$	Sat'd.	160	180	140	140	B to 212	140		400	B to 300	B to 176	B to 200	B to 400	A
Ferric Sulfate $Fe_2(SO_4)_3$		160	180	140	140	B to 212	140		200	B to 280	B to 200	B to 200	176	A
Ferrous Chloride $FeCl_2$	Sat'd.	160	180	140	140	B to 212	140		400	210	B to 200	200	185	A
Ferrous Hydroxide $Fe(OH)_2$	Sat'd.	160	180	140	140		140		400	B to 200	B to 176	B to 200	212	
Ferrous Nitrate $Fe(NO_3)_2$		160	180	140	140		140		400	B to 210	B to 200	B to 200	212	A
Ferrous Sulfate $FeSO_4$		160	180	140	140	B to 212	140		400	B to 200	B to 200	B to 200	B to 200	A
Fish Oil			180	180	140		140		300	C	250	B to 70	B to 400	
Flue Gas														
Fluoroboric Acid HBF_4		73	73	140	140		140		350	70	C	70	140	
Fluorine Gas F_2	Dry, 100%		73	C	73		C		C		C		C	B to 300
Fluorine Gas F_2	Wet	C	73	C	73		C		C		C		C	C
Fluorosilicic Acid (Hydrofluosilicic Acid) H_2SiF_6	50%		73	73	140	B to 212			300	B to 300	160	158	185	

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		ABS	CPVC	PP	PVC	PVDF	PEX	PPSU	PTFE	EPDM	NITRILE (Buna-N)	POLYCHLORO-PRENE	FKM	GRAPHITE
Formaldehyde HCHO	Dilute	160	73	140	140	B to 176			300	212	140	150	C	A
Formaldehyde HCHO	35%	160	C	140	140	B to 212	140	100	300	212	140	150	C	A
Formaldehyde HCHO	50%		C		140		140		300	B to 140	C	B to 70	C	A
Formic Acid HCOOH		C	C	140	73	B	140		300	210	C	B	B	A
Freon 11 CCl_3F	100%	C	73	C	140		73		300	C	B to 250	C	C	A
Freon 12 CCl_2F_2	100%		73	73	140		73		C	B	B	B	C	A
Freon 21 $CHCl_2F$	100%			C	C		C		300	C	C	C	C	A
Freon 22 $CHClF_2$	100%		73	73	C		C		C	140	C	250	C	A
Freon 113 $C_2Cl_2F_3$	100%			C	140		73		300	C	B	B	C	A
Freon 114 $C_2Cl_2F_4$	100%			C	140		73		300	B	B	B	C	A
Fructose $C_6H_{12}O_6$	Sat'd.	73	180	180	140		140		300					
Furfural C_4H_3OCHO		C	C	C	C		C		300	B to 160	C	C	C	
Gallic Acid $C_6H_2(OH)_3CO_2H \bullet H_2O$			73		140		73		300	C	C	C	B to 400	
Gasoline (Leaded)		C	C	C	B		73		200	C	190	C	250	A
Gasoline (Unleaded)		C	C	C	B		73		200	C		C	190	A
Gasohol		C	C	C	B		73		200					A
Gasoline (Sour)		C	C	C	B		C		200	C	250	C	B to 250	A
Gelatin			180	180	140		140		300	200	200	200	212	
Glauber's Salt									200	B to 200	C	B to 200	B to 400	

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		ABS	CPVC	PP	PVC	PVDF	PEX	PPSU	PTFE	EPDM	NITRILE (Buna-N)	POLYCHLORO-PRENE	FKM	GRAPHITE
Glucose $C_6H_{12}O_6 \bullet H_2O$		120	180	212	140		140		400	B to 212	200	200	B to 400	
Glue				140	140		140		400	B	B	B	B	
Glycerin $C_3H_5(OH)_3$		140	180	212	140		140	B to 320	400	B to 200	250	B to 180	250	A
Glycol Amine														
Glycolic Acid $OHCH_2COOH$	Sat'd.		180	73	140		140		200	140	B	140	C	
Glyoxal OCHCHO							140							
Grease										C	100	C	140	
Green Liquor		160	180		140					B to 300	B to 200	B to 160	B to 400	
Gypsum	Slurry								350					
Heptane C_7H_{16}		73	180	C	140		73		300	C	250	B to 200	200	
n-Hexane C_6H_{14}		C	73	73	73				300	C	250	B to 140	B to 250	
Hexanol $CH_3(CH_2)_4CH_2OH$			180		140		140		300	C	140	C	212	
Hydraulic Oil (Petroleum)					73		73		300	C	250	C	70	A
Hydrazine H_2NNH_2			C	73	C				250		C	C	C	A
Hydrobromic Acid HBr	20%	73	73	140	140	B to 212	140		250	B to 300	C	C	200	A
Hydrobromic Acid HBr	50%	C		120		B to 140	140		250	200	C	C	200	A
Hydrochloric Acid HCl	10%	C	180	140	140	280		73	250	176	B to 150	140	230	A
Hydrochloric Acid HCl	30%	C	180	140	140	280			250	B to 130	B to 70	B to 100	160	
Hydrocyanic Acid HCN	10%	160	180	73	140	B to 248	140		250	B to 300	B to 200	C	B to 400	

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		ABS	CPVC	PP	PVC	PVDF	PEX	PPSU	PTFE	EPDM	NITRILE (Buna-N)	POLYCHLORO-PRENE	FKM	GRAPHITE
Hydrofluoric Acid HF	Dilute	73	73	180	73	B to 212	140		300	212	B to 70	B to 185	212	A
Hydrofluoric Acid HF	30%	C	73	140	73		140		300	B to 140	C		212	A
Hydrofluoric Acid HF	50%	C	C	73	73	B to 212	120		300	B to 140	C	C	70	A
Hydrogen H_2	Gas		73	140	140	B to 248	140		300	200	B to 220	200	210	
Hydrogen Perox-ide H_2O_2	50%		180	73	140	B to 212	140	B to 73	300	B to 100	C	C	70	A
Hydrogen Perox-ide H_2O_2	90%		180	C	140		73		30	B to 70	C	C	C	C
Hydrogen Sulfide H_2S	Dry		180	150	140	B to 248	140			250	140	140	C	A
Hydrogen Sulfide H_2S	Wet		180		140		140			130	C	70	C	A
Hydrogen Sulfite H_2SO_3														
Hypochlorous Acid HOCl	10%	73	180	73	140	B to 212	140		300	104	C	C	120	
Inks				140			140		300	B	B	B	70	
Iodine I_2	10%	C	73	73	C	B to 176	C		200	B to 160	80	B to 80	190	B to 70
Iron Phosphate														A
Isobutane									140	C	250	C	250	
Isobutyl Alcohol $(CH_3)_2CHCH_2OH$		C	C	73			140		300	B to 300	C	160	B to 400	
Isooctane $(CH_3)_3CCH_2CH(CH_3)_2$				C			73	73	300	C	250	C	250	A
Isopropyl Acetate $CH_3COOCH(CH_3)_2$		C	C				73		200	B to 160	C	C	C	A
Isopropyl Alcohol $(CH_3)_2CHOH$			C	212	140	C	140	B to 130	300	160	70	B to 120	170	550

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		ABS	CPVC	PP	PVC	PVDF	PEX	PPSU	PTFE	EPDM	NITRILE (Buna-N)	POLYCHLORO-PRENE	FKM	GRAPHITE
Isopropyl Ether $(CH_3)_2CHOCH(CH_3)_2$			C	C	C		73		140	C	C	C	C	
JP-3 Fuel									200	C	70	C	140	
JP-4 Fuel			C	C	B		73		300	C	250	C	B to 400	
JP-5 Fuel			C	C	B		73		300	C	250	C	B to 400	
JP-6 Fuel									200	C	B to 120	C	70	
Kelp Slurry														
Kerosene		73	B	C	B		C		250	C	250	C	B to 400	A
Ketchup					73				250	210	200	70	200	
Ketones		C	C	C	C		73		200	200	200	C	C	A
Kraft Liquors		73	180		140		120		250					
Lactic Acid $CH_3CHOHCOOH$	25%	73	180	212	140		140		300	212	80	70	B to 400	A
Lactic Acid $CH_3CHOHCOOH$	80%	C	C	140	73		140		300	176	80	70	B to 400	A
Lard OIl			C		140		C		300					
Latex				140			140		200	B to 200	200	160	160	
Lauric Acid $CH_3(CH_2)_{10}COOH$			180	140	140		120		300	C	70	70	70	
Lauryl Chloride $CH_3(CH_2)_{10}CH_2Cl$			73		140	B to 248	120		300					
Lead Acetate $Pb(CH_3COO)_2 \bullet 3H_2O$	Sat'd.		180	180	140	B to 212	140		300	200	B to 140	B to 140	C	
Lead Chloride $PbCl_2$			180	140	140		120		300	176	140	C	212	A
Lead Nitrate $Pb(NO_3)_2$	Sat'd.		180	140	140		120		300	B to 300	B to 220	200	212	A

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		ABS	CPVC	PP	PVC	PVDF	PEX	PPSU	PTFE	EPDM	NITRILE (Buna-N)	POLYCHLORO-PRENE	FKM	GRAPHITE
Lead Sulfate $PbSO_4$			180	140	140		120		300	B to 210	120	B to 180	212	A
Lemon Oil			C	C				B to 73	300	C	70	C	70	
Lime Sulfur			73	73	73		120			B to 300	B to 220	B to 180	B to 420	
Linoleic Acid			180	180	140				300	C	C	C	C	
Linseed Oil		73	C	140	140	B to 248	B to 73		300	C	200	B to 180	250	
Lithium Bromide LiBr				140	140		140	B to 212	300					A
Lithium Chloride LiCl				140	140		120			160	160	160	160	A
Lithium Hydroxide LiOH				140			120			160	C	70	C	
Lubricating Oil (ASTM #1)			180	C	140	B to 248	73		350	C	180	150	70	
Lubricating Oil (ASTM #2)			180	C	140		73		350	C	B to 180	C	70 - 300	
Lubricating Oil (ASTM #3)			180	C	140		73		350	C	180	C	350	
Ludox														
Magnesium Carbonate $MgCO_3$		120	180	212	140	B to 212	140		225	B to 300	140	B to 180	212	
Magnesium Chloride $MgCl_2$	Sat'd.	120	180	140	140	B to 140	140		400	230	176	B to 200	185	A
Magnesium Citrate $MgHC_6H_5O_7 \bullet 5H_2O$			180		140		140		300	176	140		212	
Magnesium Oxide MgO		160												
Magnesium Sulfate $MgSO_4 \bullet 7H_2O$		160	180	212	140	B to 212	140		300	194	B to 230	B to 200	B to 390	A
Maleic Acid HOOCCH=CHCOOH	Sat'd.	160	180	140	140	B to 140	140		250		C	C	140	A

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		ABS	CPVC	PP	PVC	PVDF	PEX	PPSU	PTFE	EPDM	NITRILE (Buna-N)	POLYCHLORO-PRENE	FKM	GRAPHITE
Manganese Sulfate $MnSO_4 \bullet 4H_2O$			180	180	140		140		300	176	B to 200	B to 200	212	A
Mercuric Chloride $HgCl_2$			180	180	140		140		300	B to 210	B to 200	160	B to 300	A
Mercuric Cyanide $Hg(CN)_2$	Sat'd.		180	140	140	B to 212	140		300	B to 210	B to 160	B to 70	C	
Mercuric Sulfate $HgSO_4$	Sat'd.		180	140	140		140		300	70	70	B to 70	C	A
Mercurous Nitrate $HgNO_3 \bullet 2H_2O$	Sat'd.		180	140	140		140		300	100	B to 90	90	C	A
Mercury Hg			180	140	140	B to 248	140		300	210	140	140	185	A
Methane CH_4		C	73	73	140		140		300	C	B	B to 140	B	
Methanol (Methyl Alcohol) CH_3OH			C	180	140		B to 140		300	B to 176	B to 160	160	C	A
Methyl Acetate $CH_3CO_2CH_3$		C	C	140	C		C		300	160	C	C	C	
Methyl Acetone														C
Methyl Amine CH_3NH_2			C	C	C				300					
Methyl Bromide CH_3Br			C	C	C		C		300	C	C	C	185	
Methyl Cellosolve $HOCH_2CH_{20}CH_3$			C	73	C		C			C	C	C	C	
Methyl Chloride CH_3Cl	Dry	C	C	C	C		C		250	C	C	C	C	
Methyl Chloro-form CH_3CCl_3		C	C	C	C		C		200	C	C	C	C	
Methyl Ethyl Ketone (MEK) $CH_3COC_2H_5$		C	C	73	C			C	200	B to 200	C	C	C	A
Methyl Formate										B to 120	C	C	C	

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		ABS	CPVC	PP	PVC	PVDF	PEX	PPSU	PTFE	EPDM	NITRILE (Buna-N)	POLYCHLORO-PRENE	FKM	GRAPHITE
Methyl Isobutyl Ketone $(CH_3)_2CHCH_2COCH_3$		C	C	73	C		73		200	B to 130	C	C	C	A
Methyl Isopropyl Ketone $CH_3COCH(CH_3)_2$			C		C		73		150	C	C	C	C	
Methyl Methacrylate $CH_2=C(CH_3)COOCH_3$			C		73		140		150	C	C	C	C	
Methylene Bromide CH_2Br_2			C	C	C		C		250	C	C	C	C	
Methylene Chloride CH_2Cl_2			C	C	C	C	C	C	250	C	C	C	C	
Methylene Chlorobromide CH_2ClBr			C		C									
Methylene Iodine CH_2I_2			C	C	C		C		200			C	70	
Methylsulfuric Acid CH_3HSO_4			180	140	140					70	C	70	C	
Milk		160	180	212	140	B to 212	140		400	250	250	250	250	
Mineral Oil		73	180	C	140	B to 212		B to 73	300	C	250	B to 200	B to 400	
Molasses			180	140	140		140		300	B to 212	200	200	212	
Monochloroacetic Acid $CH_2ClCOOH$	50%			140	140		140		200		C	70	C	A
Monochlorobenzene C_6H_5Cl			C	73	C		C		200	C	C	C	C	A
Monoethanolamine $HOCH_2CH_2NH_2$					C				100	120	C	C	C	A
Morpholine C_4H_8ONH				140			140		200	C	C	C	B to 70	
Motor Oil			180	C	140		B to 140		350	C	190	B to 70	190	A
Muriatic Acid	37%								250					

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		ABS	CPVC	PP	PVC	PVDF	PEX	PPSU	PTFE	EPDM	NITRILE (Buna-N)	POLYCHLORO-PRENE	FKM	GRAPHITE
Naphtha			73	73	140	B to 122			200	C	B to 250	C	B to 400	
Naphthalene $C_{10}H_8$			C	73	C		73		250	C	C	C	176	
Natural Gas		73		73	140		140		300	C	250	140	250	
Nickel Ammonium Sulfate									250	70	70	70	B to 70	
Nickel Chloride $NiCl_2$	Sat'd.	160	180	180	140	B to 212	140		406	176	176	B to 200	B to 400	A
Nickel Nitrate $Ni(NO_3)_2 \bullet 6H_2O$	Sat'd.	160	180	180	140	B to 248	140		400	212	B to 200	B to 200	248	A
Nickel Sulfate $NiSO_4$	Sat'd.	160	180	180	140	B to 212	140		400	176	176	160	B to 400	A
Nicotine $C_{10}H_{14}N_2$			180		140		140				C	C	C	
Nicotinic Acid C_5H_4NCOOH			180		140	B to 212	140			B to 140	70	B to 200		
Nitric Acid HNO_3	<10%	C	180	180	140	B to 212			250	B to 104	C	C	B to 185	A
Nitric Acid HNO_3	30%	C	B to 130	140	140	B to 212			250		C	C	B to 185	C
Nitric Acid HNO_3	40%	C	B to 120	73	140				250	C	C	C	70	C
Nitric Acid HNO_3	50%	C	110	C	100				250	C	C	C	70	C
Nitric Acid HNO_3	70%	C	100	C	73				250	C	C	C	C	C
Nitric Acid	Fuming								70	C	C	C	C	C
Nitrobenzene $C_6H_5NO_2$		C	C	C	C	B to 122	C		400	C	C	C	C	A
Nitrogen N_2	Gas								300	B to 350	B to 230	300	B to 400	A
Nitroglycerin $CH_2NO_3CHNO_3CH_2NO_3$					C		73	B to 73	70	70	C	70	C	

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		ABS	CPVC	PP	PVC	PVDF	PEX	PPSU	PTFE	EPDM	NITRILE (Buna-N)	POLYCHLORO-PRENE	FKM	GRAPHITE
Nitrous Acid HNO_2	10%		180	C	140		73		400	100	C	100	C	
Nitrous Oxide N_2O			73	73	73		73	73	400	140	70	B to 80	C	A
n-Octane C_8H_{18}			C					B to 250	400	C	B to 200	C	B to 400	550
Oleic Acid		160	180	73	140	B to 248	C		250	C	B to 225	C	B to 212	A
Oleum (Sulfuric Acid) $xH_2SO_4 \bullet ySO_3$	Fum-ing	C	C	C	C	C	C			C	C	C	C	
Olive Oil		160	C	73	140	B to 248	B to 68		350	C	250	C	250	
Oxalic Acid $HOOCCOOH \bullet 2H_2O$	50%	160	180	140	140	B to 122	140		300	300	C	C	B to 400	A
Oxygen O_2	Gas	160	180	C	140	B to 212	140		406		C		B to 190	A
Ozone O_3			180	C	140		C		300	B	C	C	B	C
Palm Oil				73			140		200	C	250	C	250	
Palmitic Acid $CH_3(CH_2)_{14}COOH$	10%	73	73	180	140		120		300	C	220	C	400	
Palmitic Acid $CH_3(CH_2)_{14}COOH$	70%		73	180	73		120		300	C	220	C	400	
Parafin $C_{36}H_{74}$		73	180	140	140	B to 212	C		250	C	250	C	400	
Peanut Oil			C	140		B to 248			250	C	250	C	400	
n-Pentane $CH_3(CH_2)_3CH_3$		C	C	C	C		C		100	C	250	70	200	
Peracetic Acid CH_3COOOH	40%	C		73	73			B to 73		C	C	70	C	
Perchloric Acid $HClO_4$	10%					B to 212			250	B to 140	C	140	400	A
Perchloric Acid $HClO_4$	70%	73	180	C	73	B to 212	73			B to 140	C	70	400	C

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		ABS	CPVC	PP	PVC	PVDF	PEX	PPSU	PTFE	EPDM	NITRILE (Buna-N)	POLYCHLORO-PRENE	FKM	GRAPHITE
Perchloroethylene (Tetrachloroethylene) $Cl_2C=CCl_2$		C	C	C	C	C	C	C	200	C	C	C	400	
Perphosphate			73	140	73				250					
Phenol C_6H_5OH		C	73	73	73		140	B to 140		C	C	C	B to 210	A
Phenylhydrazine $C_6H_5NHNH_2$			C	C	C	B to 104	C		B to 70	C	C	C	C	
Phosphate Esters										250	C	C		
Phosphoric Acid H_3PO_4	10%		180	212	140		140		300	B to 300	104	B to 206	B to 400	A
Phosphoric Acid H_3PO_4	50%	73	180	212	140	B to 212	140		300	176	B to 104	171	212	A
Phosphoric Acid H_3PO_4	85%		180	212	140		73		300	176	C	122	B to 185	A
Phosphoric Anhydride P_2O_5			73	73	73					200	B	B	B	
Phosphorus Pentoxide P_2O_5			73	73	73		140							
Phosphorus Trichloride PCl_3			C	73	C	C	120		300	70	C	C	70	A
Photographic Solutions			180	140	140		140			B to 104	B to 70	B to 140	185	
Phthalic Acid $C_6H_4(COOH)_2$				140	C		140			B to 100	C	B to 100	C	A
Picric Acid $C_6H_2(NO_2)_3OH$	10%	C	C	73	C	B to 212	73			200	B to 200	70	400	
Pine Oil			C	140			B to 73			C	70	C	70	
Plating Solutions (Brass)			180	140	140		140		300	70	B	140	140	
Plating Solutions (Cadmium)			180	140	140		140		300	300	B to 180	B to 200	190	
Plating Solutions (Chrome)			180	140	140		140		300	210	C	C	B to 400	

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CHEMICALS AND FORMULA	CONCENTRATION	PLASTICS MAX TEMPERATURE (°F)							SEAL MATERIALS MAX TEMPERATURE (°F)					
		ABS	CPVC	PP	PVC	PVDF	PEX	PPSU	PTFE	EPDM	NITRILE (Buna-N)	POLYCHLORO-PRENE	FKM	GRAPHITE
Plating Solutions (Copper)			180	140	140		140		300	B to 300	B to 190	B to 160	185	
Plating Solutions (Gold)			180	140	140		140		300	B	B	B	B	
Plating Solutions (Lead)			180	140	140		140		300	B to 300	B to 190	140	185	
Plating Solutions (Nickel)			180	140	140		140		300	B to 300	B	B to 200	185	A
Plating Solutions (Rhodium)			180	140	140		140		300	120	B to 200	80	B to 190	
Plating Solutions (Silver)			180	140	140		140		300	B to 300	B to 180	B to 200	B to 190	
Plating Solutions (Tin)			180	140	140		140		300	210	B to 180	140	140	
Plating Solutions (Zinc)			180	140	140		140		300	B to 300	B to 180	B	B to 190	
Polysulfide Liquor									300					
Polyvinyl Acetate									350	B to 280	80	C	C	
Potassium Alum			180		140		140		400	176	B to 180	B to 200	212	
Potassium Aluminum Sulphate			180		140		140		400	176	B to 180	B to 200	212	
Potassium Bicarbonate $KHCO_3$	Sat'd.		180	140	140	B to 212	140		400	200	200	200	212	
Potassium Bichromate $K_2Cr_2O_7$	Sat'd.		180	140	140	B to 212			400	140	140	104	212	A
Potassium Bisulfate $KHSO_4$			180	212	140	B to 212	140		400	B	140	70	212	A
Potassium Bromate $KBrO_3$			180	212	140	B to 212	140		400	212	B to 70	B to 140	212	
Potassium Bromide KBr			180	212	140	B to 248	140		400	212	200	200	B to 212	A

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		ABS	CPVC	PP	PVC	PVDF	PEX	PPSU	PTFE	EPDM	NITRILE (Buna-N)	POLYCHLORO-PRENE	FKM	GRAPHITE
Potassium Carbonate (Potash) K_2CO_3		73	180	180	140	C	140		400	B	200	200	B to 212	A
Potassium Chlorate (Aqueous) $KClO_3$		160	180	212	140	C	140		400	B to 200	70	B to 200	B	C
Potassium Chloride KCl		160	180	212	140	B to 212	140		400	B	200	200	212	
Potassium Chromate K_2CrO_4			180	212	140		140		400	176	B to 140	140	B to 212	C
Potassium Cyanide KCN			180	180	140	B to 212	140		400	B	200	200	200	
Potassium Dichromate $K_2Cr_2O_7$	Sat'd.		180	180	140		140		400	212	140	120	212	C
Potassium Ferricyanide $K_3Fe(CN)_6$			180	180	140	B to 248	140		400	70	C	70	B to 212	
Potassium Ferrocyanide $K_4Fe(CN)_6 \bullet 3H_2O$			180	180	140	B to 248	140		400	140	C	70	140	
Potassium Fluoride KF			180	180	140	B to 212	140		400	200	B to 180	70	212	A
Potassium Hydroxide KOH	25%	160	180	212	140		B to 140	248	300	320	B to 80	B to 212	80	A
Potassium Hypochlorite KClO		160	180		140		120		400	70	C	B to 70	C	
Potassium Iodide KI			180	73	73	B to 212	140		400	70		70	B	A
Potassium Nitrate KNO_3		160	180	140	140		140		400	B	B to 200	B to 200	212	C
Potassium Perborate KBO_3			180	140	140		140		400	70	B to 70	70	B to 70	A
Potassium Perchlorate $KClO_4$			180	140	140		140		200	140	C	70	190	
Potassium Permanganate $KMnO_4$	10%		180	73	140		140		400	210	C	140	B to 212	

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		ABS	CPVC	PP	PVC	PVDF	PEX	PPSU	PTFE	EPDM	NITRILE (Buna-N)	POLYCHLORO-PRENE	FKM	GRAPHITE
Potassium Permanganate $KMnO_4$	25%		180	73	73	B to 212	140		400	200	C	140	B to 212	
Potassium Persulfate $K_2S_2O_8$			180	140	140	B to 176	140		400	180	C	B	210	
Potassium Sulfate K_2SO_4		160	180	180	140	B to 212	140		200	176	B to 200	B to 200	212	A
Potassium Sulfide K_2S			180	140		68	140		300	70		70	210	
Potassium Sulfite $K_2SO_3 \bullet 2H_2O$			180	140			140		300	200	B to 150	B to 150	210	
Potassium Tetraborate									400					A
Potassium Tripolyphosphate									300					A
Propane C_3H_8			73	73	140	B to 248	140		300	C	250	140	250	A
Propargyl Alcohol			C	140	140		140			140	70	70	140	
Propionic Acid $CH_3CH_2CO_2H$		C	C	140		B to 140	140			200		C	C	
Propyl Acetate									140	C	C	C	C	
Propyl Alcohol $CH_3CH_2CH_2OH$		73	C	140	140	B to 122	B to 140		350	B to 225	180	B to 176	B to 300	
n-Propyl Bromide									300					
Propylene Glycol	<25%		C		C			180	300	200	180	70	250	A
Propylene Glycol	>25%		C		C			B to 180	300	200	180	70	250	A
Propylene Oxide CH_3CHCH_2O			C	73	C		140		150	C	C	C	C	
n-Propyl Nitrate									200	C	C	C	C	
Pyridine $N(CH)_4CH$			C	C	C	B to 68	73			C	C	C	C	
Pyrogallic Acid $C_6H_3(OH)_3$					73				150	C	B to 100	C	140	

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		ABS	CPVC	PP	PVC	PVDF	PEX	PPSU	PTFE	EPDM	NITRILE (Buna-N)	POLYCHLORO-PRENE	FKM	GRAPHITE
Pyrrole										C	C	C	C	
Quinone $C_6H_4O_2$				140			140			C	C	C	C	
Rosin									200	C	B to 200	200	B	
Salicylic Acid $C_6H_4(OH)(COOH)$				140	140	B to 212	140		300	300	C		300	
Selenic Acid H_2SeO_4			180		140		140			70	C	70	C	
Silicic Acid $SiO_2 \bullet nH_2O$			180	140	140	B to 212	140		400	176	176	70	212	
Silicone Oil			180	212	73		73		350	140	212	212	400	A
Silver Chloride AgCl		160	180	140	140					70	C	70	90	A
Silver Cyanide AgCN			180	180	140	B to 212	140		350	70	C	70	140	
Silver Nitrate $AgNO_3$		160	180	180	140		B to 140		350	300	C	B to 200	185	A
Silver Sulfate Ag_2SO_4		160	180	140	140		140		350	176	140	70	212	A
Soaps		73	180	140	140		B to 140		400					
Sodium Acetate CH_3COONa	Sat'd.		180	212	140	B to 212	140		400	212	C	C	B	
Sodium Aluminate $Na_2Al_2O_4$	Sat'd.				140				300	B to 200	B to 180	140	B to 200	
Sodium Benzoate C_6H_5COONa			180	140	140		140		300	140	B to 140	B to 70	B to 140	
Sodium Bicarbonate $NaHCO_3$		73	180	212	140	B to 212	140		400	212	B to 200	B to 200	212	
Sodium Bichromate	Sat'd.								400	176	140	B to 70	B to 212	C
Sodium Bisulfate $NaHSO_4$		73	180	140	140		140			B to 200	B to 200	B to 200	212	

CHEMICALS AND FORMULA	CONCENTRATION	PLASTICS MAX TEMPERATURE (°F)							SEAL MATERIALS MAX TEMPERATURE (°F)					
		ABS	CPVC	PP	PVC	PVDF	PEX	PPSU	PTFE	EPDM	NITRILE (Buna-N)	POLYCHLORO-PRENE	FKM	GRAPHITE
Sodium Bisulfite $NaHSO_3$			180	140	140		140		400	176	160	B to 200	212	
Sodium Borate (Borax) $Na_2B_4O_7 \bullet 10H_2O$	Sat'd.	160	180	180	140		140		300	B to 300	B to 220	B to 200	210	A
Sodium Bromide NaBr	Sat'd.	120	180	140	140		140		300	140	C	70	B to 180	A
Sodium Carbonate Na_2CO_3		73	180	212	140	C	140	B to 73	400	176	B to 200	B to 200	212	
Sodium Chlorate $NaClO_3$	Sat'd.		180	140	73	C	140		350	B to 200	B to 200	B to 200	B to 200	
Sodium Chloride NaCl		120	180	212	140		140		350	B to 212	160	120	212	
Sodium Chlorite $NaClO_2$	25%		180	73	C		140		200	70	C		B to 140	C
Sodium Chromate $Na_2CrO_4 \bullet 4H_2O$		120	180	140		B to 176	140			140	140	70	140	C
Sodium Cyanide NaCN			180	180	140	B to 212	140		350	176	B to 230	140	176	200
Sodium Dichromate $Na_2Cr_2O_7 \bullet 2H_2O$	20%		180	180	140		140		300	176	140	C	B to 212	C
Sodium Ferricyanide $Na_3Fe(CN)_6 \bullet 2H_2O$	Sat'd.		180	140	140		140		350	300	70	70	140	
Sodium Ferrocyanide $Na_3Fe(CN)_6 \bullet 10H_2O$	Sat'd.		180	140	140		140		350	140	80	70	140	
Sodium Fluoride NaF		120	180	180	140	B to 212	140		350	140	100	140	140	A
Sodium Hydroxide NaOH	<5%					B to 68								
Sodium Hydroxide NaOH	<10%								400	B to 200	212	B to 200	B to 140	A
Sodium Hydroxide NaOH	30%	120	180	212	140	C	B to 140		350	B to 130	212	B to 200	80	A

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		ABS	CPVC	PP	PVC	PVDF	PEX	PPSU	PTFE	EPDM	NITRILE (Buna-N)	POLYCHLORO-PRENE	FKM	GRAPHITE
Sodium Hydroxide $NaOH$	50%	120	180	212	140		B to 140	194	350	B to 130	212	B to 200	B to 70	A
Sodium Hydroxide $NaOH$	70%	120	180	212	140		B to 140		350	B to 130	B to 70	B to 200	B to 70	A
Sodium Hypochlorite $NaOCl \bullet 5H_2O$		120	180	73	140	B to 200	140	B to 190	350	C	C	C	B to 130	
Sodium Metaphosphate $(NaPO_3)n$			180	120	140					300	220	150	B to 400	A
Sodium Nitrate $NaNO_3$	Sat'd.	160	180	180	140	B to 212	140		400	200	B to 171	B to 200	212	A
Sodium Nitrite $NaNO_2$		160	180	73	140	B to 212	140		400	176	171	B to 140	212	
Sodium Perborate $NaBO_3 \bullet 4H_2O$		120	180	73	140		73		350	140	C	B	140	A
Sodium Perchlorate $NaClO_4$			180	212	140		140		350	70	C	70	C	
Sodium Peroxide Na_2O_2	10%		180		140		140		250	300	C	C	400	C
Sodium Phosphate NaH_2PO_4	Acid	120	180	212	140	B to 140	140		400					A
Sodium Phosphate NaH_2PO_4	Alkaline		120	180	212		140		400					A
Sodium Phosphate NaH_2PO_4	Neutral		120	180	212				400					A
Sodium Silicate			180	140	140		140			B to 200	140	B to 200	212	
Sodium Sulfate Na_2SO_4	Sat'd.	160	180	212	140				400	B to 200	200	B to 200	212	A
Sodium Sulfide Na_2S	Sat'd.	160	180	212	140		140		350	200	B to 200	B to 200	176	
Sodium Sulfite Na_2SO_3	Sat'd.	160	180	212	140	B to 212	140	B to 73	350	200	B to 200	B to 200	140	
Sodium Thiosulfate $Na_2S_2O_3 \bullet 5H_2O$			180	180	140		140		350	140		160	140	

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		ABS	CPVC	PP	PVC	PVDF	PEX	PPSU	PTFE	EPDM	NITRILE (Buna-N)	POLYCHLORO-PRENE	FKM	GRAPHITE
Sour Crude Oil				140	140					C	C	C		
Soybean Oil				73			140		400	C	250	250	B to 400	
Stannic Chloride $SnCl_4$	Sat'd.		180	140	140		140		350	300	220	C	B to 400	A
Stannous Chlo-ride $SnCl_2$	15%	120	180	140	140		140		350	B to 210	B to 150	B to 140	B to 185	A
Starch			180	140	140		140		300	176	B to 176	212	212	
Steam (Low Pressure)									400					A
Steam (Medium Pres-sure)									400					
Steam (High Pressure)									C					
Stearic Acid $CH_3(CH_2)_{16}COOH$			180	73	140		120		350	C	B to 70	C	140	A
Stoddard's Solvent			C		C		73			C	250	C	250	
Styrene $C_6H_5CH{=}CH_2$				73			C		350	C	C	C	C	
Succinic Acid $COOH(CH_2)_2COOH$			180	140	140		140		200	140	70	B to 70	B to 176	
Sugar $C_6H_{12}O_6$			180		140		140		350					
Sulfamic Acid HSO_3NH_2	20%		C	180	C					70	C	B to 150	C	
Sulfate Liquors (Oil)	6%		180	140	140				200	B to 250	B to 150	B to 150	170	
Sulfite Liquors	6%	73	180		140				350	B	C	B to 70	140	
Sulfur S			180	212	140				350	250	C	70	266	A
Sulfur Chloride S_2Cl_2				C					350	C	C	C	140	A

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		ABS	CPVC	PP	PVC	PVDF	PEX	PPSU	PTFE	EPDM	NITRILE (Buna-N)	POLYCHLORO-PRENE	FKM	GRAPHITE
Sulfur Dioxide SO_2	Gas (Dry)	C	73	140	140		140		350	160	C	C	B to 250	A
Sulfur Dioxide SO_2	Gas (Wet)	C	C	140	73		120			140	C	C	B to 140	A
Sulfur Trioxide SO_3	Gas		C		73		C			B to 120	C	C	B	C
Sulfuric Acid H_2SO_4	<30%	120	180	180	140	250	B to 140	B to 73	250	212	B	158	248	A
Sulfuric Acid H_2SO_4	50%	73	180	140	140	250	B to 140	212	250	212	C	158	212	A
Sulfuric Acid H_2SO_4	70%	C	180	73	140	200			200	140	C	C	180	212
Sulfuric Acid H_2SO_4	90%	C	150	73	73	200			200	70	C	C	158	212
Sulfuric Acid H_2SO_4	98%	C	125	C	C	125			200	70	C	C	158	212
Sulfuric Acid H_2SO_4	100%	C	C	C	C				200	C	C	C	158	C
Sulfurous Acid H_2SO_3	Sat'd.		180	140	140	B to 212	140		350	C	C	C	C	A
Tall Oil			C	180	140		120		250	C	200	C	200	
Tannic Acid $C_{76}H_{52}O_{46}$	10%	C	180	73	140	B to 212	140		250	200	200	B to 200	200	
Tanning Liquors		160	180	73	140		120			200	B to 200	70	200	
Tar			C		C				250	C	C	C	B	
Tartaric Acid $HOOC(CHOH)_2COOH$		160	180	140	140	B to 248	140		250	C	200	158	B to 200	A
Tetrachloroethane $CHCl_2CHCl_2$				C	C		C	C	400	C	C	C	200	
Tetrachloroethyl-ene $Cl_2C{=}CCl_2$		C	C	C	C		C		350	C	C	C	212	
Tetraethyl Lead $Pb(C_2H_5)_4$			73	73	73				350	C	C	C	120	
Tetrahydrofuran C_4H_8O		C	C	C	C		C	C		C	C	C	C	

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		ABS	CPVC	PP	PVC	PVDF	PEX	PPSU	PTFE	EPDM	NITRILE (Buna-N)	POLYCHLORO-PRENE	FKM	GRAPHITE
Thionyl Chloride $SOCl_2$			C	C	C	C	C	C		C	C	C	C	A
Thread Cutting Oils			73	73	73			73	350					
Titanium Tetra-chloride $TiCl_4$				140	C		120			C	C	C	160	A
Toluene (Toluol) $CH_3C_6H_5$		C	C	C	C		C	C	200	C	C	C	B to 200	
Tomato Juice			180	212	140		140		350	70	140	140	140	
Transformer Oil			180	73	140		C		300	C	B	C	300	A
Transformer Oil DTE/30			180		140		B to 120		300					A
Tributyl Phos-phate $(C_4H_9)_3PO_4$			C	C	C		73		300	250	C	C	C	
Trichloroacetic Acid CCl_3COOH	50%			140	140	B to 104	140		200	C	C	C	C	A
Trichloroethylene $CHCl{=}CCl_2$		C	C	C	C	B to 176	C	C	200	C	C	C	200	A
Triethanolamine $(HOCH_2CH_2)_3N$		C	73	140	73	C	73	B to 190		B	C	B	C	
Triethylamine $(C_2H_5)_3N$				C	140		73	B to 73		160	140	B to 70	C	
Trimethylpropane $(CH_2OH)_3C_3H_5$				140	73		C			C	C	C	70	
Triso-dium Phosphate $Na_3PO_4 \bullet 12H_2O$		73	180	140	140		140		350	212	C	C	B to 300	A
Tung Oil										C	250	B to 120	250	
Turpentine		C	C	C	140		C			C	250	C	B to 200	
Urea $CO(NH_2)_2$			180	180	140		140							
Urine		160	180	180	140		140		400	140	140	C	140	

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		ABS	CPVC	PP	PVC	PVDF	PEX	PPSU	PTFE	EPDM	NITRILE (Buna-N)	POLYCHLORO-PRENE	FKM	GRAPHITE
Varnish									350	C	C	C	B to 400	
Vaseline (Petroleum Jelly)			C	140	C		120		300	C	140	140	140	
Vegetable Oil			C	140	140	B to 248	B to 140		300	C	200	C	200	
Vinegar		73	150	140	140		140		300	B to 210	C	C	200	
Vinyl Acetate $CH_3COOCH{=}CH_2$			C	73	C	C	140		350	C	C	C	C	
Water (Acid Mine) H_2O		160	180	140	140		140		400	200	B to 210	C	B to 190	A
Water (Deionized) H_2O		160	180	140	140		140		400	B to 140	B to 200	B to 150	B to 200	A
Water (Distilled) H_2O		160	180	212	140	B to 248	140		400	140	B to 210		250	A
Water (Potable) H_2O		160	180	212	140	B to 248	140		400					A
Water (Salt) H_2O		160	180	212	140		140		400	B to 250	B to 210	140	B to 200	A
Water (Sea) H_2O		160	180	212	140	B to 248	140		400	B to 250	B to 210	B to 140	212	A
Water (Soft) H_2O		160	180	212	140		140		400					A
Water (Waste) H_2O		73	180	212	140		140		400					A
Whiskey			180	140	140	B to 212	140		350	200	200	140	B	
White Liquor		73	180		140					300	104	140	190	
Wine		73	180	140	140	B to 248	140		350	200	200	140	200	

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Xylene (Xylol) $C_6H_4(CH_3)_2$		C	C	C	C	C	C	C	350	C	C	C	B to 200	A
Zinc Acetate $Zn(CH_3COO)_2 \bullet 2H_2O$			180							140	C	C	C	
Zinc Carbonate $ZnCO_3$			180	140		B to 212	140			70	70	70	70	
Zinc Chloride $ZnCl_2$		120	180	180	140		140		400	210	B to 200	194	212	A
Zinc Nitrate $Zn(NO_3)_2 \bullet 6H_2O$		160	180	180	140		140			180	140	100	190	A
Zinc Sulfate $ZnSO_4 \bullet 7H_2O$		160	180	212	140		140		400	B to 300	B to 220	171	B	A

C-CRG-0613

Chemical Resistance Guide for Valves & Fittings

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Pipe, 20 ft. Lengths[1]

Nominal Pipe Size	Approximate Weight per 100 ft. PVC	CPVC	Polypropylene	PVDF	Nom. Outside Diameter (In.)	Nom. Inside Diameter (In.)	Wall Thickness (In.) Nom.	Min	Cross-sectional Area. (in.^{2})	Internal Area. (in.^{2})	Fluid Capacity. (ft.^{2}/10 ft.)	Outside Surface Area (ft.^{2}/100ft.)	Threshold Flow (GPM)
1/4	10.1	11.9	—	—	.540	.282	.129	.119	.167	.062	.32	14.14	.97
1/2	20.5	24.3	14.0	24.4	.840	.526	.157	.147	.337	.217	1.13	21.99	3.39
3/4	27.8	32.9	18.9	33.0	1.050	.722	.164	.154	.457	.409	2.13	27.49	6.38
1	40.4	48.5	27.1	48.7	1.315	.936	.1895	.179	.670	.688	3.57	34.43	10.72
1 1/4	56.7	66.9	37.9	—	1.660	1.255	.2025	.191	.927	1.237	6.43	43.46	19.28
1 1/2	68.9	81.1	44.8	81.4	1.900	1.476	.212	.200	1.124	1.711	8.89	49.74	26.67
2	94.9	108.5	62.3	112.6	2.375	1.913	.231	.218	1.556	2.874	14.93	62.18	44.79
2 1/2	144.9	165.4	—	—	2.875	2.290	.2925	.276	2.373	4.119	21.40	75.27	64.19
3	193.8	221.3	126.6	256.4	3.500	2.864	.318	.300	3.179	6.442	33.47	91.63	100.40
4	283.3	323.4	185.2	357.0	4.500	3.786	.357	.337	4.647	11.258	58.48	117.81	175.44
6	541.1	616.8	359.9	714.3	6.625	5.709	.458	.432	8.873	25.598	132.98	173.44	398.93
8	821.9	905.8	—	—	8.625	7.565	.530	.500	13.479	44.948	233.49	225.80	700.48
10	1227.7	—	—	—	10.750	9.493	.6285	.593	19.985	70.778	367.68	281.43	1103.02
12	1710.4	—	—	—	12.750	11.294	.726	.687	27.495	100.181	520.79	333.79	1562.36

1 Dimensions shown are listed in ASTM D1785 and F441 for PVC and CPVC Schedule 80 plastic pipe, respectively.
2 Upper threshold rate of flow = 5 ft./sec. fluid velocity.

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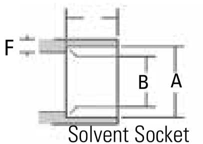
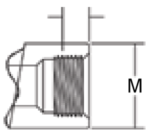
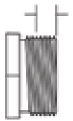
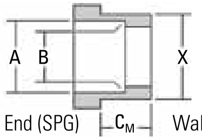
Fittings[1]









		Solvent Socket			Female Threads (FPT)		Male Threads (MPT)	Male End (SPG)		Wall Thickness	
Size	IPS Dia	A[3]	B[3]	C[4] Nom	Y[2]	M[5] Min	Z[2]	X	Cm[4] Nom	F[4] Min	E[4] Min
1/4	.540	.552	.536	.640	.311	.840	.311	.540	.655	.149	.119
1/2	.840	.848	.836	.890	.427	1.280	.427	.840	.905	.185	.147
3/4	1.050	1.058	1.046	1.015	.446	1.500	.446	1.050	1.030	.195	.154
1	1.315	1.325	1.310	1.140	.530	1.810	.530	1.315	1.155	.225	.179
1 1/4	1.660	1.670	1.655	1.265	.550	2.200	.550	1.660	1.280	.240	.191
1 1/2	1.900	1.912	1.894	1.390	.550	2.500	.550	1.900	1.405	.250	.200
2	2.375	2.387	2.369	1.515	.566	2.375	.566	2.375	1.530	.275	.218
2 1/2	2.875	2.889	2.868	1.780	.870	3.560	.870	2.875	1.810	.345	.276
3	3.500	3.516	3.492	1.905	.954	4.300	.954	3.500	1.933	.375	.300
4	4.500	4.518	4.491	2.280	1.032	5.430	1.032	4.500	2.310	.420	.337
6	6.625	6.647	6.614	3.030	–	–	–	6.625	3.060	.540	.432
8	8.625	8.655	8.610	4.500	–	–	–	8.625	4.590	.625	.500
10	10.750	10.780	10.735	5.500	–	–	–	10.750	5.590	.741	.593
12	12.750	12.780	12.735	6.500	–	–	–	12.750	6.590	.859	.687

1 With exception of thread lengths, dimensions shown are listed in ASTM D2467 and F439 for PVC and CPVC socket-type and threaded-type Schedule 80 fittings, respectively.
2 Dimensions shown are typical male component engagement, hand-tight (L_1 in ANSI B1.20.1 thread spec.) plus 1 1/2 turns lightening.
3 Dimensions shown are not applicable for polypropylene or PVDF. Socket diameters in these materials are designed for Chemtrol® thermo-seal socket fusion joining.
4 Chemtrol® fittings may exceed certain minimum ASTM dimensional requirements in order to ensure functional satisfaction.
5 Dimensions are listed in ASTM D2646 and F437 for PVC and CPVC threaded Schedule 80 fittings, respectively.

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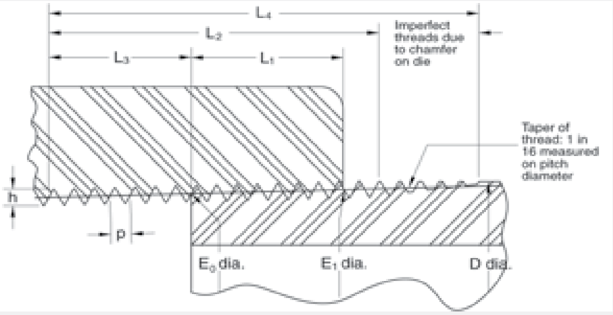
National (American) Standard Taper Pipe Thread, NPT (excerpt from ANSI B1.20.1)

Nominal Size	Outside Diameter D	Number of Threads Per Inch n	Pitch of Thread p	Normal Engagement By Hand L1	Length of Effective Thread L2	Wrench Makeup Length for Internal Thread L3	Total Length: End of Pipe to Vanish Point L4	Pitch Diameter at Beginning of External Thread E0	Pitch Diameter at Beginning of Internal Thread E1	Height of Thread (Max.) h
in.	in.		in.	in.	in.	in.	in.	in.	in.	in.
1/4	0.540	18	.05556	.228	.4018	.1667	.5946	.47739	.49163	.04444
1/2	0.840	14	.07143	.320	.5337	.2143	.7815	.75843	.77843	.05714
3/4	1.050	14	.07143	.339	.5457	.2143	.7935	.96768	.98887	.05714
1	1.315	11 1/2	.08696	.400	.6828	.2609	.9845	1.21363	1.23863	.06957
1 1/4	1.660	11 1/2	.08696	.420	.7068	.2609	1.0085	1.55713	1.58338	.06957
1 1/2	1.900	11 1/2	.08696	.420	.7235	.2609	1.0252	1.79609	1.82234	.06957
2	2.375	11 1/2	.08696	.436	.7565	.2609	1.0582	2.26902	2.29627	.06957
2 1/2	2.875	8	.12500	.682	1.1375	.2500	1.5712	2.71953	2.76216	.10000
3	3.500	8	.12500	.766	1.2000	.2500	1.6337	3.34062	3.38850	.10000
4	4.500	8	.12500	.844	1.3000	.2500	1.7337	4.33438	4.38712	.10000



Do not thread Schedule 40 pipe.

ANSI B16.5 Dimensional Data – Flanges and Flanged Fittings

Dimensions‡

Pipe Size	Outside Diameter	Number of Holes	Drilling Diameter of Bolt (in.)	Diameter of Bolt Circle (in.)
1/2	3.50	4	1/2	2.38
3/4	3.88	4	1/2	2.75
1	4.25	4	1/2	3.12
1 1/4	4.62	4	1/2	3.50
1 1/2	5.00	4	1/2	3.88
2	6.00	4	5/8	4.75
2 1/2	7.00	4	5/8	5.50
3	7.50	4	5/8	6.00
4	9.00	8	5/8	7.50
6	11.00	8	3/4	9.50
8	13.50	8	3/4	11.75
10	16.00	12	7/8	14.25
12	19.00	12	7/8	17.00

‡ Dimensions and bolts conform to ANSI B16.5 for 150 lb. steel flanges.
Bolt holes are 1/8" larger in diameter than the required bolts.

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Key to Chemtrol Valve Figure Number System

X XX XX - X - XX - SIZE
(1) (2) (3) (4) (5) (6)

1 End Configurations

S	Socket
F	Flanged
T	Threaded (female)
M	Threaded (male)
A	Hose x Male Threaded
W	Wafer Style Butterfly
U	Universal (socket and threaded)

2 Body Material

45	PVC Schedule 80
51	CPVC Schedule 80
61	Black Polypropylene (PP)
62	Chem-Pure® Natural Polypropylene (PP)
65	Red ® PVDF
66	Natural Kynar® PVDF

3 Types of Valves

AC	Angle
BC	Ball Check
BF	Butterfly (Model B)
BG	Butterfly (Model C)
CC	Chemcock®
CN	Needle
D2	Diverter (3-Way, 2-Position)
FV	Ball Foot
M3	Multiport (3-Way, 3 Position)
TB	Tru-Bloc® True Union Ball Valve
YP	Y-Pattern

4 O-Ring Material

E	EPDM
V	FKM

5 Operating Mechanisms

NO	None
LH	Lever Handle, Manual
RH	Round Safety Handle, Manual
GO	Gear Operator, Manual

6 Size

State Valve Size

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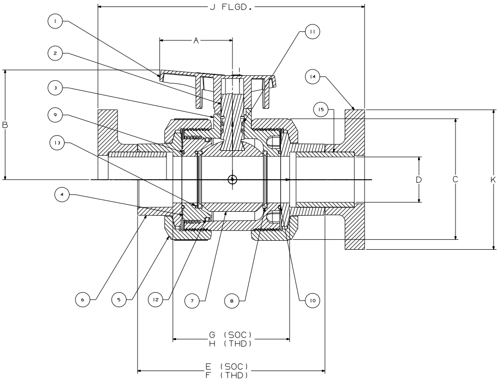
PVC and CPVC Tru-Bloc® True Union Ball Valve, Model D

Chemtrol Figure Number

Valve Style	Elastomeric Trim	PVC			CPVC		
		Soc.	Thd.	Flgd.	Soc.	Thd.	Flgd.
TU/TB	FKM	U45TB-V*	U45TB-V*	F45TB-V	U51TB-V*	U51TB-V*	F51TB-V
	EPDM	U45TB-E*	U45TB-E*	F45TB-E	U51TB-E*	U51TB-E*	F51TB-E

* As original equipment, 1/2" - 2" True Union Tru-Bloc valve models are supplied with universal connectors (i.e., a set of both socket and thread end connectors).



Dimensions–Weights–Flow Coefficients

Valve Size	E Soc.	F Thd.	G Soc.	H Thd.	J Flgd.	PVC Approx.[2] Wt. Lbs.	CPVC Approx.[2] Wt. Lbs.
	TU Figures End-to-End						
1/2	4.20	4.10	2.42	2.44	6.30	0.350	0.370
3/4	5.02	4.62	3.02	3.05	7.34	0.690	0.730
1	5.47	5.32	3.22	3.40	8.17	0.960	1.000
1 1/4	6.53	6.07	4.01	4.06	9.41	2.155	2.255
1 1/2	6.89	6.23	4.10	4.18	10.05	2.190	2.315
2	8.04	7.39	5.01	5.19	11.44	4.410	4.670

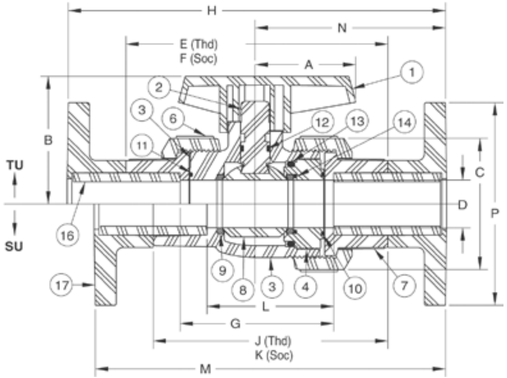
Valve Size	A[1]	B	C	D	K Flgd.	CV[3] TU
	TU Figures Profile					Fluid Flow Coefficient
1/2	2.07	2.16	1.82	.50	3.50	6.4
3/4	2.74	2.90	2.36	.75	3.88	38.7
1	2.74	3.07	2.73	1.00	4.26	58.2
1 1/4	2.62	3.91	4.07	1.25	4.62	61.7
1 1/2	2.62	3.91	4.07	1.50	5.00	117.4
2	3.12	4.71	5.23	2.00	6.00	178.4

1 Handle is not symmetrical about centerline. Dimensions shown represent the longest operational radius. The handle position is correctly shown for the 1/2" - 3" True Union valve style.
2 Weight for 1/2" - 2" TU figures includes both sets of end connectors.
3 C_V values computed for basic valve laying lengths (G).

PVC and CPVC Tru-Bloc® True Union Ball Valve, Model C

Chemtrol Figure Number							
Valve Style	Elasto-meric Trim	PVC			CPVC		
		Soc.	Thd.*	Flgd.	Soc.	Thd.*	Flgd.
TU/TB	FKM	S45TB-V	T45TB-V	F45TB-V	S51TB-V	T51TB-V	F51TB-V
	EPDM	S45TB-E	T45TB-E	F45TB-E	S51TB-E	T51TB-E	F51TB-E

* Thread end connections are not available for 6" valves.



Dimensions–Weights–Flow Coefficients

Valve Size	TU Figures End-to-End				
	E Thd.	F Soc.	G Soc.	H Flgd	Approx.[2] Wt. Lbs.
3	10.39	10.39	6.58	14.63	11.25
4	12.22	12.22	7.66	17.63	17.68
6[4]	NA	30.22	24.16	24.08	29.25

Valve Size	TU Figures Profile						Fluid Flow Coefficient
	A[1]	B	C	D	N	P	CV[3] TU
3	4.00	5.59	7.18	3.00	7.42	7.50	1348
4	8.00	6.05	8.78	4.00	8.52	9.00	2602
6[4]	8.00	6.05	8.78	4.00	11.90	11.05	2602

1 Handle is not symmetrical about center line. Dimensions shown represent the longest operational radius. The handle position is correctly shown for the 3" True Union valve style, but the position must be rotated 180° from that shown for the 4" - 6" True Unions.
2 Weight includes socket end connections only for 3" - 6" sizes. The material represented is PVC in all cases.
3 C_V values computed for basic valve laying lengths (G).
4 The 6" ball valve is a Venturi design derived from the 4" valve: a 4" end connector and a 6" coupling are connected by a 6" x 4" Venturied reducer, with a union nut captured within the assembly. Threaded end connection not available.

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PVC and CPVC Tru-Bloc® True Union Vented (Bleach) Ball Valve, Model D

The Problem
Sodium hypochlorite, used in water treatment, aquatic centers, and paper and textile applications, can become trapped in the body cavity of a closed ball valve and create conditions that may result in damage to the valve or system as a result of unstable chemical decomposition.

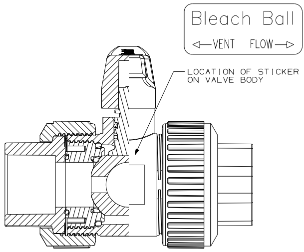
The Chemtrol Solution
The Vented Ball Valve is a special factory modification to a PVC or CPVC True Union Ball Valve that effectively vents sodium hypochlorite out-gassing to the pressure port. In addition, the inner valve surfaces are kept constantly wetted to ensure problem-free use of the ball valves in bleach transfer and injection applications.

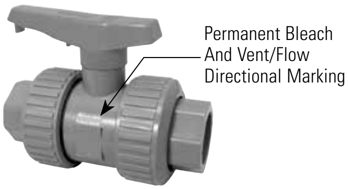
Background
In the search for a safer alternative to chlorine vacuum gas injection, fresh and wastewater treatment, paper and textile plants, and aquatic centers are converting to the use of sodium hypochlorite as a disinfectant or bleaching agent. A high pH level characterizes commercial bleach, which consists of a nominal 15% solution of sodium hypochlorite along with approximately 1-2% of sodium hydroxide to act as a chemical stabilizer. Known as a good oxidizer, the solution has been found to cause stress cracking in polyethylene and polypropylene materials. And metallic materials react, causing rapid decomposition of the “hypo.” However, PVC and CPVC, with fluorocarbon rubber (FKM) seals, have been successfully used for years to handle this aggressive chemical solution.

Some system design considerations are important, though. Heat, time, and positive ions are enemies of bleach stability. When a ball valve is closed in periods of inactivity, the bleach will decompose over time liberating oxygen gas. The decomposition rate is increased by heat absorbed from sun shining on exposed piping, or by reaction heat resulting from debris trapped in a ball valve body between the ball and its seats. Gas pressure may slowly build in the closed valve cavity, or quite rapidly in the reactive case. Such conditions may result in damage to the valve or system.

Also, evaporation of sodium hypochlorite in the ball cavity can lead to the formation of crystalline residue that eventually embeds in the PTFE seats of a ball valve and significantly raises the turning torque due to excessive wear on the ball by fouled seats. Such conditions may result in a broken valve stem, frozen valve ball, or other damage to the valve or system.

The Chemtrol® Vented Ball Valve offers a viable solution for sodium hypochlorite transfer and injection applications. Our unique factory-assembled bleach ball valve has effectively eliminated the problems associated with these uses. By ensuring that all inner surfaces of the valve are kept constantly wetted and vented to the upstream side when the valve is in the closed position, we have eliminated the conditions required for gas accumulation and caustic crystallization in the body cavity.



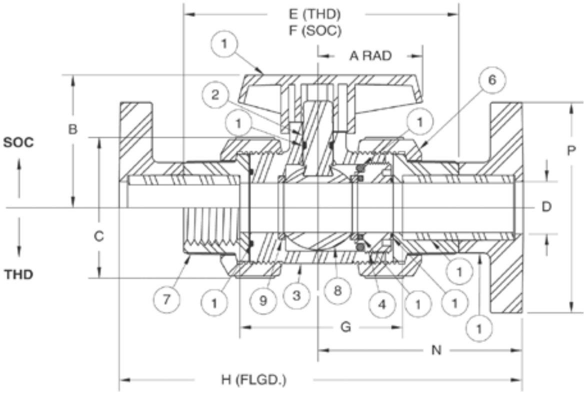


Black and Chem-Pure® (Natural) Polypropylene Tru-Bloc® True Union Ball Valve, Model C

Chemtrol Figure Number

Valve Sizes	Materials	Elastomeric Trim	End Connections Soc..	Thd.	Flgd.
1/2"- 4"	Black Polypro	FKM	S61TB-V1	T61TB-V1	F61TB-V1
1/2" - 4"	Natural Polypro	FKM	S62TB-V2	S62TB-V2	NA2

1 Flanged figures are not available in the 1 1/4" size.
2 Socket Chem-Pure® (natural PP) Valves are available in the range of sizes shown except for the 1 1/4" size. Socket valves may be converted to threaded by exchanging the socket end connector with a threaded end connector. Flanged figures are not available.



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Black and Chem-Pure® (Natural) Polypropylene Tru-Bloc® True Union Ball Valve, Model C

Dimensions–Weights–Flow Coefficients

Valve Size	End-to-End E Thd.	End-to-End F Soc.	End-to-End G Soc.	End-to-End H Flgd	Approx.[2] Wt. Lbs.
1/2	4.19	4.19	2.49	6.04	0.32
3/4	5.00	5.00	3.05	7.32	0.58
1	5.50	5.50	3.30	8.06	0.76
1 1/4	6.47	N/A	N/A	N/A	1.69
1 1/2	6.76	6.76	4.06	9.92	1.79
2	8.01	8.01	5.06	11.41	3.52
3	10.39	10.39	6.70	14.87	7.98
4	12.22	12.22	7.78	17.52	15.78

Valve Size	Profile A[1]	Profile B	Profile C	Profile D	Profile N	Profile P	Fluid Flow Coefficient CV[3]
1/2	1.70	1.94	1.96	0.50	2.98	3.44	22
3/4	2.12	2.50	2.41	0.75	3.63	3.82	56
1	2.12	2.69	2.76	1.00	4.13	4.20	113
1 1/4	2.56	3.74	4.01	1.25	4.70	4.55	180
1 1/2	2.56	3.74	4.01	1.50	4.98	4.91	288
2	2.92	4.25	5.13	2.00	5.78	5.87	544
3	4.00	5.59	7.04	2.97	7.42	7.41	1348
4	8.00	6.05	8.59	4.01	8.52	8.85	2602

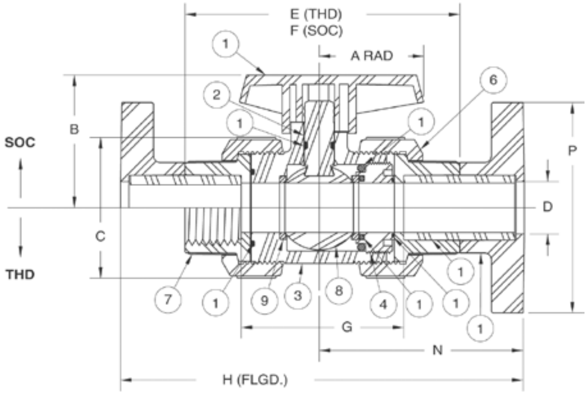
1 Handle is not symmetrical about centerline. Dimension shown represents the longest operational radius, but the handle position must be rotated 180° from that shown for the 4" size.
2 Weight shown represents the polypropylene threaded figure.
3 C_V values were computed for basic valve laying lengths (G).
4 No flanged figures are offered in any size for natural PP.

Red and Natural Kynar® PVDF Tru-Bloc® True Union Ball Valve, Model C

Chemtrol Figure Number

Valve Sizes	Materials	Elastomeric Trim	End Connections Soc..	Thd.	Flgd.
1/2"- 4"	Red PVDF[1]	FKM	S65TB-V	T65TB-V	F65TB-V
1/2" - 4"	Natural PVDF[1]	FKM	S66TB-V	S66TB-V	F66TB-V

1 No Kynar® pipe, fittings, or valves are offered in the 1 1/4” size.



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Red and Natural Kynar® PVDF Tru-Bloc® True Union Ball Valve, Model C

Dimensions–Weights–Flow Coefficients

Valve Size[4]	End-to-End E Thd.	F Soc.	G Soc.	H Flgd	Approx.[2] Wt. Lbs.
1/2	4.19	4.19	2.49	6.04	0.47
3/4	5.00	5.00	3.05	7.32	0.84
1	5.50	5.50	3.30	8.06	1.15
1 1/2	6.76	6.76	4.06	9.92	2.59
2	8.01	8.01	5.06	11.41	5.30
3	10.39	10.39	6.70	14.87	12.58
4	12.22	12.22	7.78	17.52	24.41

Valve Size[4]	Profile A[1]	B	C	D	N	P	Fluid Flow Coefficient CV[3]
1/2	1.70	1.94	1.95	0.50	2.98	3.41	22
3/4	2.12	2.50	2.36	0.75	3.63	3.77	55
1	2.12	2.69	2.75	1.00	4.13	4.15	112
1 1/2	2.56	3.74	3.98	1.50	4.98	4.86	285
2	2.92	4.25	5.13	2.00	5.78	5.82	540
3	4.00	5.59	6.99	2.90	7.42	7.31	1348
4	8.00	6.05	8.54	3.95	8.52	8.70	2602

1 Handle is not symmetrical about the centerline. Dimension shown represents the longest operational radius, but the handle position must be rotated 180° from that shown for the 4" size.
2 Weight shown represents the socket figure.
3 C_V values were computed for the basic valve laying lengths (G).
4 No pipe, fittings, or valves are offered in the 1 1/4" size.

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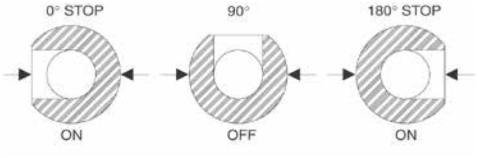
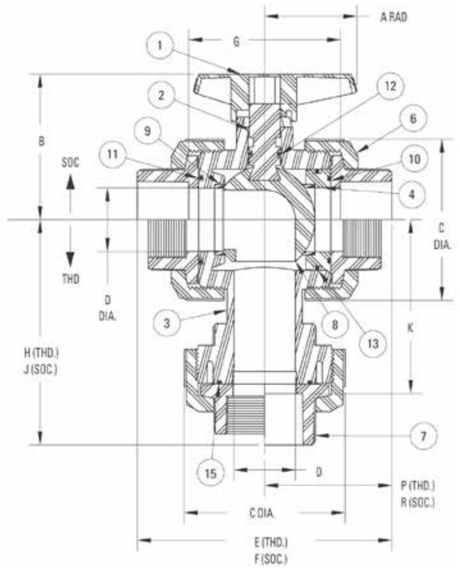
PVC and CPVC 3-Way, 3-Position (Multiport/Diverter) True Union Ball Valve, Model A

Multiport



Diverter



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PVC and CPVC 3-Way, 3-Position (Multiport /Diverter) True Union Ball Valve, Model A

Chemtrol Figure Numbers					
Valve Style	Elastomeric Trim	PVC Soc.	Thd.	CPVC Soc.	Thd.
1/2" – 2" Multiport	FKM	S45M3-V	T45M3-V	S51M3-V	T51M3-V
(3-Way/3-Position)	EPDM	S45M3-E	T45M3-E	S51M3-E	T51M3-E

Dimensions–Weights–Flow Coefficients

Valve Size	Soc. & Thd. Figures A[1]	B	C	D
1/2	2.07	1.94	2.00	0.50
3/4	2.74	2.50	2.44	0.75
1	2.74	2.69	2.86	1.00
1 1/4	2.62	3.74	4.08	1.25
1 1/2	2.62	3.74	4.08	1.25
2	3.12	4.25	5.25	2.00

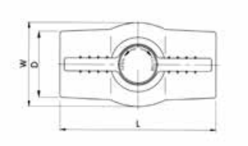
Valve Size	Socket Figures F	G	J	K	R	Approx.[2] Wt. Lbs.
1/2	4.19	2.41	3.56	2.69	2.13	0.64
3/4	5.00	2.97	4.19	3.19	2.50	1.15
1	5.50	3.22	4.63	3.50	2.75	1.59
1 1/4	6.47	3.94	5.88	4.63	3.25	3.43
1 1/2	6.76	3.98	6.00	4.63	3.38	3.62
2	8.01	4.98	7.08	5.63	3.96	7.02

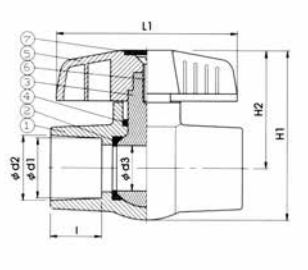
Valve Size	Threaded Figures E	H	P	Approx.[2] Wt. Lbs.	Fluid Flow Coefficient CV[3]
1/2	4.00	3.50	2.06	0.60	8
3/4	4.63	4.00	2.31	1.05	19
1	5.18	4.44	2.63	1.50	36
1 1/4	6.10	5.63	3.06	3.24	55
1 1/2	6.15	5.63	3.06	3.37	55
2	7.35	6.81	3.62	6.25	149

1 Handle is not symmetrical about stem centerline. Dimension shown represents the longest operational radius.
2 Weights shown for socket figures are CPVC models. Weights for threaded figures are PVC models.
3 C_V values were computed using equivalent cylinder length for 90° turn with full bore.

* 1 1/2" valve has conventional port on center outlet.

PVC Compact Economy Ball Valve





Chemtrol Figure Numbers			
Material	O-Rings	Ends	(1/2" - 2")
PVC	EPDM	Soc.	S45CE-E
PVC	EPDM	Thd.	T45CE-E
PVC	FKM	Soc.	S45CE-V
PVC	FKM	Thd.	T45CE-E

Dimensions–Weights–Flow Coefficients

Size In.	Size mm	Thd./In. (NPT)	d1	d2	d3	D	L	L1
1/2	15	14	0.84	0.85	0.55	1.18	3.27	2.76
3/4	20	14	1.05	1.06	0.79	1.50	3.74	3.46
1	25	11.5	1.31	1.32	0.98	1.77	4.17	3.94
1 1/4	32	11.5	1.65	1.67	1.18	2.13	4.48	3.94
1 1/2	40	11.5	1.89	1.91	1.42	2.44	5.12	4.29
2	50	11.5	2.39	2.39	1.83	3.03	5.79	5.28

Size In.	Size mm	l	H1	H2	W	Weight/lbs.	Cv
1/2	15	0.87	2.44	1.69	1.50	0.18	8.84
3/4	20	1.00	3.07	2.13	1.93	0.18	—
1	25	1.12	3.66	2.56	2.24	0.49	25.24
1 1/4	32	1.25	3.86	2.64	2.48	0.64	38.53
1 1/2	40	1.38	4.53	3.07	2.95	0.94	51.28
2	50	1.50	5.31	3.50	3.62	1.50	96.67

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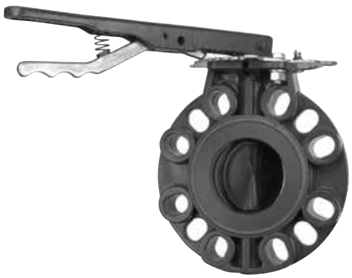
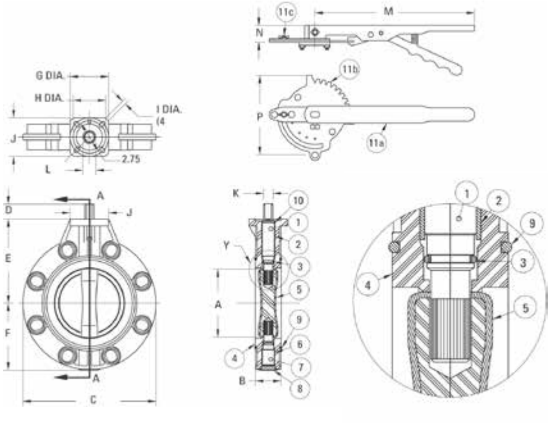
PVC Butterfly Valves, Model C





Chemtrol Figure Number

Disk Material	Operating Mechanism	2" – 10" Figure No.[1]
EPDM	Lever Handle[2]	W45BG-E-3
	Gear Operator	W45BG-E-5

1 10" is available with gear operator only.
2 Includes throttle plate and lock.

C_v Table

	Degrees Open								
Size	10°	20°	30°	40°	50°	60°	70°	80°	90°
2	2.5	8	18	33	50	73	100	131	166
2 1/2	3.7	12	27	49	74	109	148	195	247
3	4.3	16	35	62	94	135	180	235	290
4	8.6	34	76	137	215	310	420	550	690
6	17.5	67	200	265	410	580	790	1040	1340
8	20.8	83	190	320	530	770	1060	1380	1780
10	50.0	195	430	775	1200	1775	2700	3100	4000

PVC Butterfly Valves, Model C

Dimensions–Weights

Valve Size	A	B	C	D	E	F	G	H	I
2	1.94	1.69	6.41	1.25	3.94	3.29	3.25	2.75	0.44
2 1/2	2.44	1.81	7.19	1.25	4.13	3.63	3.25	2.75	0.44
4	3.82	2.06	9.08	1.25	5.31	4.57	3.25	2.75	0.44
6	5.76	2.20	11.22	1.25	7.09	5.64	3.25	2.75	0.44
8	7.74	2.36	13.66	1.25	8.00	6.83	3.25	2.75	0.44
10	9.57	2.68	16.49	1.25	9.84	8.40	5.00	4.01	0.56

Valve Size	J	K	L	M	Handle N	P	Approx.[1] Wt./Lbs.
2	3.26	0.37	0.50	10.50	1.01	6.19	2.02
2 1/2	3.26	0.37	0.50	10.50	1.01	6.19	2.56
4	3.26	0.50	0.65	10.50	1.01	6.19	5.04
6	3.26	0.56	0.78	13.75	1.01	6.19	8.99
8	3.26	0.56	0.78	13.75	1.01	6.19	14.27
10	4.76	0.74	1.06	Gear Operator Only			27.70

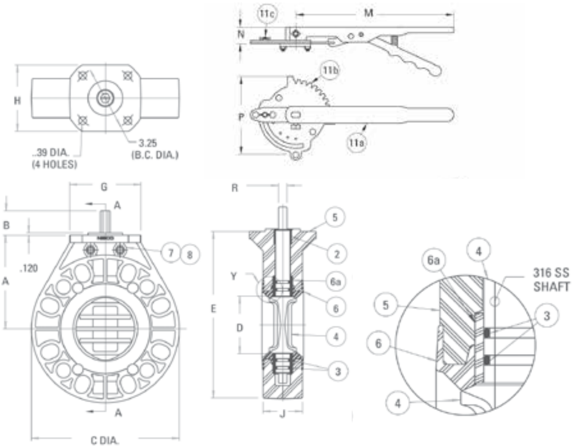
1 Operator not included in weight.

PVC Butterfly Valves, Model B

Chemtrol Figure Numbers				
Seat Material	Operating Mechanism	3" (CPVC)[2] Figure No.	4" (PVC) Figure No.	6" (PVC) Figure No.
EPDM	No Operator	W51BF-E-NO	W45BF-E-NO	W45BF-E-NO
	With Lever[1] Handle	W51BF-E-LH	W45BF-E-LH	W45BF-E-LH
	With Gear Operator	NA	W45BF-E-GO	W45BF-E-GO
FKM[1]	No Operator	W51BF-V-NO	W45BF-V-NO	W45BF-V-NO
	With Lever[1] Handle	W51BF-V-LH	W45BF-V-LH	W45BF-V-LH
	With Gear Operator	NA	W45BF-V-GO	W45BF-V-GO

1 Includes throttle plate and hardware.
2 Body and disk/stem for 3" size are available in CPVC only.

PVC Butterfly Valves, Model B



C_V Table

	Degrees Open								
Size	10°	20°	30°	40°	50°	60°	70°	80°	90°
3	4.3	16	35	62	94	135	180	235	290
4	8.6	34	76	137	215	310	420	550	690
6	17.5	67	200	265	410	580	790	1040	1340

Dimensions–Weights

Valve Size	A	B	C	D	E	J	G
3	4.75	1.26	7.00	3.06	8.50	2.00	3.62
4	6.13	1.22	9.00	4.00	10.63	2.22	3.62
6	7.50	1.62	11.00	5.97	13.00	2.77	3.76

Valve Size	G	H	R	M	N	Handle P	Approx. Wt./Lbs.
3	3.62	3.38	.37	10.50	1.01	6.19	3.25
4	3.62	3.38	.50	10.50	1.01	6.19	6.00
6	3.76	3.50	.56	13.75	1.01	6.19	12.00

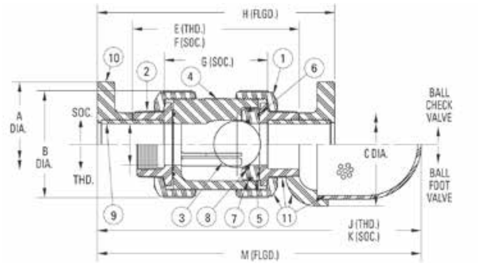
1 Operator not included in weight.

PVC and CPVC True Union Ball Check, Foot, and Vent Valves

Chemtrol Figure Numbers

Type Valve	End Conn	Elastomeric Trim	Materials	
			PVC	CPVC
Ball Check Valve	Soc.	FKM EPDM	U45BC-V[1] U45BC-E[1]	U51BC-V[1] U51BC-E[1]
	Thd.	FKM EPDM	U45BC-V[1] U45BC-E[1]	U51BC-V[1] U51BC-E[1]
	Flgd.	FKM EPDM	F45BC-V F45BC-E	F51BC-V F51BC-E

1 1/2"–2" PVC and CPVC TU ball check figures are supplied with universal connection components (i.e., a set of both socket and threaded end connectors). For 3" and 4" sizes of PVC and CPVC BC valves, replace U in the figure no. with S or T for socket or threaded units respectively.



PVC and CPVC True Union Ball Check, Foot, and Vent Valves

Dimensions–Weights–Flow Coefficients

Valve Size	Ball Check/Foot A	B	C	D	Ball Check Valve E Thd.	F Soc.	G Soc.	H Flgd.	Approx.[2] Wt. Lbs.
1/2	3.50	1.98	2.63	0.50	3.94	4.13	2.36	6.27	0.42
3/4	3.88	2.44	2.63	0.75	4.65	5.02	3.00	7.38	0.72
1	4.26	2.83	3.63	1.00	5.08	5.40	3.12	7.99	1.05
1 1/4	4.62	4.08	5.50	1.25	6.38	6.75	4.22	9.65	2.46
1 1/2	5.00	4.08	5.50	1.50	6.38	6.99	4.21	10.18	2.62
2	6.00	5.23	5.50	2.00	7.36	8.02	4.99	11.45	4.76
3	7.50	7.17	5.50	3.00	9.98	9.98	6.17	14.22	9.21
4[4]	9.00	7.17	5.50	3.00	20.76	20.76	16.20	16.14	14.18

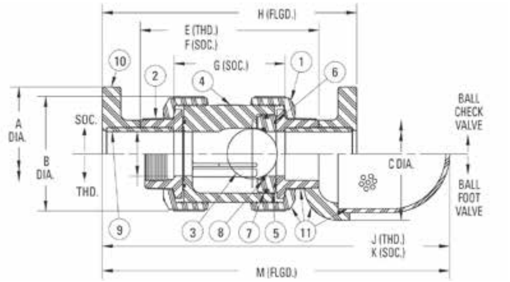
Valve Size	Ball Foot Valve J Thd.	K Soc.	M Flgd.	Approx.[3] Wt Lbs	Seating Head Ft - H_2O Vert.	Horiz.	Fluid Flow Coefficient C_V[3]
1/2	6.13	6.19	7.25	0.23	6	7	5
3/4	6.88	7.13	8.25	0.29	6	7	10
1	8.13	8.25	9.63	0.37	4	5	19
1 1/4	11.13	11.25	12.75	1.34	4	5	37
1 1/2	11.13	11.50	13.13	1.34	4	5	56
2	11.75	12.13	13.75	1.88	4	5	101
3	13.38	13.38	15.63	3.00	3	4	251
4[4]	18.50	18.50	16.25	3.00	3	4	251

1 Foot valve screen housing assemblies are available for the field conversion of PVC and CPVC TU ball check valves in sizes 1/2" - 4".
2 Weights shown for ball valve figures are PVC threaded models. For an approximation of CPVC check valve weights, the PVC weight may be multiplied by factor of 1.123. Weights shown for foot valves are actually those for PVC F.V. screen housing assemblies. So, the weight for a CPVC F.V. screen housing assy. may be found by multiplying the PVC weight by the 1.123 factor. These must be added to check valve weight for full foot valve weight.
3 C_v values are based on the basic valve laying length (G).
4 The 4" PVC and CPVC check valves are fabricated by solvent cementing either reducing flanges or reducing couplings onto the ends of a 3" valve with plain-end nipples.

Polypropylene and Kynar® PVDF True Union Ball Check, and Vent Valves

Chemtrol Figure Numbers

Type Valve	End Conn	Elastomeric Trim	Materials			
			Black Polypro	Chem-Pure Natural Polypro	Red PVDF	Natural PVDF
Ball Check Valve	Soc.	FKM	S61BC-V	S62BC-V	S65BC-V	S66BC-V
	Thd.	FKM	T61BC-V	NA	T65BC-V	T66BC-V
	Flgd.	FKM	F61BC-V	NA	F65BC-V	F66BC-V



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Polypropylene and Kynar® PVDF True Union Ball Check, and Vent Valves

Dimensions[1]–Weights–Flow Coefficients

Valve Size	Ball Check/Foot A	B	C	D	E Thd.
1/2	3.50	1.98	2.63	0.50	3.94
3/4	3.88	2.44	2.63	0.75	4.65
1	4.26	2.83	3.63	1.00	5.08
1 1/2	5.00	4.08	5.50	1.50	6.38
2	6.00	5.23	5.50	2.00	7.36

Valve Size	Ball Check Valve F Soc.	G Soc.	H Flgd.	Approx.[2] Wt. Lbs	Seating Head Ft - H_20 Vert.	Horiz.	Fluid Flow Coefficient C_V[3]
1/2	4.13	2.36	6.27	0.42	6	7	5
3/4	5.02	3.00	7.38	0.72	6	7	10
1	5.40	3.12	7.99	1.05	4	5	19
1 1/2	6.99	4.21	10.18	2.62	4	5	56
2	8.02	4.99	11.45	4.76	4	5	101

1 Dimensions shown are for PVC and CPVC. Due to molding shrinkage the dimensions for PP and PVDF would be somewhat less, and the end-to-end length of threaded equals socket valves.
2 Weights shown for ball valve figures are PVC threaded models. For an approximation of PVDF, and PP check valve weights the PVC weight may be multiplied by factors of 1.275, or 0.656 respectively.
3 C_v values are based on the basic valve laying length (G).

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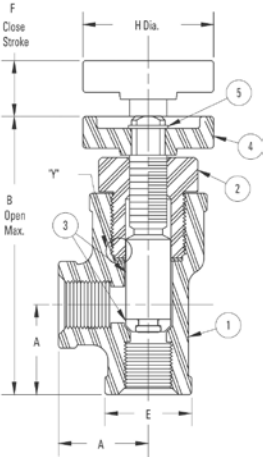
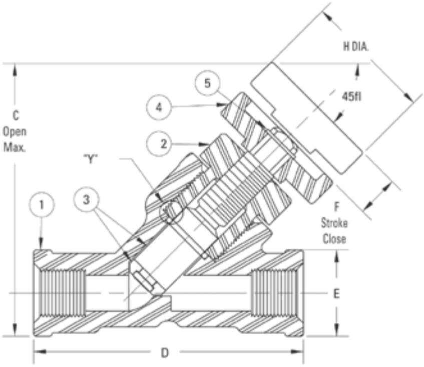
PVC Angle and Y-Pattern Globe Valves

Chemtrol Figure No.
T45AC-V

Chemtrol Figure No.
T45YC-V





Both styles available with threaded end connections only.

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PVC Angle and Y-Pattern Globe Valves

Dimensions–Weights–Flow Coefficients

Valve Size	Common Dimensions: Hub Dia. E	Close Stroke F	Handle Dia. H
1/4	0.88	.44	1.32
1/2	1.25	.75	2.19
3/4	1.50	.94	2.19
1	1.75	1.19	2.19

Valve Size	Angle Valve[1]: Center-To-Face A	Open Max. B	Flow Coefficient C_V[2]	Approx. Weight Lbs.
1/4	0.88	3.56	1.1	0.11
1/2	1.31	5.38	5.4	0.28
3/4	1.41	6.50	9.9	0.47
1	1.88	7.88	15.8	0.69

Valve Size	Y-Pattern Valve[1]: End-To-End D	Open Max. C	Flow Coefficient Cv2	Approx Weight Lbs.
1/4	2.75	2.75	3.1	0.12
1/2	3.50	4.63	17.7	0.30
3/4	4.25	5.56	32.5	0.53
1	5.00	6.31	49.3	0.73

1 Available with threaded end connections only.
2 C_V measured with valves completely open.

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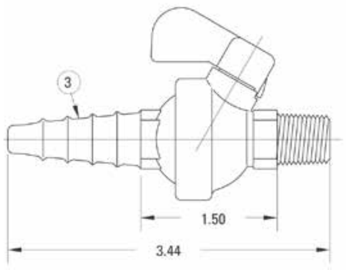
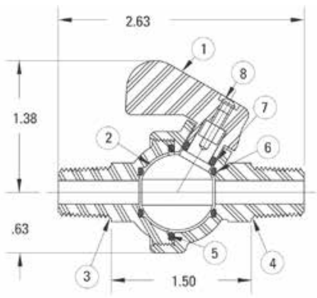
PVC Chemcock® Valves





Chemtrol Figure No.	
A45CC-V	1/4" Hose x 1/4" MPT
M45CC-V	1/4" MPT x 1/4" MPT

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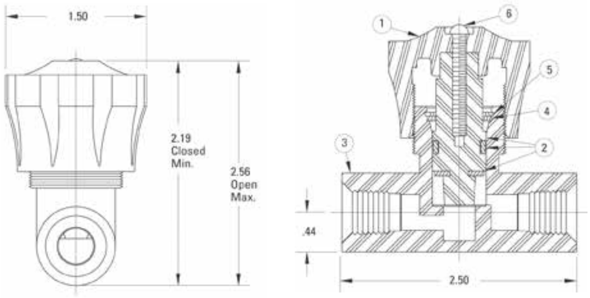
Calibrated Needle Lab Valves



Chemtrol Figure No.	
T45CN-V	1/4" FPT x 1/4" FPT

Knob Position	GPM @ Constant 50 PSI
8	.85
7	1.41
6	1.79
5	2.15
4	2.42
3	3.15
2	4.40
1	4.50

Alternative Manual Operators

Part Numbers for Alternative Manual Operators						
Accessory	Use	Valve Size 1/2	3/4 & 1	1 1/4 & 11/2	2	
2" Sq. Nut Stem Adapter	PVC for TB Ball Valves	21630007	21630009	21630011	21630012	
	PVC for HV Ball Valves	21630007	21630009	21630011	21630011	
Round Safety Handle	PVC for TB Ball Valves	81616007	81616009	81621011	81621012	
	PVC for HV Ball Valves	81616007	81616009	81621011	81621011	
Accessory	Use	2 1/2	3	4	6	8
2" Sq. Nut Stem Adapter	PVC for TB Ball Valves	—	21630014	21630016	21630016	—
	PVC for HV Ball Valves	—	—	—	—	—
Round Safety Handle	PVC for TB Ball Valves	—	—	—	—	—
	PVC for HV Ball Valves	—	—	—	—	—

PVC Standoff Stem Extensions For Ball Valve						
Length Of Ext.	Valve Size 1/2	3/4 & 1	1 1/4 & 1 1/2	2	3	4 & 6
1" Long	21618007	21618009	—	—	—	—
2" Long	21617150	21617175	21617214	21617226	21617069	21617076
3" Long	21617151	21617177	21617216	21617229	21617249	21617078
4" Long	21617153	21617179	21617218	21617231	21617251	21617257
5" Long	21617155	21617181	21617220	21617228	21617299	21617298
6" Long	21617157	21617183	21617222	21617235	21617252	21617260

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Alternative Manual Operators

2" Square Nut Stem Adapter–Permits operation of a valve with a standard utility (AWWA) wrench. The most common application is for valves located in an underground valve box. The square nut for ball valves is made from PVC. It snaps onto the stem and locks into the slot for turning-stops of a ball valve of any material, in place of its standard handle.

Round Safety Handle–Design prevents accidental operation of low-torque ball valve by snagging the lever handle with personal clothing or equipment. Suitable for PVC and CPVC Tru-Bloc® True Union Ball Valves, Model D.

Standoff Stem Extensions for Ball Valves– Provide handle clearance, with the integrity of turning-stops, for insulating, panel-mounting, or shallow submerged applications. These extensions are made of solid PVC, and are short; so top support is not required. Although priced in increments of 1" standoff, between handle and stem, they can be supplied in exact lengths if specified when ordered. And, if the extension is to be installed on a valve of material other than PVC or CPVC, that must also be specified when ordering.

Valve Lockout Devices

Type Lockout Device	Location Mounted	Valve Size 1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	6	8
BV Handle and Locking Ring Kit	Field	81644007	81644008	81644009	81644011	81644011	81644012	—	—	—	—	—
PP Lockout Cover for Ball Valve	Field	70060210	70060210	70060210	70060211	70060211	70060211	—	70060212	—	—	—
Ball Valve-Mounted Lockout Kit	Field	70050007	70050008	70050009	70050011	70050011	70050012	—	70050014	70050016	70050016	—
W/ Std. Plastic Handle	Factory	70050107	70050108	70050109	70050111	70050111	70050112	—	70050114	70050116	70050116	—
Ball Valve-Mounted Lockout Kit	Field	70080007	70080008	70080009	70080011	70080011	70080012	—	70080014	70080016	70080016	—
W/ Lever Handle and Index Plate	Factory	70080107	70080108	70080109	70080111	70080111	70080112	—	70080114	70080116	70080116	—

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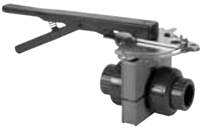
Valve Lockout Devices

Meet OSHA Standard 29 CFR 1910.147; The Control of Hazardous Energy (Lockout/Tagout). The range in complexity and cost of these devices generally reflects the various usage requirements of frequency, permanency, and multiples of function. The gang hasp, for multi-discipline locking, is shown for the purpose of illustration only. It is not available with any of the devices.

TB Ball Valve Handle and Locking Ring Kit
The locking ring surrounds the valve body for permanent attachment to the valve. When the lock device is removed from the handle and retaining arm of the ring, the ring arm simply hangs beneath the valve. This single function kit is effective for valve-off lockout only or may be added to other Tru-Bloc® valves of any material.

Ball Valve Lockout Cover
This two-piece molded polypropylene split clamshell closure, which is hinged to fasten around the common handles of Tru-Bloc valves, is a simple provision for maintenance or operations lockout. The cover can be locked with the handle in the on, off, or any throttling position, but when the cover is locked the handle position, relating ball posture, is not visible. One of three cover sizes is usually transported to the point of use, because a cover is not easily attached to the valve when it is unlocked.

TB Ball Valve-Mounted Lockout Kit w/ Standard Plastic Handle
This all-plastic kit, permanently mounted on a valve, may be locked in the on or off valve position. Whether locked or unlocked, the distinguishing handle position is clearly visible at all times, including throttling postures.



TB Ball Valve-Mounted Lockout Kit w/ Lever Handle and Index Plate
This kit consists of a lever-lock handle and index plate, adapted to fit a ball valve mount. It provides for locking the valve in the off position or any of the 9 increments of opening (10° each), including the full on position. The handle position, aligned with the fully on ball posture, is visible at all times.

Chemtrol® Ball Valve Actuation

Features

Control Chemtrol® ball valves with a selection of NIBCO® pneumatic or electric actuators

- Double-acting and spring return pneumatic actuators
- NEMA 4 electric actuators with heater and thermostat
- Modulating control: 3-15 psi and 4-20 mA
- Easy-to-assemble mounting hardware

Size	Pneumatic Spring Return			Pneumatic Double Acting		
	ISO	Mount [2]	Actuator	ISO	Mount [2]	Actuator
½″	F03	T117002	NSR2	F03	T117002	NDA2
¾″	F04	T117009	NSR4	F03	T117003	NDA2
1″	F04	T117010	NSR4	F03	T117004	NDA2
1 ¼″	F04	T117011	NSR4	F03	T117005	NDA2
1 ½″	F04	T117011	NSR4	F03	T117005	NDA2
2″	F05	T117012 / T117584	NSR8-5	F04	T117006	NDA4
3″ [3]	F07	T117013 / T117586	NSR20-7	F05	T117007 / T117584	NDA8-5
4″ [3]	F07	T117014 / T117586	NSR20-7	F05	T117008 / T117584	NDA8-5

Size	115 VAC Electric, NEMA 4 [1]		
	ISO	Mount	Actuator
½″	F04	T116998	NE300-4-4
¾″	F04	T117009	NE300-4-4
1″	F04	T117010	NE300-4-4
1 ¼″	F04	T117011	NE300-4-4
1 ½″	F04	T117011	NE300-4-4
2″	F04	T117006	NE300-10-4
3″ [3]	F07	T117013	NE500-10
4″ [3]	F07	T117013	NE500-10

[1] Electric actuators specified with NEMA 7 enclosures are available. Electric actuators with DC power or 220 VAC power are available. For additional options, contact NIBCO Technical Services at 888.446.4226.

[2] Two separate materials are only required for NIBCO actuators used with 2" and above valves where the NIBCO actuator is not designed to the ISO dimensional standard.

[3] 3″ and 4″ actuation is not available for polypropylene or PVDF valves.

For more actuator dimensions and details, see the NIBCO Pnuematic Actuation catalog and various Electric Actuator product sheets by visiting www.nibco.com/literature.

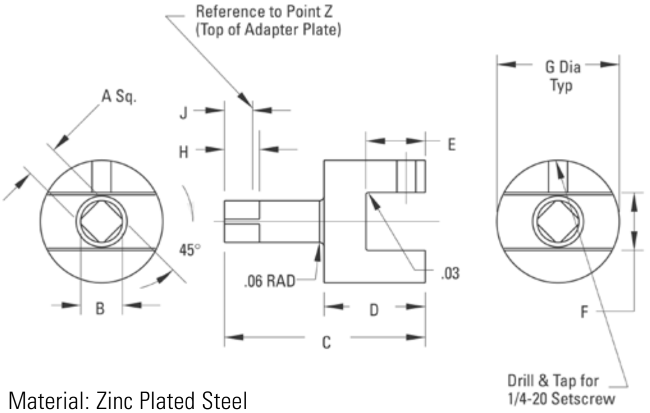
Actuator Mounting Data

The same plastic modular mounting kits, including fastener hardware and drive couplings, used for factory assembly, are available for field assembly of *Chemtrol® actuation* equipment to installed valves. When designing the *CPVC mounting brackets and adapter plates* we recognized that some facilities specify Chemtrol® plastic valves, but are standardized on other actuator brands. Therefore, holes in the mounting platforms are slotted and the heights of platforms over valve stems are set to offer the broadest mounting flexibility. For many reasons, including economic, the use of Chemtrol® mount kits is also encouraged when joining Chemtrol® valves to other actuator brands, and the critical data on this page is offered to facilitate adaptation.

True Union Ball Valve Min. Torque & Actuator-Mounting Dimensions

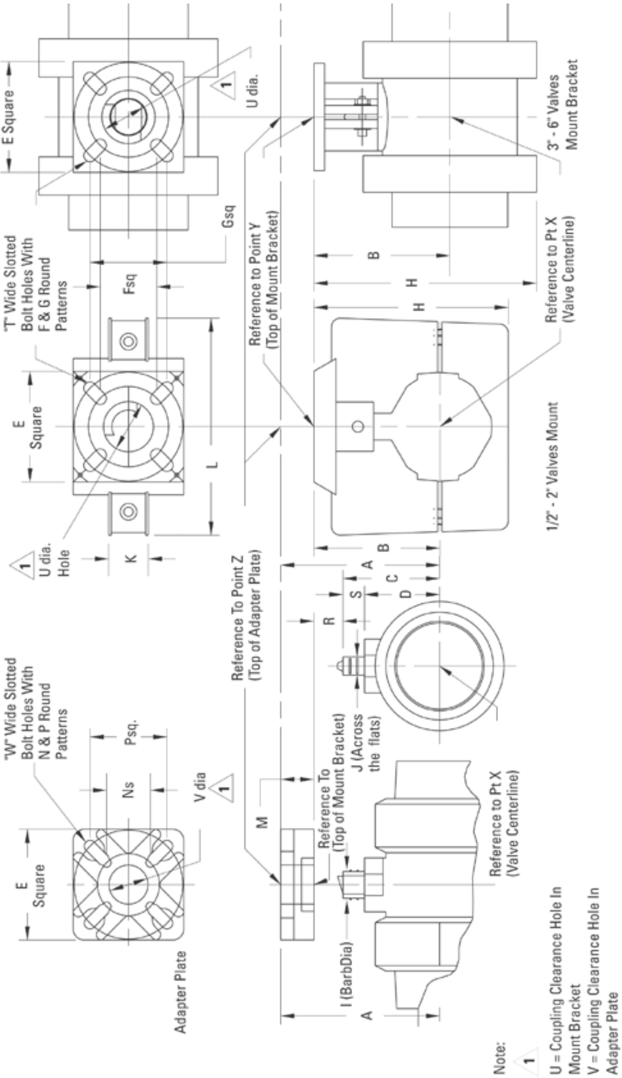
Valve Size	Min. Torque (in. lbs.)	A	B	C	D
1/2	40	3.62	2.87	1.35	0.96
3/4	50	3.62	2.87	1.87	1.53
1	50	3.62	2.87	2.16	1.70
1 1/4 / 1 1/2	90	5.25	4.50	3.01	2.46
2	170	5.25	4.50	3.75	3.07
3	360	7.00	6.00	4.75	4.00
4/6	540	8.35	7.35	5.81	5.31

Ball Valve Drive Coupling



Material: Zinc Plated Steel

Actuator Mounting Data



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Actuator Mounting Data

Valve Size	E	F		G		H	I	J	K	L	M	N		P		R	S	T	U	V	W
		B.C.	Sq.	B.C.	Sq.		Dia.	Flats				B.C.	Sq.	B.C.	Sq.						
1/2	2.50	1.82	1.29	2.46	1.74	4.43	0.422	0.280	0.90	4.89	0.75	1.40	0.99	2.60	1.84	1.34	0.57	0.28	1.13	0.88	0.26
3/4	2.50	1.82	1.29	2.46	1.74	4.43	0.613	0.450	0.90	4.89	0.75	1.40	0.99	2.60	1.84	1.00	0.34	0.28	1.13	0.88	0.26
1	2.50	1.82	1.29	2.46	1.74	4.43	0.613	0.450	0.90	4.89	0.75	1.40	0.99	2.60	1.84	0.71	0.46	0.28	1.13	0.88	0.26
1 1/4 / 1 1/2	3.00	2.46	1.74	3.02	2.14	7.22	0.738	0.535	1.26	7.32	0.75	1.40	0.99	3.02	2.14	1.49	0.55	0.34	1.64	0.88	0.32
2	3.00	2.46	1.74	3.02	2.14	7.22	0.988	0.755	1.26	7.32	0.75	1.40	0.99	3.02	2.14	0.75	0.68	0.34	1.64	0.88	0.32
3	5.00	2.74	1.94	5.16	3.65	9.59	1.240	0.900	–	–	1.00	1.84	1.30	5.16	3.65	1.25	0.75	0.32	1.83	1.02	0.40
4/6	5.00	4.20	2.97	5.16	3.65	11.74	2.090	1.260	–	–	1.00	1.84	1.30	5.16	3.65	1.54	0.50	0.39	3.03	1.02	0.40

Actuator Mounting Data

Ball Valve Mount Kit Part Numbers & Coupling Dimensions

		Drive Coupling Dimensions				
Valve Size	Actuator Type[1]	A	B	C	D	E
1/2	A/A, A/SR & E	0.351	0.437	3.08	1.81	0.67
3/4	A/A, A/SR & E	0.351	0.437	2.51	1.24	0.44
1	A/A, A/SR & E	0.351	0.437	2.34	1.07	0.56
1 1/4 / 1 1/2	A/A & E	0.351	0.437	3.24	1.97	0.65
	A/SR	0.430	0.549	3.28	1.97	0.65
2	A/A	0.430	0.549	2.64	1.33	0.78
	A/SR	0.548	0.704	2.64	1.33	0.78
	E	0.351	0.437	2.60	1.33	0.78
3	A/A & E	0.548	0.704	3.46	1.90	0.86
	A/SR	0.666	0.882	2.46	1.90	0.86
4/6	A/A	0.666	0.882	3.44	1.88	0.59
	A/SR	0.863	1.000	3.44	1.88	0.59
	E	0.548	0.704	3.44	1.88	0.59

		Drive Coupling Dimensions			
Valve Size	Actuator Type[1]	F	G	H	J
1/2	A/A, A/SR & E	0.281	1.10	0.46	0.42
3/4	A/A, A/SR & E	0.451	1.10	0.46	0.42
1	A/A, A/SR & E	0.451	1.10	0.46	0.42
1 1/4 / 1 1/2	A/A & E	0.539	1.61	0.46	0.45
	A/SR	0.539	1.61	0.57	0.49
2	A/A	0.761	1.61	0.50	0.46
	A/SR	0.761	1.61	0.50	0.46
	E	0.761	1.61	0.46	0.42
3	A/A & E	0.911	1.50	0.50	0.46
	A/SR	0.911	1.50	0.50	0.46[2]
4/6	A/A	1.266	1.75	0.50	0.40
	A/SR	1.266	1.75	0.50	0.40
	E	1.266	1.75	0.50	0.40

1 A/A = Pneumatic Air to Air. A/SR = Pneumatic Air to Spring Return (fail-safe). E = Electric (motor driven).
2 No adapter plate is used with this coupling. J represents distance above reference point Y (top of mount bracket).

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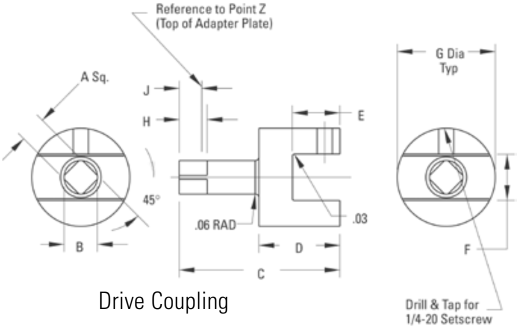
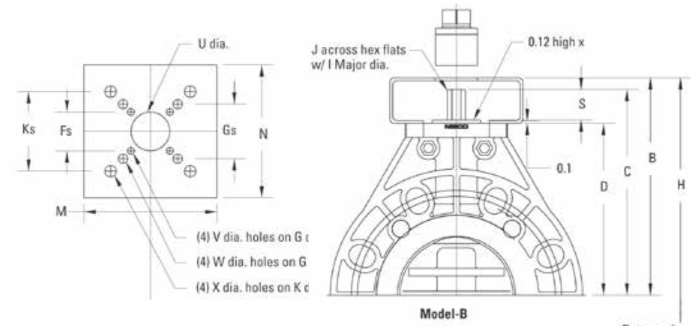
Actuator Mounting Data

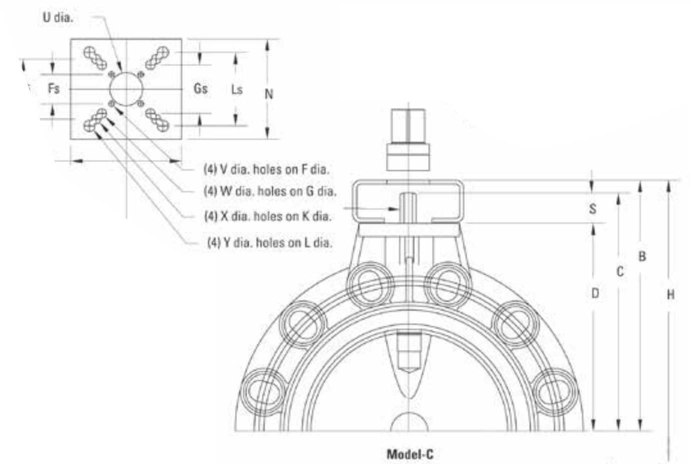
The same mounting kits, including fastener hardware and drive couplings, used for factory assembly are available for field assembly of Chemtrol® actuation equipment to installed valves. Recognizing that some facilities specify Chemtrol® Butterfly Valves while standardizing on other actuator brands, the use of Chemtrol® mount kits is required in these situations, and the critical data on this page are offered to facilitate adaptation.



Drive Coupling



Model-B



Model-C

Actuator Mounting Data

MODEL B - Ball Valve Torques, Valve Mounting & Drive Coupling Dimensions and Mounth Kit Part Numbers

		Valve Mounting Dimensions					Actuator	Drive Coupling Dimensions								
Valve Size	Min. Torque (in. lbs.)	C	D	I Cir. Ø	J Flats	S	Type[1]	A Sq.	B Dia.	C	D	E	F	G Dia.	H	J Proj.
3	400	6.00	4.75	0.51	0.37	1.13	A/A & E	0.549	0.697	1.95	1.30	1.03	0.374	1.50	0.50	0.45
							A/SR	0.864	1.090	1.95	1.30	1.03	0.374	1.50	0.50	0.45
4	700	7.35	6.13	0.65	0.50	1.10	A/A	0.667	0.859	1.98	1.33	1.03	0.499	1.50	0.50	0.45
							A/SR	0.864	1.090	1.98	1.33	1.03	0.499	1.50	0.50	0.45
							E	0.549	0.697	1.98	1.33	1.04	0.566	1.50	0.50	0.45
6	1350	9.15	7.50	0.78	0.56	1.53	A/A	0.864	1.090	2.66	2.00	1.40	0.563	1.75	0.50	0.45
							A/SR	1.061	1.365	2.90	2.00	1.40	0.563	1.75	0.75	0.70
							E	0.549	0.697	2.91	2.26	1.66	0.879	1.75	0.50	0.45

[1] A/A = Pneumatic Air to Air. A/SR = Pneumatic Air to Spring Return (fail-safe).
E = Electric (motor driven).

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Actuator Mounting Data

MODEL C - Ball Valve Torques, Valve Mounting & Drive Coupling Dimensions and Mounth Kit Part Numbers

		Valve Mounting Dimensions					Actuator	Drive Coupling Dimensions								
Valve Size	Min. Torque (in. lbs.)	C	D	I Cir. Ø	J Flats	S	Type[1]	A Sq.	B Dia.	C	D	E	F	G Dia.	H	J Proj.
2	224	5.19	3.94	0.50	0.37	1.25	A/A	0.430	0.540	1.26	0.70	0.53	0.376	1.00	0.50	0.35
							A/SR & E	0.548	0.692	1.44	0.75	0.53	0.376	1.25	0.63	0.53
2 1/2							A/A	0.430	0.540	1.26	0.70	0.53	0.376	1.00	0.50	0.35
	285	5.38	4.13	0.50	0.37	1.25	A/SR	0.666	0.854	1.56	0.75	0.53	0.376	1.25	0.75	0.65
							E	0.548	0.692	1.44	0.75	0.53	0.376	1.25	0.63	0.53
3	337	5.58	4.43	0.50	0.37	1.15	A/A & E	0.548	0.692	1.44	0.75	0.53	0.376	1.25	0.63	0.43
							A/SR	0.666	0.854	1.56	0.75	0.53	0.376	1.25	0.75	0.55
4	420	6.56	5.31	0.65	0.50	1.25	A/A & E	0.548	0.692	1.44	0.75	0.53	0.501	1.25	0.63	0.53
							A/SR	0.666	0.854	1.56	0.75	0.53	0.501	1.25	0.75	0.65
6							A/A	0.863	1.085	2.13	1.13	0.66	0.565	1.25	0.88	0.72
	1261	8.34	7.09	0.78	0.56	1.25	A/SR	1.060	1.390	2.31	1.00	0.56	0.565	1.50	1.19	1.00
							E	0.666	0.854	1.54	0.73	0.53	0.565	1.25	0.75	0.63
8							A/A	0.863	1.085	2.13	1.13	0.66	0.565	1.25	0.88	0.72
	1901	9.25	8.00	0.78	0.56	1.25	A/SR	1.060	1.390	2.31	1.00	0.56	0.565	1.50	1.19	1.00
							E	1/4" key	1.373	3.25	1.37	0.94	0.565	1.50	1.63	1.56
10							A/A	0.863	1.085	2.25	1.25	0.75	0.753	1.50	0.88	0.75
	2595	11.09	9.84	1.06	0.75	1.25	A/SR	1.413	1.862	2.88	1.25	0.75	0.753	2.00	1.56	1.25
							E	1/4" key	1.370	3.31	1.37	1.00	0.754	1.75	1.63	1.56

[1]A/A = Pneumatic Air to Air. A/SR = Pneumatic Air to Spring Return (fail-safe).
E = Electric (motor driven).

Actuator Mounting Data

Butterfly Valve Mount Bracket Dimensions

Valve Model	Valve Size	Actuator Type1	B	F B. C.	F Sq.	G B. C.	G Sq.	H	K B. C.	K Sq.	L B. C.	L Sq.	M	N	U Dia.	V Dia.	W Dia.	X Dia.	Y Dia.
Model B	3	A/A, A/SR & E	6.40	1.97	1.39	2.76	1.95	10.15	4.02	2.84	-	-	4.75	4.75	1.38	0.25	0.33	0.41	-
	4	A/A, A/SR & E	7.78	1.97	1.39	2.76	1.95	11.28	4.02	2.84	-	-	4.75	4.75	1.38	0.25	0.33	0.41	-
	6	A/A, A/SR & E	10.08	1.97	1.39	4.02	2.84	15.58	4.92	3.48	-	-	4.75	4.75	1.38	0.25	0.41	0.48	-
Model C	2	A/A	5.57	1.42	1.00	1.65	1.17	8.86	3.25	2.30	-	-	3.25	3.25	1.06	0.20	0.20	0.44	-
		A/SR & E	5.57	1.97	1.39	2.76	1.95	8.86	-	-	-	-	3.50	3.25	1.44	0.27	0.34	-	-
	2 1/2	A/A	5.76	1.42	1.00	1.65	1.17	9.39	3.25	2.30	-	-	3.25	3.25	1.06	0.20	0.20	0.44	-
		A/SR & E	5.76	1.97	1.39	2.76	1.95	9.39	-	-	-	-	3.50	3.25	1.44	0.27	0.34	-	-
	3	A/A, A/SR & E	6.06	1.97	1.39	2.76	1.95	9.97	-	-	-	-	3.50	3.25	1.44	0.27	0.34	-	-
	4	A/A, A/SR & E	6.94	1.97	1.39	2.76	1.95	11.51	-	-	-	-	3.50	3.25	1.44	0.27	0.34	-	-
	6	A/A & A/SR	9.09	3.25	2.30	4.02	2.84	14.73	4.92	3.48	-	-	4.53	4.75	1.75	0.44	0.44	0.53	-
		E	8.72	1.97	1.39	2.76	1.95	14.36	-	-	-	-	3.50	3.25	1.44	0.27	0.34	-	-
	8	A/A, A/SR & E	10.00	3.25	2.30	4.02	2.84	16.83	4.92	3.48	-	-	4.53	4.75	1.75	0.44	0.44	0.53	-
	10	A/A & E	11.84	1.97	1.39	3.25	2.30	20.24	4.02	2.84	4.92	3.48	5.25	4.75	1.56	0.27	0.44	0.44	0.53
		A/SR	11.97	5.00	3.54	5.51	3.90	20.37	-	-	-	-	5.75	5.75	2.09	0.56	0.69	-	-

[1] A/A = Pneumatic Air to Air. A/SR = Pneumatic Air to Spring Return (fail-safe). E = Electric (motor driven).

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Valve Installation

For socket-end valves refer to the solvent cement joining instructions for PVC and CPVC, and the heat fusion joining instructions for PP and PVDF in the *Chemtrol Thermoplastic Piping Technical Manual*. For threaded-end valves usually one or two turns beyond hand-tight using a suitable strap wrench, if necessary, is sufficient. Do not overtighten threads. ANSI B1.20.1 defines hand tight as 4 to 5 threads for sizes through 2” and 5 to 6-3/4 threads for sizes greater than 2”.For flanged-end valves refer to the plastic flange joining instructions in the *Chemtrol Thermoplastic Piping Technical Manual*. CAUTION: Over tightening threads may result in damage to products.

Ball and Check Valves

When joining union-end valves, or when flanging end connectors, never make the joint to the end connectors while they are attached to the valve body. Remove the union nuts and end connectors from the valve cartridge first. Slide the union nut (smallest bore first) over the pipe or nipple and flange hub (when flanging) before making the joint to the end connector.

After allowing the proper joint drying time, or cooling time in the case of PP and PVDF, end connections may be joined to the valve cartridge. O-rings provide the seal between the valve cartridge faces and the end connectors. Ensure that these O-rings are clean and in their proper grooves before slipping the valve cartridge between its end connectors. Slide the union nuts over the end connectors and screw onto the valve cartridge threads, no more than hand tight. Once the end connector engages the O-ring seal, no more than 1/8 to 1/4 turn of the union nut will fully compress the O-ring in its groove. CAUTION: Over tightening threads may result in damage to products.

The pipe supports surrounding the valve must be loose and the adjoining piping must be well aligned with the valve. The union nuts cannot be expected to bend and/or stretch the adjoining pipe in order to allow the end connectors to make the required flush seal against the valve cartridge faces.

3-Way Valve Seat Adjustment - The seat-carrier in multiport and diverter valves is of the Model-A design, meaning that it is not fastened to the valve body with internal threads. Therefore, the union nut on the valve end with “ADJ” marked on the body serves the dual purpose of external adjustment for “squeeze” on the operating envelope within the cartridge, preventing leakage across the ball, as well as compression of the face-seal, preventing shell leakage at the cartridge face. Upon installation of multiport or diverter valves, with the handle parallel with the body and fully against the handle/body stop, tighten that union nut on the “ADJ” body end while minutely operating the handle off the stop and back to the stop. The handle turning torque should become snug, but not excessive when the valve is properly adjusted for leak-free operation. If proper adjustment cannot be made by hand tightening the union nut (valves larger than 1-1/2"), a suitable strap-wrench may be used.

CAUTION: Over tightening threads may result in damage to products.

Check Valves - Check valves should be installed at least four feet from the discharge side of a pump. Ball chatter and internal damage may result if fluid flow is too turbulent. Also, in keeping with good mechanical design practice, the upper threshold of fluid flow recommended from Chemtrol products is five feet per second.

The valves may be installed vertically or horizontally (refer to the preceding page for minimum seating head requirements), but the molded-in flow arrow on the valve cartridge must be installed in the direction of the fluid flow such that reverse flow will be checked.

Valve Installation

Ball and Check Valves cont...

Foot Valve Conversion - Foot valve screen housing assemblies are available to convert ball check valves to foot valves in the field. The assemblies are to be installed on the supply side of a standard Chemtrol Ball Check Valve, replacing the union nut and end connector. Foot valves are normally installed in an open tank or sump on the suction side of a pump. Its function is to screen debris from entering the pump.

Vent Valve Conversion - The ball in a standard Chemtrol Ball Check Valve is intended by design to have a greater density than the fluid medium. When installed in the upright (seat down – arrow on body pointed in direction of normal flow) to horizontal positions, gravitational force on the ball allows it to sink in the fluid and seal at the seat in order to prevent back-flow when directional flow is ceased (e.g., pump stops). However, the mechanical designer sometimes wants air or gas to be vented from a piping system or vessel as fluid fills the system, but to check flow of fluid beyond the vent tube. As fluid is evacuated from the system or vessel, the vent valve must open to prevent formation of a vacuum. The field conversion of the check valve to the venting function requires the replacement of the standard ball with a polypropylene ball, which will float in water or fluids of greater density. A vent valve must be installed in the inverted vertical position (seat up – arrow on body pointed in opposite direction of normal venting). The floater ball must also be chemically resistant to the medium. Failure to follow these instructions may cause stress cracking to the polypropylene ball (e.g., bleach, concentrated sulfuric or nitric acids).

Butterfly Valves

Chemtrol® Butterfly Valves are installed by bolting between two pipe flanges and may be mounted in any position. They are designed to be operated with pipes up to and including Schedule 80 wall thicknesses. If the I.D. of connecting pipe or equipment is smaller than Schedule 80, it will be necessary to chamfer the inside edge to avoid interference with the rotating butterfly disk.

Alignment - Excessive angular misalignment and/or axial displacement is detrimental to proper function of the companion flange face-seals built into the valves. For reference, ANSI/ASME B31.3, Code for Pressure Piping, Chemical Plant, and Petroleum Refinery Piping, stipulates that flange faces shall be aligned to the design plane (butterfly valve in this case) to within 1/16" in./ft. (0.5%) maximum measured across any diameter, and flange bolt holes shall be aligned to within 1/8" maximum offset.

Insertion in System - The end flaps of the elastomeric seat (Model B) or the O-rings (Model C) serve as face-seals for the companion flanges to be mounted on each side of the butterfly valve. Other gaskets are not to be used. Flange clearance required for insertion is given in the bolting chart below. For installation between the flanges, the valve should be partially open, but not so far as to damage the edge of the disk on mating flanges. If the spacing between mating flanges is tight, the valve sealing surface should be coated with a lubricant to prevent distortion during installation. If more than soapy water is required, a non-hydrocarbon base material, such as silicone grease, may be used on EPDM face-seals. An oil-based lubricant, such as glycerin, is acceptable for FKM face-seals. Insert valve in desired position and install bolts with metal back-up washers (corresponding to ANSI B18.22.1, designated N – narrow washers previously known as SAE series washers) under both the bolt head and nut.

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Valve Installation

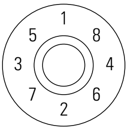
Butterfly Valves cont...

Note: Bolt size x washer OD – 1/2", 1.092"; 5/8", 1.342"; 3/4", 1.499"; 7/8", 1.780".

Bolting - Snug up the bolts finger-tight so that the circumference of the inside bore of each companion flange evenly touches the face-seals of the butterfly valve. Make sure the valve is properly aligned before proceeding. Then, use of a torque wrench for pulling on the nuts is suggested for actual bolt tightening. It is critical that bolts be equally tightened in a sequential pattern diametrically opposed to each other, and that the final recommended bolt torque be accomplished through a minimum of three progressive stages of tightening. The recommended progressive tightening pattern and the final torque levels are shown on the following chart and diagram:

Valve Size (Nom.)	Flange Clearance Model B (in.)	Flange Clearance Model C (in.)	Bolt Diameter (in.)	Bolts Required (No.)	Recommended Bolt Torque[2] (Ft.-Lbs.)
* 2	-	1.69	5/8	4	20-30
* 2 1/2	-	1.81	5/8	4	20-30
3	2.00	1.81	5/8	4 or 8 [1]	20-30
4	2.25	2.06	5/8	8	20-30
6	2.81	2.19	3/4	8	33-50
* 8	-	2.38	3/4	8	33-50
* 10	-	2.69	7/8	12	53-75

* Available in Model C only.
1 Four (4) bolt hole pattern for ANSI 150 flange pattern; eight (8) bolt hole pattern for DIN standard flange pattern.
2 Refers to well-lubricated bolts.



When valve installation is complete, open and close the valve to check for ease of operation and proper alignment. Caution: Do not allow the valve to support the weight of any related piping. Direct support is required when mechanical operators or actuators are utilized. Failure to follow these instructions may result in damage to products or property.

Valve Maintenance

Valve repair should only be performed by qualified maintenance personnel. Contact the nearest Chemtrol distributor should further information be required.

Ball Valves

Should a valve need repair, depressurize and drain the system on all sides of the valve. Loosen the valve union nuts and slide them back over the end connectors. To minimize downtime, it may be advisable to have a replacement valve cartridge ready to install in place of the one to be repaired. An advantage of the Chemtrol design is that the current model is interchangeable with all earlier models. Disassemble valve cartridge following the instructions provided with the valve.

Valve Maintenance

Butterfly Valves

Following testing and soon after commissioning of a system, if either the Model B or Model C valve develops a leak at the top bearing, the flange face-seal(s), and/or across the valve disk, the most likely cause of the leak would be inappropriate selection of the elastomeric seat and seals. In this case, check the NIBCO Chem-Guide for compatibility with the fluid medium. If there is leakage at the flange face-seal(s) only, further tightening of bolts will almost never stop any flange joint leak. Rather, the remedy is to disassemble the joint and reseat the flanges on the valve face-seals, being careful to follow the bolting paragraph under the butterfly valve installation instructions.

After extended operation, if leakage should occur at the top bearing or across the valve disk of either the Model B or Model C valve, this is a likely cause of wear to the elastomeric seat and/or O-ring seals, requiring their replacement. In most cases, valve replacement may be less expensive than parts replacement. In fact, the Model C valve cannot be disassembled. Only the handle assembly and O-ring face-seals may be replaced. Otherwise, replacement of the entire Model C valve is recommended. When maintenance to a Model B valve is required, refer to the disassembly and reassembly instructions included with the valve.

General Design and Installation Guidelines

- The manufacturer does NOT recommend running a thermoplastic piping system with velocity greater than 5 feet/sec.
- WARNING: Do NOT close a quarter turn valve quickly. This will create shock in the system and cause damage to property or personal injury.
- Installing thermoplastic piping components at temperatures at 40°F requires extra precaution in handling because the material may be at increased risk of impact damage.
- WARNING: Follow the recommended bolt tightening techniques, including sequence of tightening and final torque values, for flanges and butterfly valves because failure to do so will result in damage to the product.
- Do not allow primer or solvent cement to come in contact with the sealing face of valve end connectors or internal components of the valve.
- Valves must be installed with the molded-in flow arrow(s) on the valve cartridge facing in the direction of the fluid flow.
- To ensure comprehensive chemical compatibility, a piping system must take into consideration the chemical resistance of all system components, including, but not limited to, plastic components, solvent cements or thread pastes (if applicable), elastomeric seals, all valve components and lubricants. Testing under field conditions may be the best way to ensure selected materials will work in a particular application.
- Consult the Chemtrol Thermoplastic Piping Technical Manual for additional design and installation requirements for Chemtrol products.

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Fitting Terms and Abbreviations *Schedule 80 only*

FPT	Female Pipe Thread	S	Female Socket
CL	Close	SH	Short
MPT	Male Pipe Thread	SPG	Male End (Spigot)

Dimensions and Standards

Universal Part No.

XX XX - XXX
(1) (2) (4)

Chemtrol Part No.
(Discontinued)

XX XXX XXX
(1) (2) (4)

Material and Product Type

Product Line	(1) Universal Part Number	(1) Chemtrol Part Number	(1) Chemtrol Figure Number
PVC Sch. 80	8	01	45
CPVC Sch. 80	18	05	51
PP Black Sch. 80.	28	07	61
Sch. 80	78	10	62
PVDF Red Sch. 80	38	58	65
NPVDF Natural Sch. 80	48	06	66

Fitting Description

Fitting & End Connection	(2) Universal Part No.	(2) Chemtrol Part No.	(2) Chemtrol Figure No. Fitting	(3) Connection(s)
Tee-Socket	01	013	00	Blank
Tee-Socket x Thread	02	015	12	Blank
Tee-Thread	05	014	12	3-3
90° ELL-Socket	06	001	07	Blank
90° ELL-Socket x Thread	07	003	07	3
90° ELL-Thread	08	002	07	3-3
90° Street ELL-Male Thread x Socket	10	219	07	4
90° Street ELL-Male Thread x Thread	12	213	07	3-4
45° ELL-Socket	17	007	06	Blank
45° ELL-Thread	19	008	06	3-3
Coupling-Socket	29	025	01	Blank
Coupling-Thread	30	026	01	3-3
Adapter Coupling-Socket x Thread	35	027	03	Blank
Male Adapter-Male Thread x Socket	36	217	04	Blank
Reducing Bushing-Socket	37	049	18	Blank
Reducing Bushing-Spigot x Thread	38	051	18	3
Reducing Bushing-Thread	39	050	18	3-4
Cap-Socket	47	031	17	Blank
Cap-Thread	48	032	17	3
Plug-Spigot	49	042	16	Blank
Plug-Thread	50	043	16	4
Flange-Socket	51	045	51	Blank
Flange-Thread	52	044	51	3
Flange-Blind	53	046	19	Blank
Van Stone Flange-Socket	54	069	51	A
Union-Socket	97	028	33	Blank
Union-Thread	98	029	33	3-3
Nipple-Thread x Thread	61	053	29	Blank

Chemtrol Figure

XX XX - X - X - SIZE

① ② ③ ④

Size Description

Size	④ Universal Part Number	④ Chemtrol Part Number	④ Chemtrol Figure Number
1/4	002	004	
1/2	005	007	
3/4	007	008	
1	010	009	
1 1/4	012	010	
1 1/2	015	011	
2	020	012	
2 1/2	025	013	
3	030	014	
4	040	016	
6	060	018	
8	080	019	
10	100	020	
12	120	021	
1/2 x 1/4	072	027	
3/4 x 1/4	098	029	
3/4 x 1/2	101	031	
1 x 1/4	128	032	
1 x 1/2	130	034	
1 x 3/4	131	035	
1 1/4 x 1/2	166	038	
1 1/4 x 3/4	167	039	
1 1/4 x 1	168	040	Simply State Size
1 1/2 x 1/2	209	043	
1 1/2 x 3/4	210	044	
1 1/2 x 1	211	045	
1 1/2 x 1 1/4	212	046	
2 x 1/2	247	049	
2 x 3/4	248	050	
2 x 1	249	051	
2 x 1 1/4	250	052	
2 x 1 1/2	251	053	
2 1/2 x 1/2	287	056	
2 1/2 x 3/4	288	057	
2 1/2 x 1	289	058	
2 1/2 x 1 1/4	290	059	
2 1/2 x 1 1/2	291	060	
2 1/2 x 2	292	061	
3 x 1	335	066	
3 x 1 1/4	336	067	
3 x 1 1/2	337	068	
3 x 2	338	069	
3 x 2 1/2	339	069	
4 x 2	420	076	
4 x 2 1/2	421	077	
4 x 3	422	078	
6 x 2	528	082	
6 x 3	530	084	
6 x 4	532	085	
8 x 6	585	088	

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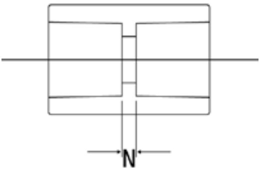
Couplings

Chemtrol
Fig. No.

4501 Socket Coupling (S x S)



Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. N
1/4	829-002	25	0.05	0.12
1/2	829-005	50	0.09	0.25
3/4	829-007	50	0.13	0.25
1	829-010	40	0.14	0.25
1 1/4	829-012	25	0.22	0.25
1 1/2	829-015	20	0.29	0.25
2	829-020	25	0.42	0.25
2 1/2	829-025	5	0.68	0.20
3	829-030	12	1.05	0.19
4	829-040	10	1.83	0.19
6	829-060	4	3.56	0.25
8	829-080	2	8.69	0.25
10	829-100	1	13.88	0.38
12	829-120	1	22.69	0.50

4501-R Reducing Socket Coupling (S x S)

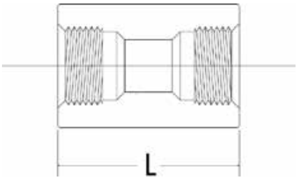
Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. N
3/4 x 1/2	829-101	25	0.12	0.44
1 x 1/2	829-130	25	0.18	0.67
1 x 3/4	829-131	25	0.19	0.55
1 1/4 x 3/4	829-167	25	0.26	0.72
1 1/4 x 1	829-168	10	0.27	0.60
1 1/2 x 1/2	829-209	10	0.31	0.81
1 1/2 x 3/4	829-210	10	0.31	0.76
1 1/2 x 1	829-211	10	0.33	0.63
1 1/2 x 1 1/4	829-212	10	0.35	0.51
2 x 1	829-249	10	0.44	0.75
2 x 1 1/2	829-251	10	0.50	0.50
3 x 2	829-338	5	1.00	1.24
4 x 2	829-420	5	1.59	1.59
4 x 3	829-422	5	1.88	1.20

Other Reducing Couplings are produced by solvent cementing appropriate Reducer Bushings into Socket Couplings. They may be ordered as factory fabrications or may be assembled in the field.

Couplings

Chemtrol
Fig. No.

4501-3-3 Thread Coupling (FPT x FPT)



Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. L
1/4	830-002	25	0.06	1.41
1/2	830-005	25	0.09	2.03
3/4	830-007	25	0.14	2.28
1	830-010	25	0.23	2.53
1 1/4	830-012	10	0.33	2.78
1 1/2	830-015	10	0.41	3.03
2	830-020	10	0.60	3.28
2 1/2	830-025	5	0.86	3.76
3	830-030	5	1.22	4.00
4	830-040	5	2.13	4.75

4501-3-3-R Reducing Thread Coupling (FPT x FPT)

Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. L
3/4 x 1/2	830-101	25	0.14	2.34
1 x 1/2	830-130	25	0.20	2.70
1 x 3/4	830-131	25	0.18	2.70
1 1/4 x 3/4	830-167	10	0.29	3.00
1 1/4 x 1	830-168	10	0.31	3.00
1 1/2 x 3/4	830-210	10	0.35	3.16
1 1/2 x 1	830-211	10	0.38	3.16
1 1/2 x 1 1/4	830-212	10	0.40	3.16
2 x 1	830-249	10	0.50	3.40
2 x 1 1/2	830-251	10	0.56	3.40
3 x 2	830-338	5	1.15	4.66
4 x 2	830-420	5	1.79	5.38
4 x 3	830-422	5	2.11	5.38

Other Reducing Couplings are produced by solvent cementing appropriate Reducer Bushings into Socket Couplings. They may be ordered as factory fabrications or may be assembled in the field.

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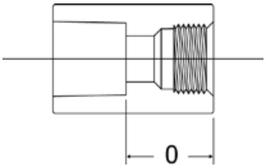
Adapters

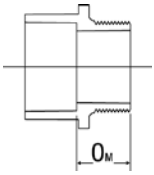
Chemtrol
Fig. No.

4503 Female Adapter Coupling (S x FPT)



Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. O
1/4	835-002	15	0.04	0.77
1/2	835-005	25	0.09	1.14
3/4	835-007	25	0.14	1.27
1	835-010	20	0.21	1.39
1 1/4	835-012	10	0.30	1.52
1 1/2	835-015	10	0.38	1.64
2	835-020	10	0.56	1.77
2 1/2	835-025	5	0.77	1.98
3	835-030	5	1.15	2.10
4	835-040	5	1.95	2.47

4504 Male Adapter (S x MPT)

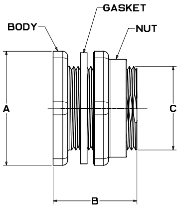


Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. O_M
1/2	836-005	25	0.04	0.94
3/4	836-007	25	0.06	0.97
1	836-010	25	0.10	1.15
1 1/4	836-012	10	0.14	1.12
1 1/2	836-015	10	0.19	1.12
2	836-020	10	0.27	1.20
2 1/2	836-025	5	0.50	1.89
3	836-030	5	0.79	1.99
4	836-040	5	1.30	2.09

Adapters

Chemtrol
Fig. No.

4501-3-3 Thread Coupling (FPT x FPT)



Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. A	Dim. B	Dim. C
1/2		15	0.20	2.00	2.75	1.38
3/4	Use	15	0.35	2.38	2.88	1.63
1	Figure	15	0.40	2.56	2.88	1.88
1 1/4	No. &	10	0.55	3.25	3.00	2.63
1 1/2	Nom.	10	0.65	3.25	3.00	2.63
2	Size	5	1.15	4.38	3.25	3.25
3		5	2.10	6.00	3.63	4.50

Note: Gasket is EPDM and nut is self-tightening left hand thread.

*For complete technical information and more, refer to our website at **www.chemtrol.com**.*

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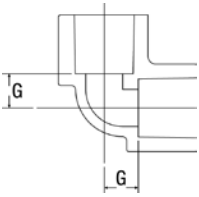
Elbows

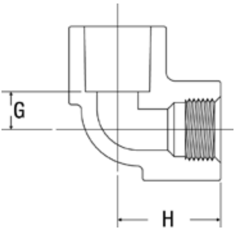
Chemtrol
Fig. No.

4507 Socket 90° Elbow (S x S)



Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. G
1/4	806-002	25	0.01	0.33
1/2	806-005	50	0.11	0.52
3/4	806-007	50	0.16	0.69
1	806-010	50	0.21	0.75
1 1/4	806-012	25	0.25	0.92
1 1/2	806-015	25	0.38	1.06
2	806-020	25	0.57	1.27
2 1/2	806-025	5	1.16	1.53
3	806-030	12	1.50	1.84
4	806-040	12	3.08	2.34
6	806-060	4	8.03	3.50
8	806-080	2	15.25	4.56
10	806-100	1	27.70	5.75
12	806-120	1	43.90	6.89

4507-3 Socket x Thread 90° Elbow (S x FPT)



Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. G	Dim. H
1/2	807-005	10	0.12	0.52	1.41
3/4	807-007	10	0.17	0.69	1.71
1	807-010	10	0.28	0.75	1.89
1 1/4	807-012	10	0.33	0.92	2.18
1 1/2	807-015	10	0.55	1.06	2.45
2	807-020	10	0.82	1.27	2.78

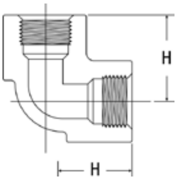
Elbows

Chemtrol
Fig. No.

4507-12/4506-12 Flanged ELLs

Flanged fitting center-to-face dimensions may be found on page 12. When ordering, specify the figure number and the nominal size (e.g., 2" Schedule 80 PVC flanged 90° Elbow–4507-12 2")

4507-3-3 Thread 90° Elbow (FPT x FPT)



Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. H
1/4	808-002	25	0.04	0.97
1/2	808-005	25	0.12	1.41
3/4	808-007	25	0.18	1.71
1	808-010	25	0.28	1.89
1 1/4	808-012	10	0.42	2.18
1 1/2	808-015	10	0.55	2.45
2	808-020	10	0.82	2.78
2 1/2	808-025	5	1.25	3.31
3	808-030	5	1.90	3.74
4	808-040	5	3.62	4.62

For questions concerning thermoplastic piping systems, please call or fax: ***888.446.4226 (ph),*** *888.336.4226 (fx).*

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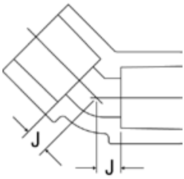
Elbows

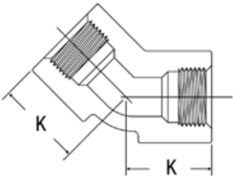
Chemtrol
Fig. No.

4506 Socket 45° Elbow (S x S)



Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. J
1/4	817-002	15	0.03	0.18
1/2	817-005	25	0.04	0.26
3/4	817-007	25	0.14	0.33
1	817-010	25	0.15	0.37
1 1/4	817-012	10	0.24	0.43
1 1/2	817-015	10	0.31	0.47
2	817-020	10	0.48	0.61
2 1/2	817-025	5	0.93	0.68
3	817-030	6	1.23	0.78
4	817-040	6	2.46	1.02
6	817-060	4	6.21	1.75
8	817-080	2	13.03	2.22
10	817-100	1	19.70	2.61
12	817-120	1	32.70	3.08

4506-3-3 Thread 45° Elbow (FPT x FPT)

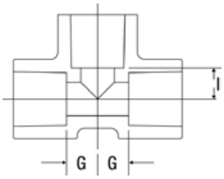


Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. K
1/4	819-002	15	0.04	0.82
1/2	819-005	25	0.11	1.15
3/4	819-007	25	0.13	1.35
1	819-010	25	0.25	1.51
1 1/4	819-012	10	0.35	1.70
1 1/2	819-015	10	0.48	1.86
2	819-020	10	0.71	2.13
2 1/2	819-025	5	1.03	2.46
3	819-030	6	1.53	2.69
4	819-040	6	2.52	3.30

Tees

Chemtrol
Fig. No.

4511 Socket Tee (S x S x S)



Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. G	Dim. G	Dim. I
1/4	801-002	25	0.05	0.33	0.33	0.33
1/2	801-005	50	0.11	0.52	0.52	0.52
3/4	801-007	50	0.17	0.69	0.69	0.69
1	801-810	25	0.25	0.75	0.75	0.75
1 1/4	801-012	10	0.48	0.92	0.92	0.92
1 1/2	801-015	10	0.52	1.06	1.06	1.06
2	801-020	20	0.97	1.27	1.27	1.27
2 1/2	801-025	5	1.50	1.53	1.53	1.53
3	801-030	12	2.00	1.84	1.84	1.84
4	801-040	10	3.54	2.34	2.34	2.34
6	801-060	4	10.47	3.50	3.50	3.50
8	801-080	1	20.57	4.56	4.56	4.56
10	801-100	1	35.40	5.75	5.75	5.75
12	801-120	1	58.40	6.89	6.89	6.89

4511-12 Flanged Tee

Flanged fitting center-to-face dimensions may be found on page 12. When ordering, specify the figure number and the nominal size (e.g., 2" Schedule 80 PVC flanged tee–4511-12 2")

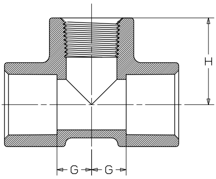
4511-R Reducing Socket Tee (S x S x S)

Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. G	Dim. G	Dim. I
3/4 x 3/4 x 1/2	801-101	25	0.18	0.52	0.52	0.62
1 x 1 x 1/2	801-130	10	0.24	0.53	0.53	0.73
1 x 1 x 3/4	801-131	10	0.26	0.63	0.63	0.74
1 1/2 x 1 1/2 x 3/4	801-210	10	0.48	0.67	0.67	1.05
1 1/2 x 1 1/2 x 1	801-211	10	0.52	0.77	0.77	1.04
2 x 2 x 1/2	801-247	10	0.61	0.61	0.61	1.30
2 x 2 x 3/4	801-248	10	0.65	0.71	0.71	1.30
2 x 2 x 1	801-249	10	0.69	0.81	0.81	1.30
2 x 2 x 1 1/2	801-251	10	0.83	1.08	1.08	1.30
3 x 3 x 2	801-338	5	1.73	1.37	1.37	1.86
4 x 4 x 2	801-420	5	2.79	1.42	1.42	2.36
4 x 4 x 3	801-422	5	3.33	1.90	1.90	2.38
6 x 6 x 4	801-532	4	7.29	2.60	2.60	3.56

Tees

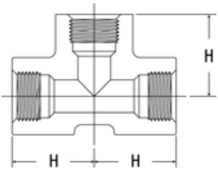
Chemtrol
Fig. No.

4512 Socket x Thread Tee (S x S x FPT)



Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. G	Dim. G	Dim. H
1/2	802-005	10	0.16	0.52	0.52	1.41
3/4	802-007	10	0.24	0.69	0.69	1.71
1	802-010	10	0.34	0.75	0.75	1.89
1 1/4	802-012	10	0.57	0.92	0.92	2.18
1 1/2	802-015	10	0.80	1.06	1.06	2.45
2	802-020	10	1.13	1.27	1.27	2.78

4512-3-3 Threaded Tee (FPT x FPT x FPT)

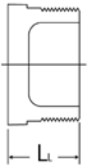


Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. H
1/4	805-002	25	0.05	0.97
1/2	805-005	25	0.16	1.41
3/4	805-007	25	0.26	1.71
1	805-010	25	0.35	1.89
1 1/4	805-012	10	0.57	2.18
1 1/2	805-015	10	0.75	2.45
2	805-020	10	1.13	2.78
2 1/2	805-025	5	1.79	3.31
3	805-030	5	2.60	3.74
4	805-040	5	4.63	4.62

Plugs

Chemtrol
Fig. No.

4516-4 Thread Plug (MPT)



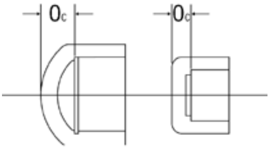
Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. L_L
1/4	850-002	25	0.01	0.85
1/2	850-005	50	0.03	1.04
3/4	850-007	50	0.03	1.10
1	850-010	25	0.06	1.25
1 1/4	850-012	10	0.10	1.66
1 1/2	850-015	10	0.14	1.78
2	850-020	10	0.19	1.92
2 1/2	850-025	5	0.29	2.18
3	850-030	5	0.51	2.42
4	850-040	5	0.95	2.81

1/4" Plug is solid, only

Caps

Chemtrol
Fig. No.

4517 Socket Cap* (S)



Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. O_C
1/4	847-002	15	0.03	0.25
1/2	847-005	25	0.06	0.39
3/4	847-007	25	0.08	0.37
1	847-010	25	0.14	0.41
1 1/4	847-012	10	0.20	0.40
1 1/2	847-015	10	0.26	0.41
2	847-020	10	0.38	0.42
2 1/2	847-025	5	0.57	0.57
3	847-030	5	0.87	1.29
4	847-040	5	1.53	1.58
6	847-060	5	3.77	2.13

*Sizes 2" and smaller are flat; 2 1/2" and larger are domed.

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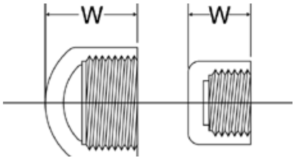
Caps

Chemtrol
Fig. No.

4517-3 Thread Cap* (FPT)



Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. W
1/4	848-002	15	0.01	0.89
1/2	848-005	25	0.06	1.28
3/4	848-007	25	0.10	1.38
1	848-010	25	0.15	1.55
1 1/4	848-012	10	0.22	1.66
1 1/2	848-015	10	0.29	1.80
2	848-020	10	0.41	1.93
2 1/2	848-025	5	0.64	2.35
3	848-030	5	0.93	3.19
4	848-040	5	1.73	3.86

*Sizes 2" and smaller are flat; 2 1/2" and larger are domed.

Bushings

Design Styles

The design style of most bushings is to have a solid wall between the inside and outside connections. Some of the multistep reductions with exceedingly thick cross-sections are not solid. This design style achieves structural support with a web of ribs attaching the inner and outer connection walls, with the open area toward the exterior bushing face. The styles are denoted by W and S for webbed and solid designs respectively.

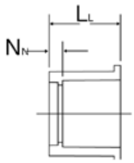
Webbed design

Solid design

Bushings

Chemtrol
Fig. No.

4518 Flush Socket Reducer Bushing (SPG x S)



Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Design Style	Dim. LL	Dim. NN
1/2 x 1/4	837-072	50	0.03	S	1.17	0.53
3/4 x 1/2	837-101	50	0.05	S	1.15	0.26
1 x 1/2	837-130	50	0.06	S	1.28	0.39
1 x 3/4	837-131	50	0.05	S	1.28	0.27
1 1/4 x 1/2	837-166	10	0.10	S	1.41	0.52
1 1/4 x 3/4	837-167	10	0.10	S	1.41	0.40
1 1/4 x 1	837-168	10	0.06	S	1.41	0.27
1 1/2 x 1/2	837-209	25	0.12	W	1.53	0.64
1 1/2 x 3/4	837-210	25	0.10	S	1.53	0.52
1 1/2 x 1	837-211	25	0.08	S	1.53	0.39
1 1/2 x 1 1/4	837-212	10	0.06	S	1.53	0.27
2 x 1/2	837-247	25	0.20	W	1.66	0.77
2 x 3/4	837-248	25	0.20	W	1.66	0.65
2 x 1	837-249	25	0.20	W	1.66	0.52
2 x 1 1/4	837-250	10	0.19	S	1.66	0.40
2 x 1 1/2	837-251	25	0.15	S	1.66	0.27
2 1/2 x 1	837-289	10	0.31	W	1.94	0.80
2 1/2 x 1 1/4	837-290	10	0.31	W	1.94	0.68
2 1/2 x 1 1/2	837-291	10	0.27	S	1.94	0.55
2 1/2 x 2	837-292	10	0.24	S	1.94	0.43
3 x 1	837-335	10	0.65	W	2.42	1.28
3 x 1 1/2	837-337	10	0.67	W	2.42	1.03
3 x 2	837-338	10	0.64	S	2.42	0.91
3 x 2 1/2	837-339	10	0.48	S	2.42	0.64
4 x 2	837-420	10	1.14	W	2.81	1.30
4 x 2 1/2	837-421	5	1.14	W	2.81	1.03
4 x 3	837-422	10	0.93	S	2.81	0.91
6 x 2	837-528	5	3.28	W	3.06	1.55
6 x 4	837-532	10	2.68	S	3.06	0.78
8 x 6	837-585	3	5.46	S	4.59	1.56
10 x 6	837-626	1	10.68	W	5.59	2.56
10 x 8	837-628	1	9.36	S	5.59	1.09
12 x 8	837-668	1	16.73	W	6.59	2.09
12 x 10	837-670	1	12.77	S	6.59	1.09

Other Reducing Couplings are produced by solvent cementing appropriate Reducer Bushings into Socket Couplings. They may be ordered as factory fabrications or may be assembled in the field.

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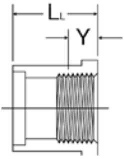
Bushings

Chemtrol
Fig. No.

4518-3 Flush Spigot x Thread Reducer Bushing (SPG x FPT)



Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Design Style	Dim. LL	Dim. Y*
1/2 x 1/4	838-072	50	0.03	S	1.17	0.31
3/4 x 1/4	838-098	50	0.04	S	1.29	0.31
3/4 x 1/2	838-101	50	0.03	S	1.29	0.43
1 x 1/2	838-130	50	0.07	S	1.56	0.43
1 x 3/4	838-131	50	0.05	S	1.56	0.45
1 1/4 x 1/2	838-166	10	0.14	S	1.66	0.43
1 1/4 x 3/4	838-167	10	0.12	S	1.66	0.45
1 1/4 x 1	838-168	10	0.10	S	1.66	0.53
1 1/2 x 1/2	838-209	10	0.21	S	1.78	0.43
1 1/2 x 3/4	838-210	10	0.19	S	1.78	0.45
1 1/2 x 1	838-211	5	0.17	S	1.78	0.53
1 1/2 x 1 1/4	838-212	10	0.18	S	1.78	0.55
2 x 1/2	838-247	10	0.34	S	1.92	0.43
2 x 3/4	838-248	10	0.32	S	1.92	0.45
2 x 1	838-249	10	0.29	S	1.92	0.53
2 x 1 1/4	838-250	10	0.24	S	1.92	0.55
2 x 1 1/2	838-251	10	0.20	S	1.92	0.55
2 1/2 x 2	838-292	5	0.25	S	2.18	0.57
3 x 1	838-335	5	0.65	S	2.42	0.53
3 x 1 1/2	838-337	5	0.70	S	2.42	0.55
3 x 2	838-338	5	0.67	S	2.42	0.57
3 x 2 1/2	838-339	5	0.52	S	2.42	0.87
4 x 2	838-420	5	1.17	S	2.81	0.57
4 x 3	838-422	5	1.01	S	2.81	0.95

Other size reductions are produced by solvent cementing appropriate Reducer Bushings together. They may be ordered as factory fabrications or may be assembled in the field.

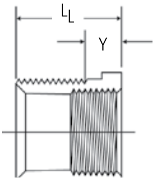
*Typical male component engagement, hand tight (L_1 in ANSI B1.20.1 thread spec.) plus 1 1/2 turns.

*For complete technical information and more, refer to our website at **www.chemtrol.com**.*

Bushings

Chemtrol
Fig. No.

4518-3-4 Flush Thread Reducer Bushing (MPT x FPT)



Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Design Style	Dim. LL	Dim. Y*
1/2 x 1/4	839-072	50	0.02	S	0.93	0.25
3/4 x 1/4	839-098	50	0.03	S	0.95	0.25
3/4 x 1/2	839-101	50	0.02	S	0.95	0.25
1 x 1/2	839-130	50	0.05	S	1.24	0.38
1 x 3/4	839-131	50	0.03	S	1.24	0.38
1 1/4 x 1/2	839-166	10	0.10	S	1.27	0.38
1 1/4 x 3/4	839-167	10	0.09	S	1.27	0.38
1 1/4 x 1	839-168	10	0.07	S	1.27	0.38
1 1/2 x 1/2	839-209	10	0.20	S	1.28	0.38
1 1/2 x 3/4	839-210	10	0.14	S	1.28	0.38
1 1/2 x 1	839-211	10	0.12	S	1.28	0.38
1 1/2 x 1 1/4	839-212	10	0.08	S	1.28	0.38
2 x 1/2	839-247	10	0.32	S	1.32	0.38
2 x 3/4	839-248	10	0.30	S	1.32	0.38
2 x 1	839-249	10	0.28	S	1.32	0.38
2 x 1 1/4	839-250	10	0.22	S	1.32	0.38
2 x 1 1/2	839-251	10	0.18	S	1.32	0.38
2 1/2 x 2	839-292	5	0.21	S	2.18	0.57
3 x 1 1/2	839-337	5	0.58	S	2.42	0.55
3 x 2	839-338	5	0.56	S	2.42	0.57
3 x 2 1/2	839-339	5	0.45	S	2.42	0.87
4 x 2	839-420	5	1.09	S	2.81	0.57
4 x 3	839-422	5	0.81	S	2.81	0.95

Other size reductions are produced by solvent cementing appropriate Reducer Bushings together. They may be ordered as factory fabrications or may be assembled in the field.

*Typical male component engagement, hand tight (L_1 in ANSI B1.20.1 thread spec.) plus 1 1/2 turns.

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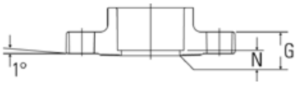
Class 150 Flanges

For flange dimensions that comply with ANSI B16.5, 150 lb., steel flanges, see Reference Data on following pages.

Chemtrol
Fig. No.

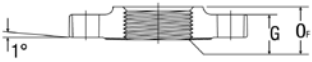
4551-H Socket Flange (S), One-Piece (Solid)



Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. G	Dim. N
1/2	851-H05	10	0.21	0.54	0.20
3/4	851-H07	10	0.31	0.61	0.17
1	851-H10	24	0.41	0.68	0.18
1 1/4	851-H12	10	0.53	0.73	0.20
1 1/2	851-H15	12	0.68	0.82	0.23
2	851-H20	12	0.96	0.92	0.27
2 1/2	851-H25	5	1.61	1.02	0.20
3	851-H30	10	2.16	1.13	0.29
4	851-H40	10	2.98	1.24	0.32
6	851-H60	5	4.44	1.36	0.31
8	851-H80	2	9.12	1.50	0.35

Reducing Flanges are produced by solvent cementing Reducer Bushings into Socket Flanges. They may be ordered as factory fabrications or may be assembled in the field.

4551-H-3 Thread Flange (FPT), One-Piece (Solid)



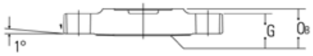
Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. G	Dim. OF
1/2	852-H05	10	0.21	0.54	0.88
3/4	852-H07	10	0.30	0.61	0.91
1	852-H10	10	0.40	0.68	1.08
1 1/4	852-H12	10	0.50	0.73	1.11
1 1/2	852-H15	12	0.65	0.82	1.12
2	852-H20	10	0.90	0.92	1.18
2 1/2	852-H25	5	1.50	1.02	1.42
3	852-H30	5	1.93	1.13	1.55
4	852-H40	5	2.80	1.24	1.67

Reducing Flanges are produced by solvent cementing Reducer Bushings into Socket Flanges. They may be ordered as factory fabrications or may be assembled in the field.

Class 150 Flanges

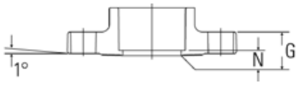
Chemtrol
Fig. No.

4519-H Blind Flange, One-Piece (Solid)



Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. G	Dim. OB
1/2	853-H05	10	0.21	0.54	0.76
3/4	853-H07	10	0.32	0.61	0.83
1	853-H10	10	0.43	0.68	0.88
1 1/4	853-H12	10	0.57	0.73	0.95
1 1/2	853-H15	12	0.69	0.82	1.04
2	853-H20	12	1.08	0.92	1.13
2 1/2	853-H25	5	1.81	1.02	1.22
3	853-H30	10	2.45	1.13	1.39
4	853-H40	5	3.56	1.24	1.51
6	853-H60	5	5.97	1.36	1.60
8	853-H80	2	10.96	1.50	1.78

4551-W Socket Flange (S), One-Piece (Webbed Design)



Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. G	Dim. N
2	851-020	12	0.79	0.92	0.27
3	851-030	10	1.52	1.13	0.29
4	851-040	10	2.25	1.24	0.32
6	851-060	5	4.24	1.36	0.31

Note: One-piece webbed flanges have oblong bolt holes which permit mating with ANSI B16.5, 150 lb.; BS 1560, class 150; ISO 2084, PN10; and DIN 2532, PN10 flanges.

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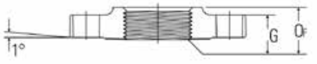
Class 150 Flanges

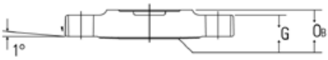
Chemtrol
Fig. No.

4551-W-3 Thread Flange (FPT), One-Piece (Webbed Design)



Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. G	Dim. O_F
2	852-020	10	0.78	0.92	1.18
3	852-030	5	1.26	1.13	1.55
4	852-040	5	2.03	1.24	1.67

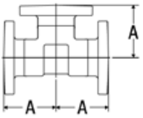
4519-W Blind Flange, One-Piece (Webbed Design)

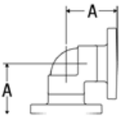


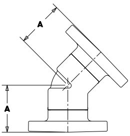
Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. G	Dim. O_B
2	853-020	12	1.16	0.92	1.13
3	853-030	10	1.41	1.13	1.39
4	853-040	5	2.56	1.24	1.51
6	853-060	5	4.96	1.36	1.60

Note: One-piece webbed flanges have oblong bolt holes which permit mating with ANSI B16.5, 150 lb.; BS 1560, class 150; ISO 2084, PN10; and DIN 2532, PN10 flanges.

Flanged Fittings*– Fabricated from Molded Components







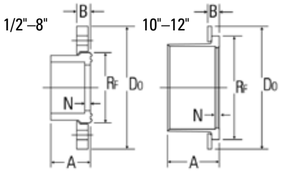
Nominal Size	Fig. No. 4511-12 Flanged Tee Approx. Lbs./Ea.	Dim. A	Fig. No. 4507-12 Flanged 90° ELL Approx. Lbs./Ea.	Dim. A	Fig. No. 4506-12 Flanged 45° ELL Approx. Lbs./Ea.	Dim. B
1	1.71	3 3/32	1.19	3 3/32	1.12	2 23/32
1 1/4	2.39	3 19/32	1.60	3 19/32	1.60	3 3/32
1 1/2	3.24	3 31/32	2.06	3 31/32	2.09	3 13/32
2	4.86	4 15/32	3.28	4 15/32	3.16	3 27/32
2 1/2	7.82	5 7/32	5.30	5 7/32	5.08	4 13/32
3	10.67	5 13/32	7.32	5 13/32	6.92	4 25/32
4	16.64	7 3/32	11.60	7 3/32	10.79	5 25/32
6	32.74	9 25/32	22.65	9 25/32	20.84	8 1/2
8	65.79	13 31/32	45.40	13 31/32	42.50	11 5/8

*Flanged fittings are produced by solvent cementing socket flanges to socket fittings with short plain end pipe nipples. They may be ordered as factory fabrications or may be assembled in the field.

Class 150 Flanges

Chemtrol
Fig. No.

4551-A Socket Flange (S), Van Stone



Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. A	Dim. B	Dim. D_O	Dim. R_F	Dim. N
1/2	854-005	10	0.19	1.00	.50	3.50	1.48	0.11
3/4	854-007	10	0.24	1.13	.50	3.88	1.75	0.11
1	854-010	24	0.38	1.25	.56	4.25	2.04	0.11
1 1/4	854-012	10	0.40	1.38	.63	4.63	2.50	0.11
1 1/2	854-015	12	0.54	1.50	.69	5.00	2.78	0.11
2	854-020	12	0.92	1.63	.75	6.00	3.41	0.11
2 1/2	854-025	5	1.37	1.94	.94	7.00	4.11	0.16
3	854-030	10	1.75	2.40	1.05	7.50	4.81	0.50
4	854-040	10	2.83	2.76	1.16	8.98	6.19	0.48
6	854-060	5	4.19	3.56	1.29	11.00	7.97	0.53
8	854-080	2	6.47	5.01	1.42	13.50	10.45	0.51
10*	854-100	1	10.20	5.83	1.31	16.00	13.29	0.33
12*	854-120	1	17.53	7.45	1.70	19.00	16.00	0.45

*Aluminum ring with PVC coating.

Van Stone Flange Assembly List

Item	Description	Material
1	Connector Hub	PVC
2	Flange Ring	PVC Coated Aluminum
3	Flange Ring	PVC

NR 51 Flange Gaskets, for Class 150 Flanges

Note: These gaskets are 1/8" thick, full face polychloroprene (CR), 70 durometer.

Nominal Size	Part No.	Approx. Lbs./Ea.
1/2	↑	0.11
3/4		0.12
1		0.13
1 1/4		0.14
1 1/2		0.15
2	Use	0.20
2 1/2	Figure No.	0.25
3	& Nom. Size	0.28
4		0.30
6		0.40
8		0.50
10		0.55
12	↓	0.60

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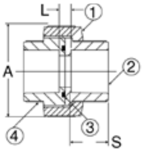
Unions

Chemtrol
Fig. No.

4533 FKM/4533E (EPDM) Socket Union (S x S)

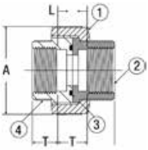


Nominal Size	FKM Part No.	EPDM Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. A	Dim. L	Dim. S*
1/4	857-002	897-002	10	0.07	1.70	0.40	0.64
1/2	857-005	897-005	10	0.16	2.00	0.43	0.89
3/4	857-007	897-007	10	0.27	2.44	0.45	1.01
1	857-010	897-010	10	0.40	2.83	0.43	1.14
1 1/4	857-012	897-012	5	0.87	4.08	0.79	1.26
1 1/2	857-015	897-015	10	0.93	4.08	0.80	1.39
2	857-020	897-020	10	1.83	5.26	0.80	1.51
3	857-030	897-030	5	3.76	7.17	0.90	1.90

The 2 1/2" Socket Union is available as a fabrication from the 3" size Bushed down.

* Socket Depth

4533 FKM/4533E (EPDM) Socket Union (S x S)



Nominal Size	FKM Part No.	EPDM Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. A	Dim. L	Dim. T*
1/4	858-002	898-002	10	0.11	1.70	1.07	0.31
1/2	858-005	898-005	10	0.16	2.00	1.30	0.43
3/4	858-007	898-007	10	0.28	2.44	1.38	0.45
1	858-010	898-010	10	0.41	2.83	1.51	0.53
1 1/4	858-012	898-012	5	0.90	4.08	2.01	0.55
1 1/2	858-015	898-015	10	0.92	4.08	2.16	0.55
2	858-020	898-020	10	1.82	5.26	2.36	0.57
3	858-030	898-030	5	3.96	7.17	2.88	0.95

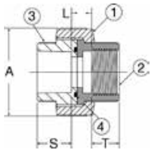
The 2 1/2" Thread Union is available as a fabrication from the 3" size Bushed down.

* Thread Joint Engagement

Unions

Chemtrol
Fig. No.

4533-3 FKM / 4533E-3 (EPDM) Female Adapter Union (S x FPT)



Nominal Size	FKM Part No.	EPDM Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. A	Dim. L	Dim. S*	Dim. T†
1/2	859-005	899-005	10	0.16	2.00	0.84	0.89	0.43
3/4	859-007	899-007	10	0.26	2.44	0.82	1.02	0.45
1	859-010	899-010	10	0.38	2.83	0.90	1.14	0.53
1 1/4	859-012	899-012	10	0.89	4.08	1.29	1.27	0.55
1 1/2	859-015	899-015	10	0.91	4.08	1.32	1.39	0.55
2	859-020	899-020	5	1.81	5.26	1.41	1.51	0.57
3	859-030	899-030	5	3.86	7.17	1.93	1.91	0.95

The 2 1/2" Socket x Thread Union is available as a fabrication from the 3" size Bushed down.

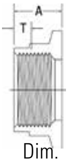
* Socket Depth
† Thread Joint Engagement

*For questions concerning thermoplastic piping systems, please call or fax: **888.446.4226 (ph),** 888.336.4226 (fx).*

Metal Transition Unions

Chemtrol
Fig. No.

TCBR-3 Brass End Connector (FPT)



Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. A	Dim. T*
1/2		1	0.33	1.02	0.43
3/4		1	0.43	1.02	0.45
1	Use Fig. No.	1	0.52	1.19	0.53
1 1/4	& Nom. Size	1	0.85	1.42	0.55
1 1/2		1	1.81	1.42	0.55
2		1	2.74	1.57	0.57
3		1	5.45	2.25	0.95

* Thread Joint Engagement

TCSS-3 Stainless Steel End Connector (FPT)

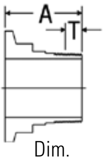
Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. A	Dim. T*
1/2		1	0.30	1.02	0.43
3/4		1	0.39	1.02	0.45
1	Use Fig. No.	1	0.47	1.19	0.53
1 1/4	& Nom. Size	1	0.77	1.42	0.55
1 1/2		1	1.64	1.42	0.55
2		1	2.48	1.57	0.57
3		1	4.97	2.25	0.95

* Thread Joint Engagement

Metal Transition Unions

Chemtrol
Fig. No.

TCBR-4 Brass End Connector (MPT)



Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. A	Dim. T*
1/2	↑	1	0.31	1.66	0.43
3/4		1	0.41	1.69	0.45
1	Use Fig. No.	1	0.49	2.19	0.53
1 1/4	& Nom. Size	1	0.81	2.38	0.55
1 1/2		1	1.72	2.38	0.55
2		1	2.60	2.63	0.57
3	↓	1	5.45	3.50	0.95

* Thread Joint Engagement

TCSS-4 Stainless Steel End Connector (MPT)

Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. A	Dim. T*
1/2	↑	1	0.28	1.66	0.43
3/4		1	0.37	1.69	0.45
1	Use Fig. No.	1	0.44	2.19	0.53
1 1/4	& Nom. Size	1	0.73	2.38	0.55
1 1/2		1	1.56	2.38	0.55
2		1	2.36	2.63	0.57
3	↓	1	4.97	3.50	0.95

* Thread Joint Engagement

For complete technical information and more, refer to our website at ***www.chemtrol.com****.*

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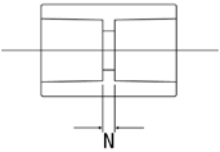
Couplings

Chemtrol
Fig. No.

5101 Socket Couplings (S x S)

Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. N
1/4	1829-002	5	0.06	0.12
1/2	1829-005	25	0.10	0.24
3/4	1829-007	15	0.14	0.24
1	1829-010	20	0.22	0.24
1 1/4	1829-012	10	0.31	0.24
1 1/2	1829-015	10	0.40	0.24
2	1829-020	10	0.57	0.24
2 1/2	1829-025	55	0.73	0.19
3	1829-030	5	1.12	0.18
4	1829-040	5	1.94	0.18
6	1829-060	4	4.01	0.23
8*	1829-080	2	9.23	0.22
10	1829-100	1	14.62	0.35
12	1829-120	1	25.26	0.46

5101-R Reducing Socket Coupling (S xS)

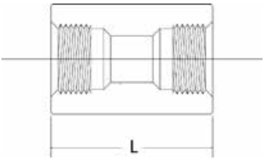
Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. N
3/4 x 1/2	1829-101	5	0.13	0.43
1 x 1/2	1829-130	5	0.20	0.66
1 x 3/4	1829-131	5	0.20	0.54
1 1/4 x 3/4	1829-167	5	0.28	0.71
1 1/4 x 1	1829-168	5	0.30	0.59
1 1/2 x 1/2	1829-209	5	0.37	XXX
1 1/2 x 3/4	1829-210	5	0.35	0.75
1 1/2 x 1	1829-211	5	0.36	0.62
1 1/2 x 1 1/4	1829-212	5	0.38	0.50
2 x 1	1829-249	5	0.50	0.73
2 x 1 1/2	1829-251	5	0.54	0.48
3 x 2	1829-338	5	1.08	1.23
4 x 2	1829-420	5	1.73	1.57
4 x 3	1829-422	5	1.98	1.18

Other Reducing Couplings are produced by solvent cementing Reducer Bushings into Socket Couplings. They may be ordered as factory fabrications or may be assembled in the field.

Couplings

Chemtrol
Fig. No.

5101-3-3 Thread Coupling (FPT x FPT)



Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. L
1/4	1830-002	5	0.07	1.40
1/2	1830-005	25	0.08	2.02
3/4	1830-007	25	0.13	2.27
1	1830-010	15	0.21	2.52
1 1/4	1830-012	5	0.31	2.77
1 1/2	1830-015	5	0.46	3.02
2	1830-020	5	0.64	3.27
2 1/2	1830-025	5	0.89	3.75
3	1830-030	5	1.30	3.99
4	1830-040	5	2.31	4.74

5101-3-3-R Reducing Thread Coupling (FPT x FPT)

Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. L
3/4 x 1/2	1830-101	5	0.15	2.33
1 x 1/2	1830-130	5	0.22	2.69
1 x 3/4	1830-131	5	0.23	2.69
1 1/4 x 3/4	1830-167	5	0.32	2.99
1 1/4 x 1	1830-168	5	0.34	2.99
1 1/2 x 3/4	1830-210	5	0.39	3.15
1 1/2 x 1	1830-211	5	0.40	3.15
1 1/2 x 1 1/4	1830-212	5	0.42	3.15
2 x 1	1830-249	5	0.53	3.39
2 x 1 1/2	1830-251	5	0.58	3.39

Other Reducing Couplings are produced by solvent cementing Reducer Bushings into Socket Couplings. They may be ordered as factory fabrications or may be assembled in the field.

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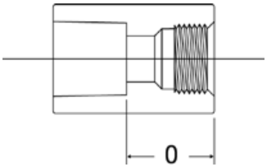
Adapters

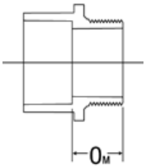
Chemtrol
Fig. No.

5103 Female Adapter Coupling (S x FPT)



Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. O
1/4	1835-002	5	0.06	0.76
1/2	1835-005	15	0.10	1.13
3/4	1835-007	10	0.15	1.26
1	1835-010	10	0.23	1.38
1 1/4	1835-012	5	0.34	1.51
1 1/2	1835-015	5	0.43	1.63
2	1835-020	5	0.60	1.76
2 1/2	1835-025	5	0.82	1.97
3	1835-030	5	1.27	2.08
4	1835-040	5	1.13	2.46

5104 Male Adapter (S x MPT)

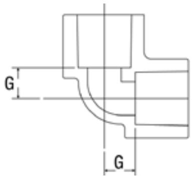


Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. OM
1/2	1836-005	25	0.04	0.94
3/4	1836-007	25	0.06	0.96
1	1836-010	25	0.10	1.14
1 1/4	1836-012	10	0.14	1.11
1 1/2	1836-015	10	0.19	1.11
2	1836-020	10	0.27	1.19
2 1/2	1836-025	5	0.56	1.88
3	1836-030	5	0.79	1.97
4	1836-040	5	1.56	2.08

Elbows

Chemtrol
Fig. No.

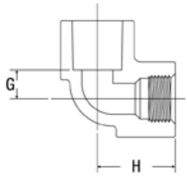
5107 Socket 90° Elbow (S x S)



Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. G
1/4	1806-002	5	0.03	0.33
1/2	1806-005	20	0.12	0.52
3/4	1806-007	20	0.18	0.68
1	1806-010	15	0.27	0.74
1 1/4	1806-012	10	0.41	0.91
1 1/2	1806-015	10	0.54	1.05
2	1806-020	10	0.81	1.26
2 1/2	1806-025	5	1.23	1.52
3	1806-030	5	1.98	1.82
4	1806-040	5	3.44	2.33
6	1806-060	4	8.38	3.48
8*	1806-080	2	16.67	4.53
10	1806-100	1	30.14	5.72
12	1806-120	1	47.77	6.85

* Consult chart on page 39 of this catalog for special rating information.

5107-3 Socket x Thread 90° Elbow (S x FPT)



Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. G	Dim. H
1/2	1807-005	10	0.13	0.52	1.41
3/4	1807-007	10	0.19	0.68	1.70
1	1807-010	10	0.30	0.74	1.88
1 1/4	1807-012	10	0.45	0.91	2.17
1 1/2	1807-015	10	0.59	1.05	2.44
2	1807-020	10	0.86	1.26	2.77

5107-12/5106-12 Flanged Elbow

Flanged fitting center-to-face dimensions may be found on page 21. When ordering, specify the figure number and the nominal size (e.g., 2" Schedule 80 CPVC flanged 90° Elbow–5107-12 2")

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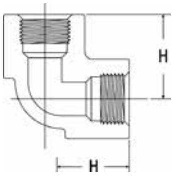
Elbows

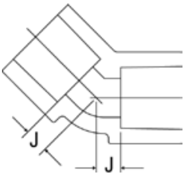
Chemtrol
Fig. No.

5107-3-3 Thread 90° Elbow (FPT x FPT)

Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. H
1/4	1808-002	5	0.03	0.97
1/2	1808-005	10	0.13	1.41
3/4	1808-007	25	0.19	1.70
1	1808-010	15	0.30	1.88
1 1/4	1808-012	5	0.45	2.17
1 1/2	1808-015	5	0.59	2.44
2	1808-020	5	0.86	2.77
2 1/2	1808-025	5	1.34	3.30
3	1808-030	5	2.14	3.73
4	1808-040	5	3.85	4.61

5106 Socket 45° Elbow (S x S)

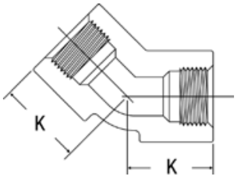
Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. J
1/4	1817-002	5	0.03	0.18
1/2	1817-005	20	0.10	0.26
3/4	1817-007	10	0.15	0.33
1	1817-010	15	0.24	0.37
1 1/4	1817-012	10	0.34	0.42
1 1/2	1817-015	10	0.47	0.46
2	1817-020	10	0.67	0.60
2 1/2	1817-025	5	0.99	0.67
3	1817-030	6	1.48	0.77
4	1817-040	6	2.62	1.01
6	1817-060	4	6.62	1.74
8*	1817-080	2	13.63	2.20
10	1817-100	1	21.44	2.59
12	1817-120	1	35.59	3.05

*Consult chart on page 39 of this catalog for special rating information.

Elbows

Chemtrol
Fig. No.

5106-3-3 Thread 45° Elbow (FPT x FPT)

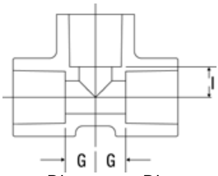



Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. K
1/4	1819-002	5	0.04	0.82
1/2	1819-005	10	0.11	1.15
3/4	1819-007	10	0.16	1.34
1	1819-010	15	0.27	1.51
1 1/4	1819-012	5	0.38	1.69
1 1/2	1819-015	5	0.52	1.85
2	1819-020	5	0.76	2.12
2 1/2	1819-025	5	1.09	2.45
3	1819-030	6	1.70	2.68
4	1819-040	6	3.06	3.29

Tees

Chemtrol
Fig. No.

5111 Socket Tee (S x S x S)

Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. G	Dim. G	Dim. I
1/4	1801-002	5	0.05	0.33	0.33	0.33
1/2	1801-005	25	0.16	0.52	0.52	0.52
3/4	1801-007	15	0.26	0.68	0.68	0.68
1	1801-010	20	0.39	0.74	0.74	0.74
1 1/4	1801-012	10	0.58	0.91	0.91	0.91
1 1/2	1801-015	10	0.78	1.05	1.05	1.05
2	1801-020	10	1.13	1.26	1.26	1.26
2 1/2	1801-025	5	1.72	1.52	1.52	1.52
3	1801-030	5	2.51	1.82	1.82	1.82
4	1801-040	5	4.41	2.33	2.33	2.33
6	1801-060	4	11.11	3.48	3.48	3.48
8*	1801-080	1	22.28	4.53	4.53	4.53
10	1801-100	1	38.52	5.72	5.72	5.72
12	1801-120	1	63.55	6.85	6.85	6.85

* Consult chart on page 41 of this catalog for special rating information.

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Tees

Chemtrol
Fig. No.

5111-12 Flanged Tees

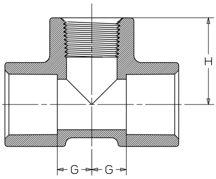
Flanged fitting center-to-face dimensions may be found on page 21. When ordering, specify the figure number and the nominal size (e.g., 2" Schedule 80 CPVC flanged tee–5111-12 2")

5111R Reducing Socket Tee (S x S x S)

Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. G	Dim. G	Dim. I
3/4 x 3/4 x 1/2	1801-101	10	0.19	0.51	0.51	0.62
1 x 1 x 1/2	1801-130	10	0.26	0.52	0.52	0.73
1 x 1 x 3/4	1801-131	10	0.28	0.62	0.62	0.73
1 1/2 x 1 1/2 x 3/4	1801-210	10	0.51	0.66	0.66	1.04
1 1/2 x 1 1/2 x 1	1801-211	10	0.56	0.76	0.76	1.03
2 x 2 x 1/2	1801-247	5	0.65	0.60	0.60	1.29
2 x 2 x 3/4	1801-248	5	0.70	0.70	0.70	1.29
2 x 2 x 1	1801-249	5	0.75	0.80	0.80	1.29
2 x 2 x 1 1/2	1801-251	5	0.89	1.07	1.07	1.29
3 x 3 x 2	1801-338	5	1.92	1.36	1.36	1.84
4 x 4 x 2	1801-420	5	3.02	1.39	1.39	2.34
4 x 4 x 3	1801-422	5	3.62	1.87	1.87	2.34
6 x 6 x 4	1801-532	4	7.69	2.56	2.56	3.52

Other Reducing Tees are produced by solvent cementing Reducer Bushings with Socket Tees. They may be ordered as factory fabrications or may be assembled in the field.

5112 Socket x Thread Tee (S x S x FPT)

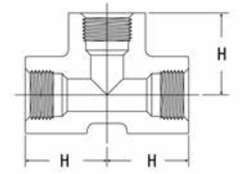


Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. G	Dim. G	Dim. H
1/2	1802-005	10	0.17	0.52	0.52	1.41
3/4	1802-007	10	0.28	0.68	0.68	1.70
1	1802-010	10	0.43	0.74	0.74	1.88
1 1/4	1802-012	10	0.62	0.91	0.91	2.17
1 1/2	1802-015	10	0.88	1.05	1.05	2.44
2	1802-020	10	1.23	1.26	1.26	2.77

Tees

Chemtrol
Fig. No.

5112-3-3 Thread Tee (FPT x FPT x FPT)

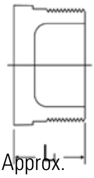


Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. H
1/4	1805-002	5	0.06	0.97
1/2	1805-005	10	0.17	1.41
3/4	1805-007	15	0.28	1.70
1	1805-010	10	0.43	1.88
1 1/4	1805-012	5	0.62	2.17
1 1/2	1805-015	5	0.88	2.44
2	1805-020	5	1.23	2.77
2 1/2	1805-025	5	1.91	3.30
3	1805-030	5	2.48	3.73
4	1805-040	5	4.88	4.61

Plugs

Chemtrol
Fig. No.

5116-4 Thread Plug (MPT)



Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. L
1/4	850-002	25	0.01	0.85
1/2	850-005	50	0.03	1.04
3/4	850-007	50	0.03	1.10
1	850-010	25	0.06	1.25
1 1/4	850-012	10	0.10	1.66
1 1/2	850-015	10	0.14	1.78
2	850-020	10	0.19	1.92
2 1/2	850-025	5	0.29	2.18
3	850-030	5	0.51	2.42
4	850-040	5	0.95	2.81

1/4" Plug is solid, only

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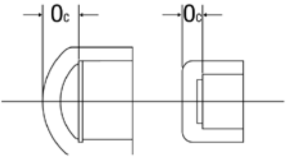
Caps

Chemtrol
Fig. No.

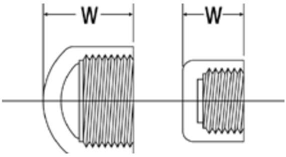
5117 Socket Cap* (S)

Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. Oc
1/4	1847-002	5	0.03	0.25
1/2	1847-005	10	0.06	0.39
3/4	1847-007	10	0.09	0.36
1	1847-010	5	0.14	0.41
1 1/4	1847-012	5	0.22	0.39
1 1/2	1847-015	5	0.28	0.41
2	1847-020	5	0.40	0.41
2 1/2	1847-025	5	0.62	1.56
3	1847-030	5	1.00	1.28
4	1847-040	5	1.61	1.57
6	1847-060	5	4.06	2.11

*Sizes 2" and smaller are flat; 2 1/2" and larger are domed.

5117-3 Thread Cap* (FPT)

Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. W
1/4	1848-002	5	0.02	0.89
1/2	1848-005	5	0.07	1.28
3/4	1848-007	5	0.10	1.38
1	1848-010	5	0.16	1.55
1 1/4	1848-012	5	0.25	1.66
1 1/2	1848-015	5	0.31	1.80
2	1848-020	5	0.46	1.92
2 1/2	1848-025	5	0.68	2.34
3	1848-030	5	1.03	3.18
4	1848-040	5	1.85	3.85

*Sizes 2" and smaller are flat; 2 1/2" and larger are domed.

Bushings

Design Styles

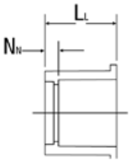
The design style of most bushings is to have a solid wall between the inside and outside connections. Some of the multistep reductions with exceedingly thick cross-sections are not solid. This design style achieves structural support with a web of ribs attaching the inner and outer connection walls, with the open area toward the exterior bushing face. The styles are denoted by W and S for webbed and solid designs respectively.

Webbed design

Solid design

Chemtrol
Fig. No.

5118 Flush Socket Reducer Bushing (SPG x S)



Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Design Style	Dim. LL	Dim. NN
1/2 x 1/4	1837-072	25	0.04	S	1.17	0.53
3/4 x 1/2	1837-101	25	0.06	S	1.15	0.26
1 x 1/2	1837-130	25	0.07	S	1.28	0.39
1 x 3/4	1837-131	25	0.06	S	1.28	0.26
1 1/4 x 1/2	1837-166	10	0.11	S	1.41	0.52
1 1/4 x 3/4	1837-167	10	0.09	S	1.41	0.39
1 1/4 x 1	1837-168	10	0.07	S	1.41	0.27
1 1/2 x 1/2	1837-209	10	0.13	W	1.53	0.64
1 1/2 x 3/4	1837-210	10	0.11	S	1.53	0.51
1 1/2 x 1	1837-211	10	0.09	S	1.53	0.39
1 1/2 x 1 1/4	1837-212	10	0.07	S	1.53	0.26
2 x 1/2	1837-247	10	0.27	W	1.66	0.77
2 x 3/4	1837-248	10	0.27	W	1.66	0.64
2 x 1	1837-249	10	0.27	W	1.66	0.52
2 x 1 1/4	1837-250	5	0.23	S	1.66	0.39
2 x 1 1/2	1837-251	10	0.21	S	1.66	0.27
2 1/2 x 1	1837-289	5	0.46	W	1.94	0.80
2 1/2 x 1 1/2	1837-291	5	0.39	S	1.94	0.55
2 1/2 x 2	1837-292	5	0.26	S	1.93	0.42
3 x 1 1/2	1837-337	5	0.75	W	2.41	1.02
3 x 2	1837-338	5	0.70	S	2.41	0.90
3 x 2 1/2	1837-339	5	0.49	S	2.41	0.63

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Caps

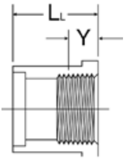
Chemtrol
Fig. No.

5118 Flush Socket Reducer Bushing (SPG x S) (cont.)

Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Design Style	Dim. L_L	Dim. N_N
4 x 2	1837-420	5	1.25	W	2.80	1.29
4 x 3	1837-422	5	1.01	S	2.80	0.90
6 x 4	1837-532	5	2.97	S	3.05	0.77
8 x 6	1837-585	2	6.00	S	4.58	1.55
10 x 6	1837-422	1	10.80	W	5.57	2.54
10 x 8	1837-626	1	9.36	S	5.57	1.07
12 x 8	1837-668	1	18.79	W	6.57	2.07
12 x 10	1837-670	1	12.78	S	6.57	1.07

Other size reductions are produced by solvent cementing appropriate Reducer Bushings together. They may be ordered as factory fabrications or may be assembled in the field.

5118-3 Flush Spigot x Thread Reducer Bushing (SPG x FPT)



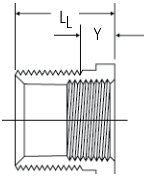
Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Design Style	Dim. L_L	Dim. Y*
1/2 x 1/4	1838-072	25	0.03	S	1.17	0.31
3/4 x 1/2	1838-101	25	0.03	S	1.29	0.43
1 x 1/2	1838-130	25	0.07	S	1.56	0.43
1 x 3/4	1838-131	25	0.06	S	1.56	0.45
1 1/4 x 1/2	1838-166	10	0.15	S	1.66	0.43
1 1/4 x 3/4	1838-167	10	0.13	S	1.66	0.45
1 1/4 x 1	1838-168	10	0.11	S	1.66	0.53
1 1/2 x 1/2	1838-209	10	0.23	S	1.77	0.43
1 1/2 x 3/4	1838-210	10	0.21	S	1.77	0.45
1 1/2 x 1	1838-211	10	0.19	S	1.77	0.53
1 1/2 x 1 1/4	1838-212	10	0.13	S	1.77	0.55
2 x 1/2	1838-247	10	0.36	S	1.91	0.43
2 x 3/4	1838-248	10	0.34	S	1.91	0.45
2 x 1	1838-249	10	0.32	S	1.91	0.53
2 x 1 1/4	1838-250	10	0.26	S	1.91	0.55
2 x 1 1/2	1838-251	10	0.21	S	1.91	0.55
2 1/2 x 2	1838-292	5	0.32	S	2.17	0.57
3 x 2	1838-338	5	0.73	S	2.41	0.57
3 x 2 1/2	1838-339	5	0.57	S	2.41	0.87
4 x 2	1838-420	5	1.30	W	2.80	0.57
4 x 3	1838-422	5	1.06	S	2.80	0.95

Other size reductions are produced by solvent cementing appropriate Reducer Bushings together. They may be ordered as factory fabrications or may be assembled in the field.
*Typical male component engagement, hand tight (L_1 in ANSI B1.20.1 thread spec.) plus 1 1/2 turns.

Tees

Chemtrol
Fig. No.

5118-3-4 Flush Thread Reducer Bushing (MPT x FPT)



Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Design Style	Dim. L_L	Dim. Y*
1/2 x 1/4	1839-072	25	0.02	S	0.95	0.25
3/4 x 1/2	1839-101	25	0.03	S	0.95	0.25
1 x 1/2	1839-130	25	0.06	S	1.24	0.38
1 x 3/4	1839-131	25	0.05	S	1.24	0.38
1 1/4 x 1/2	1839-166	10	0.13	S	1.27	0.38
1 1/4 x 3/4	1839-167	10	0.11	S	1.27	0.38
1 1/4 x 1	1839-168	10	0.09	S	1.27	0.38
1 1/2 x 1/2	1839-209	10	0.20	S	1.28	0.38
1 1/2 x 3/4	1839-210	10	0.18	S	1.28	0.38
1 1/2 x 1	1839-211	10	0.17	S	1.28	0.38
1 1/2 x 1 1/4	1839-212	10	0.11	S	1.28	0.38
2 x 1/2	1839-247	5	0.30	S	1.32	0.38
2 x 3/4	1839-248	5	0.28	S	1.32	0.38
2 x 1	1839-249	5	0.28	S	1.32	0.38
2 x 1 1/4	1839-250	5	0.27	S	1.32	0.38
2 x 1 1/2	1839-251	5	0.15	S	1.32	0.38
2 1/2 x 2	1839-292	5	0.24	S	2.18	0.57
3 x 1 1/2	1839-337	5	0.64	W	2.42	0.55
3 x 2	1839-338	5	0.59	S	2.42	0.57
3 x 2 1/2	1839-339	5	0.54	S	2.42	0.87
4 x 2	1839-420	5	1.01	W	2.81	0.57
4 x 3	1839-422	5	0.95	S	2.81	0.95

Other size reductions are produced by solvent cementing appropriate Reducer Bushings together. They may be ordered as factory fabrications or may be assembled in the field.
*Typical male component engagement, hand tight (L_1 in ANSI B1.20.1 thread spec.) plus 1 1/2 turns.

*Chemtrol has seminars available to educate in the design and installation of thermoplastic piping systems. For more information, call our customer service department at **800.343.5455**.*

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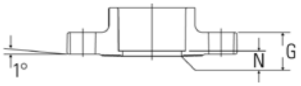
Class 150 Flanges

Chemtrol
Fig. No.

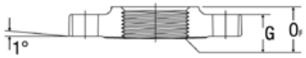
For flange dimensions that comply with ANSI B16.5, 150 lb., steel flanges, see Reference Data on following pages.

5151-H Socket Flange (S), One-Piece (Solid)



Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. G	Dim. N
1/2	1851-H05	10	0.22	0.54	0.20
3/4	1851-H07	15	0.31	0.61	0.17
1	1851-H10	10	0.45	0.68	0.18
1 1/4	1851-H12	5	0.59	0.72	0.20
1 1/2	1851-H15	10	0.73	0.82	0.21
2	1851-H20	10	1.12	0.91	0.26
2 1/2	1851-H25	5	1.77	1.02	0.20
3	1851-H30	10	2.27	1.13	0.28
4	1851-H40	10	3.17	1.24	0.31
6	1851-H60	5	5.04	1.36	0.31
8	1851-H80	2	9.35	1.52	0.35

5151-H-3 Thread Flange (FPT), One-Piece (Solid)

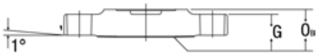


Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. G	Dim. O_F
1/2	1852-H05	10	0.23	0.54	0.88
3/4	1852-H07	10	0.34	0.61	0.91
1	1852-H10	10	0.44	0.68	1.08
1 1/4	1852-H12	5	0.55	0.72	1.11
1 1/2	1852-H15	5	0.69	0.82	1.12
2	1852-H20	5	1.05	0.91	1.17
2 1/2	1852-H25	5	1.65	1.02	1.42
3	1852-H30	5	1.84	1.13	1.55
4	1852-H40	5	2.80	1.24	1.67

Class 150 Flanges

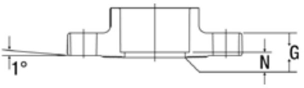
Chemtrol
Fig. No.

5119-H Blind Flange, One-Piece (Solid)



Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. G	Dim. OB
1/2	1853-H05	5	0.28	0.54	0.76
3/4	1853-H07	5	0.34	0.61	0.83
1	1853-H10	5	0.48	0.68	0.88
1 1/4	1853-H12	5	0.63	0.72	0.95
1 1/2	1853-H15	5	0.81	0.82	1.04
2	1853-H20	5	1.24	0.91	1.12
2 1/2	1853-H25	5	2.03	1.02	1.22
3	1853-H30	5	2.65	1.13	1.39
4	1853-H40	5	3.94	1.24	1.57
6	1853-H60	5	6.93	1.36	1.60
8	1853-H80	2	11.23	1.51	1.77

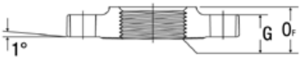
5151-W Socket Flange (S), One-Piece (Webbed Design)



Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. G	Dim. N
2	1851-020	10	0.89	0.91	0.26
3	1851-030	10	1.80	1.13	0.28
4	1851-040	10	2.72	1.24	0.31
6	1851-060	5	4.14	1.36	0.31

Note: One-piece webbed flanges have oblong bolt holes which permit mating with ANSI B16.5, 150 lb.; BS 1560, class 150; ISO 2084, PN10; and DIN 2532, PN10.

5151-W-3 Thread Flange (FPT), One-Piece (Webbed Design)



Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. G	Dim. OF
2	1852-020	5	0.88	0.91	1.17
3	1852-030	5	1.73	1.13	1.55
4	1852-040	5	2.53	1.24	1.67

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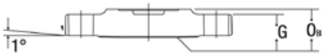
Class 150 Flanges

Chemtrol
Fig. No.

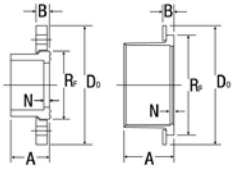
5119-W Blind Flange, One-Piece (Webbed Design)



Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. G	Dim. O_B
2	1853-020	5	0.88	0.91	1.17
3	1853-030	5	1.98	1.13	1.39
4	1853-040	5	2.88	1.24	1.51
6	1853-060	5	5.07	1.36	1.60

Note: One-piece webbed flanges have oblong bolt holes which permit mating with ANSI B16.5, 150 lb.; BS 1560, class 150; ISO 2084, PN10; and DIN 2532, PN10.

5151-A Socket Flange (S), Van Stone



Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. A	Dim. B	Dim. D_O	Dim. R_F	Dim. N
1/2	1854-005	10	0.21	1.00	.50	3.49	1.48	0.11
3/4	1854-007	15	0.26	1.12	.50	3.86	1.75	0.11
1	1854-010	10	0.41	1.25	.56	4.24	2.04	0.11
1 1/4	1854-012	5	0.44	1.37	.63	4.61	2.50	0.11
1 1/2	1854-015	10	0.59	1.50	.69	4.99	2.78	0.11
2	1854-020	10	1.00	1.62	.75	5.98	3.41	0.11
2 1/2	1854-025	5	1.49	1.93	.94	6.98	4.11	0.15
3	1854-030	10	1.87	2.40	1.04	7.48	4.80	0.50
4	1854-040	10	2.84	2.75	1.16	8.95	6.17	0.48
6	1854-060	5	4.88	3.55	1.28	10.97	7.95	0.53
8	1854-080	2	13.13	5.00	1.42	13.46	10.42	0.50

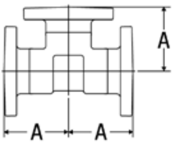
Van Stone Flange Assembly List

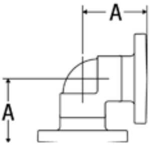
Item	Description	Material
1	Connector Hub	CPVC
3	Flange Ring	CPVC

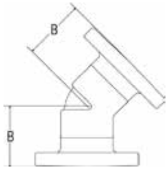
Class 150 Flanges

Chemtrol
Fig. No.

Flanged Fittings*– Fabricated from Molded Components







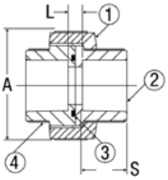
Nominal Size	Flanged Tee Approx. Lbs./Ea.	Flanged Tee Dim. A	Flanged 90° ELL Approx. Lbs./Ea.	Flanged 90° ELL Dim. A	Flanged 45° ELL Approx. Lbs./Ea.	Flanged 45° ELL Dim. B
1	1.98	3 3/32	1.34	3 3/32	1.31	2 23/32
1 1/4	2.75	3 19/32	1.86	3 19/32	1.79	3 3/32
1 1/2	3.49	3 31/32	2.35	3 31/32	2.27	3 13/32
2	5.23	4 15/32	3.54	4 15/32	3.40	3 27/32
2 1/2	8.38	5 7/32	5.67	5 7/32	5.43	4 13/32
3	11.32	5 13/32	7.85	5 13/32	7.35	4 25/32
4	17.36	7 3/32	12.07	7 3/32	11.29	5 25/32
6	32.74	9 25/32	24.50	9 25/32	22.75	8 1/2
8	–	–	–	–	–	–

* Flanged fittings are produced by solvent cementing socket flanges to socket fittings with short plain end pipe nipples.

Unions

Chemtrol
Fig. No.

5133 FKM/5133E (EPDM) Socket Union (S x S)

Nominal Size	FKM Part No.	EPDM Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. A	Dim. L	Dim. S*
1/4	1857-002	1897-002	5	0.10	1.70	0.41	0.64
1/2	1857-005	1897-005	10	0.17	1.99	0.43	0.89
3/4	1857-007	1897-007	10	0.30	2.43	0.44	1.02
1	1857-010	1897-010	5	0.43	2.82	0.43	1.14
1 1/4	1857-012	1897-012	5	0.94	4.07	0.79	1.27
1 1/2	1857-015	1897-015	5	1.01	4.07	0.81	1.39
2	1857-020	1897-020	5	1.98	5.24	0.80	1.52
3	1857-030	1897-030	5	3.77	7.15	0.94	1.91

The 2 1/2" Socket Union is available as a fabrication from the 3" size Bushed down.

* Socket Depth

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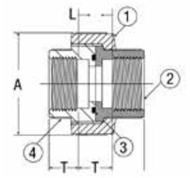
Unions

Chemtrol
Fig. No.

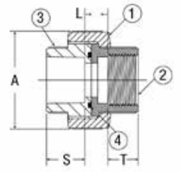
5133-3-3 FKM/5133E-3-3 (EPDM) Threaded Union (FPT x FPT)



Nominal Size	FKM Part No.	EPDM Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. A	Dim. L	Dim. S*
1/4	1858-002	1898-002	5	0.10	1.69	1.07	0.31
1/2	1858-005	1898-005	5	0.17	1.99	1.30	0.43
3/4	1858-007	1898-007	5	0.30	2.43	1.37	0.45
1	1858-010	1898-010	5	0.44	2.82	1.51	0.53
1 1/4	1858-012	1898-012	5	0.97	4.07	2.01	0.55
1 1/2	1858-015	1898-015	5	1.00	4.07	2.16	0.57
2	1858-020	1898-020	5	1.98	5.24	2.36	0.57
3	1858-030	1898-030	5	3.99	7.15	2.685	0.95

* Thread Joint Engagement

5133-3 FKM / 5133E-3 (EPDM) Female Adapter Union (S x FPT)



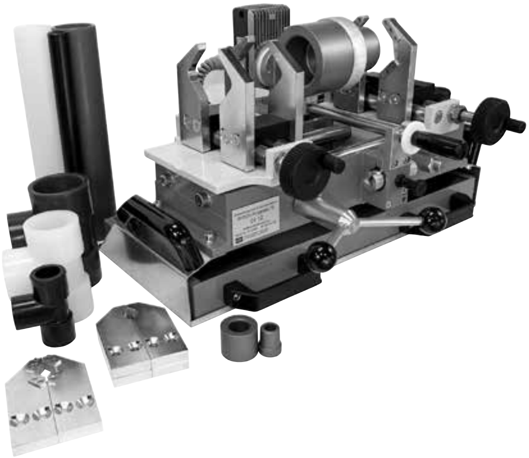
Nominal Size	FKM Part No.	EPDM Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. A	Dim. L	Dim. S*	Dim. T†
1/2	1859-005	1899-005	10/5	0.163	1.99	0.84	0.89	0.43
3/4	1859-007	1899-007	10	0.282	2.43	0.81	1.02	0.45
1	1859-010	1899-010	10	0.411	2.82	0.90	1.14	0.53
1 1/4	1859-012	1899-012	10	0.943	4.07	1.29	1.27	0.55
1 1/2	1859-015	1899-015	10	0.967	4.07	1.32	1.39	0.55
2	1859-020	1899-020	5	1.880	5.24	1.41	1.52	0.57
3	1859-030	1899-030	5	4.100	7.15	1.90	1.91	0.95

* Socket Depth
† Thread Joint Engagement

Bench-Mount Fusion Machines

The bench-mount socket fusion machine is designed to join polypropylene and Kynar® PVDF IPS piping systems. Each machine, Models 7511XT, 3511, and 3600, is sized and specified to handle a particular range of IPS pipe sizes. Two clamps hold the pipe and one clamp holds the corresponding fitting or valve end connector in the precise position for socket fusion. Detailed operating instructions are found in the *Chemtrol Thermoplastic Piping Technical Manual*.

The basic machine comes in a steel or wood shipping crate with the heating tool, wrench, fixtures, clamping unit, and joining instructions.
The Socket Heat Face Sets are ordered separately.



1/2" - 6" Benchmount Fusion Tools						
MODEL NO.	SIZE RANGE	SIZE (W x D x H) HANDLE DOWN	WEIGHT (LBS.) W/CASE	VOLTS	PHASE	WATTS
7511XT	*1/2" – 2"	23 x 18 x 12.5	95.5	110 (+/- 10%)	Single	630
3511	1/2" – 4"	32 x 24 x 19	181.5	110 (+/- 10%)	Single	1200
3600	4" – 6"	42 x 28 x 19	302	220 (+/- 10%)	Single	1200

*7511XT machine does not fit 1-1/2" and 2" flanges.

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Hand Held Fusion Tool - Multi-Size Joining Kits

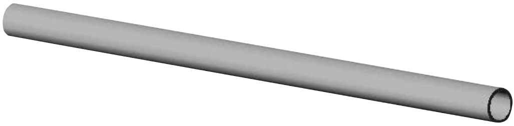
Each kit contains all of the components required for joining all sizes of socket fusion connections specified for that kit, including: heating tool, male and female heat face sets with bolts, depth gages, cold ring pipe clamp with inserts, pipe cutter, beveling tool, timer, thermal blanket, auxiliary handle, hex key wrenches, thermostat adjustment tool, joining instructions and rugged heavy duty tool box.

Multiple Size Joining Kits 1/2" - 2" or 3" - 4"				
MODEL NO.	SIZE RANGE	VOLTS	PHASE	WATTS
C168860	1/2”- 2”	110 (+/- 10%)	Single	800
C169060	3”- 4”	110 (+/- 10%)	Single	1650

Pipe

Chemtrol
Fig. No.

6100-80(1/2”-6”)/6200-80(1/2”-4”) Plain End Schedule 80 Pipe (20 ft. Lengths)

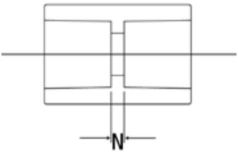


Pipe is ordered and specified with the Chemtrol figure number followed by the nominal size (e.g., 1 1/2" Schedule 80 PP Pipe – 6100 1 1/2"). Weights and dimensions for all pipe may be found in the Reference Data section of this catalog.

Couplings

Chemtrol
Fig. No.

6101/6201 Socket Couplings (S x S)



Nominal Size	Universal Part No. Black	Universal Part No. Chem-Pure	Ctn. Qty.	Approx. Lbs./Ea.	Dim. N
1/2	2829-005	7829-005	10	0.06	0.29
3/4	2829-007	7829-007	10	0.08	0.29
1	2829-010	7829-010	10	0.13	0.28
1 1/2	2829-015	7829-015	10	0.22	0.28
2	2829-020	7829-020	10	0.35	0.27
3	2829-030	7829-030	5	0.60	0.24
4	2829-040	7829-040	5	1.01	0.22
6	2829-060	—	2	2.37	0.26

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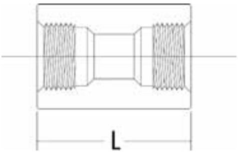
Couplings

Chemtrol
Fig. No.

6101-3-3/6201-3-3 Thread* Coupling (FPT x FPT)



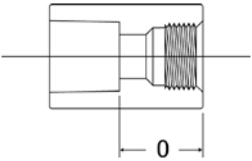
Nominal Size	Universal Part No. Black	Chem-Pure	Ctn. Qty.	Approx. Lbs./Ea.	Dim. L
1/2	2830-005	7830-005	10	0.06	1.99
3/4	2830-007	7830-007	10	0.09	2.24
1	2830-010	7830-010	10	0.14	2.48
1 1/4	2830-012	7830-012	10	0.19	2.73
1 1/2	2830-015	7830-015	10	0.26	2.98
2	2830-020	7830-020	10	0.35	3.22
3	2830-030	7830-030	5	0.73	3.93
4	2830-040	7830-040	5	1.21	4.66

*Recommended for intermittent service not exceeding 20 psi.

Adapters

Chemtrol
Fig. No.

6103/6203 Female Adapter Coupling (S x FPT*)



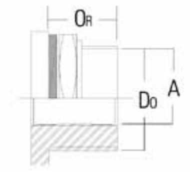
Nominal Size	Universal Part No. Black	Chem-Pure	Ctn. Qty.	Approx. Lbs./Ea.	Dim. O
1/2	2835-005	7835-005	10	0.06	1.14
3/4	2835-007	7835-007	10	0.08	1.26
1	2835-010	7835-010	10	0.13	1.38
1 1/2	2835-015	7835-015	10	0.24	1.63
2	2835-020	7835-020	10	0.34	1.75
3	2835-030	7835-030	5	0.65	2.08
4	2835-040	7835-040	5	1.16	2.44

*Recommended for intermittent service not exceeding 20 psi.

Adapters

Chemtrol
Fig. No.

6150 Tank Adapter (Tank x FPT*)



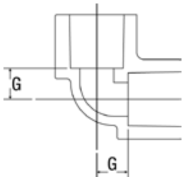
Nom. Size	Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. A	Dim. O_R	Dim. D_O
1/2	Use	5	0.20	14npt	1.19	1.63
3/4	Figure	5	0.30	14npt	1.19	1.63
1	No. &	5	0.31	11 1/2npt	1.38	2.50
1 1/4	Nom. Size	5	0.35	11 1/2npt	1.38	2.50
1 1/2		5	0.39	11 1/2npt	1.38	2.50
2		5	0.52	11 1/2npt	1.56	3.13
3		5	0.81	8npt	1.75	4.25

*Recommended for intermittent service not exceeding 20 psi.
Note: 1. Gasket is EPDM

Elbows

Chemtrol
Fig. No.

6107/6207 Socket 90° Elbow (S x S)



Nominal Size	Universal Part No. Black	Chem-Pure	Ctn. Qty.	Approx. Lbs./Ea.	Dim. G
1/2	2806-005	7806-005	10	0.06	0.53
3/4	2806-007	7806-007	10	0.08	0.70
1	2806-010	7806-010	10	0.15	0.76
1 1/2	2806-015	7806-015	10	0.32	1.06
2	2806-020	7806-020	10	0.49	1.25
3	2806-030	7806-030	5	1.14	1.83
4	2806-040	7806-040	5	1.93	2.32
6	2806-060	—	2	4.47	3.44

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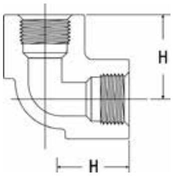
Elbows

Chemtrol
Fig. No.

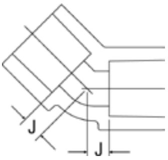
6107-3-3/6207-3-3 Thread* 90°Elbow(FPT x FPT)

Nominal	Universal Part No.		Ctn.	Approx.	Dim.
Size	Black	Chem-Pure	Qty.	Lbs./Ea.	H
1/2	2808-005	7808-005	10	0.07	1.38
3/4	2808-007	7808-007	10	0.11	1.67
1	2808-010	7808-010	10	0.16	1.86
1 1/4	2808-012	7808-012	10	0.25	2.14
1 1/2	2808-015	7808-015	10	0.33	2.41
2	2808-020	7808-020	10	0.49	2.73
3	2808-030	7808-030	5	1.12	3.67
4	2808-040	7808-040	5	2.02	4.54

*Recommended for intermittent service not exceeding 20 psi.

6106/6206 Socket 45° Elbow (S x S)

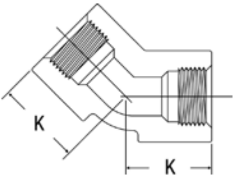



Nominal	Universal Part No.	Ctn.	Approx.	Dim.	
Size	Black	Chem-Pure	Qty.	Lbs./Ea.	J
1/2	2817-005	7817-005	10	0.06	0.28
3/4	2817-007	7817-007	10	0.08	0.35
1	2817-010	7817-010	10	0.14	0.38
1 1/2	2817-015	7817-015	10	0.25	0.48
2	2817-020	7817-020	10	0.37	0.61
3	2817-030	7817-030	5	0.80	0.79
4	2817-040	7817-040	5	1.54	1.02
6	2817-060	—	2	3.55	1.72

Elbows

Chemtrol
Fig. No.

6106-3-3/6206-3-3 Thread* 45° Elbow (FPT x FPT)

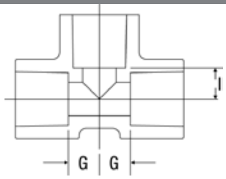
Nominal Size	Universal Part No. Black	Chem-Pure	Ctn. Qty.	Approx. Lbs./Ea.	Dim. K
1/2	2819-005	7819-005	10	0.06	1.13
3/4	2819-007	7819-007	10	0.11	1.32
1	2819-010	7819-010	10	0.15	1.48
1 1/4	2819-012	7819-012	10	0.21	1.66
1 1/2	2819-015	7819-015	10	0.30	1.83
2	2819-020	7819-020	10	0.42	2.09
3	2819-030	7819-030	5	0.92	2.64
4	2819-040	7819-040	5	1.62	3.24

*Recommended for intermittent service not exceeding 29 psi.

Tees

Chemtrol
Fig. No.

6111/6211 Socket Tee (S x S x S)

Nominal Size	Universal Part No. Black	Chem-Pure	Ctn. Qty.	Approx. Lbs./Ea.	Dim. G	Dim. I
1/2	2801-005	7801-005	10	0.09	0.53	0.53
3/4	2801-007	7801-007	10	0.14	0.70	0.70
1	2801-010	7801-010	10	0.19	0.76	0.76
1 1/2	2801-015	7801-015	10	0.43	1.06	1.06
2	2801-020	7801-020	10	1.69	1.25	1.25
3	2801-030	7801-030	5	1.43	1.83	1.83
4	2801-040	7801-040	5	2.41	2.32	2.32
6	2801-060	–	2	5.71	3.44	3.44

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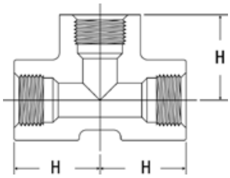
Tees

Chemtrol
Fig. No.

6112-3-3/6212-3-3 Thread* Tee (FPT x FPT x FPT)



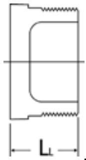
Nominal Size	Universal Part No. Black	Chem-Pure	Ctn. Qty.	Approx. Lbs./Ea.	Dim. H
1/2	2805-005	7805-005	10	0.10	1.38
3/4	2805-007	7805-007	10	0.16	1.67
1	2805-010	7805-010	10	0.24	1.86
1 1/4	2805-012	7805-012	10	0.35	2.14
1 1/2	2805-015	7805-015	10	0.46	2.41
2	2805-020	7805-020	10	0.67	2.73
3	2805-030	7805-030	5	1.54	3.67
4	2805-040	7805-040	5	1.97	4.54

* Recommended for intermittent service not exceeding 20 psi.

Plugs

Chemtrol
Fig. No.

6116-4/6216-4 Thread* Plug (MPT)



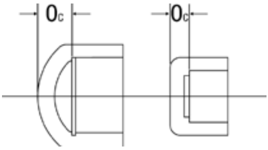
Nominal Size	Universal Part No. Black	Chem-Pure	Ctn. Qty.	Approx. Lbs./Ea.	Dim. LL
1/2	2850-005	7850-005	10	0.02	1.15
3/4	2850-007	7850-007	10	0.02	1.27
1	2850-010	7850-010	10	0.04	1.53
1 1/4	2850-012	7850-012	5	0.13	1.57
1 1/2	2850-015	7850-015	5	0.16	1.55
2	2850-020	7850-020	5	0.25	1.55
3	2850-030	7850-030	5	0.33	2.38
4	2850-040	7850-040	5	0.66	2.76

* Recommended for intermittent service not exceeding 20 psi.

Caps

Chemtrol
Fig. No.

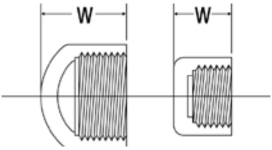
6117/6217 Socket Cap‡ (S)



Nominal Size	Universal Part No. Black	Chem-Pure	Ctn. Qty.	Approx. Lbs./Ea.	Dim. Oc
1/2	2847-005	7847-005	10	0.04	0.41
3/4	2847-007	7847-007	10	0.05	0.38
1	2847-010	7847-010	10	0.09	0.42
1 1/2	2847-015	7847-015	10	0.17	0.42
2	2847-020	7847-020	10	0.23	0.42
3	2847-030	7847-030	5	0.52	1.29
4	2847-040	7847-040	5	0.90	1.57
6	2847-060	—	2	2.08	2.04

‡ Sizes 2" and smaller are flat; 3" and larger are domed.

6117-3/6217-3 Thread* Cap‡ (FPT)



Nominal Size	Universal Part No. Black	Chem-Pure	Ctn. Qty.	Approx. Lbs./Ea.	Dim. W
1/2	2848-005	7848-005	10	0.04	1.26
3/4	2848-007	7848-007	10	0.08	1.36
1	2848-010	7848-010	10	0.09	1.52
1 1/4	2848-012	7848-012	10	0.13	1.63
1 1/2	2848-015	7848-015	10	0.19	1.77
2	2848-020	7848-020	10	0.26	1.90
3	2848-030	7848-030	5	0.58	3.13
4	2848-040	7848-040	5	1.02	3.79

* Recommended for intermittent service not exceeding 20 psi.
‡ Sizes 2" and smaller are flat; 3" and larger are domed.

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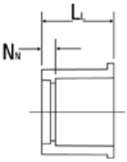
Bushings

Chemtrol
Fig. No.

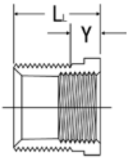
6118/6218 Flush Socket Reducer Bushing (SPG x S)



Nominal Size	Universal Part No. Black	Chem-Pure	Ctn. Qty.	Approx. Lbs./Ea.	Design Style†	Dim. LL	Dim. NN
3/4 x 1/2	2837-101	7837-101	10	0.02	S	1.28	0.43
1 x 1/2	2837-130	7837-130	10	0.04	S	1.53	0.68
1 x 3/4	2837-131	7837-131	10	0.03	S	1.53	0.56
1 1/2 x 1	2837-211	7837-211	10	0.10	S	1.78	0.68
2 x 1	2837-249	7837-249	10	0.18	S	1.91	0.81
2 x 1 1/2	2837-251	7837-251	10	0.12	S	1.91	0.56
3 x 2	2837-338	7837-338	5	0.42	S	2.38	0.90
4 x 3	2837-422	7837-422	5	0.62	S	2.76	0.91
6 x 4	2837-532	—	2	1.74	S	3.00	0.78

Note: 3" and 4" sizes are hex head, 3/4", 1", 1 1/2", 2", and 6" have round heads.
† All Bushings have solid walls.

6118-3-4/6218-3-4 Flush Thread* Reducer Bushing (MPT x FPT)



Nominal Size	Universal Part No. Black	Chem-Pure	Ctn. Qty.	Approx. Lbs./Ea.	Design Style†	Dim. LL	Dim. Y**
3/4 x 1/2	2839-101	7839-101	10	0.02	S	1.27	0.43
1 x 1/2	2839-130	7839-130	10	0.04	S	1.53	0.43
1 x 3/4	2839-131	7839-131	10	0.03	S	1.53	0.45
1 1/4 x 3/4	2839-167	7839-167	10	0.09	S	1.38	0.45
1 1/4 x 1	2839-168	7839-168	10	0.07	S	1.38	0.53
1 1/2 x 1	2839-211	7839-211	10	0.11	S	1.55	0.53
1 1/2 x 1 1/4	2839-212	7839-212	10	0.07	S	1.55	0.55
2 x 1	2839-249	7839-249	10	0.18	S	1.57	0.53
2 x 1 1/2	2839-251	7839-251	10	0.13	S	1.57	0.55
3 x 2	2839-338	7839-338	5	0.38	S	2.38	0.57
4 x 3	2839-422	7839-422	5	0.49	S	2.76	0.95

* Recommended for intermittent service not exceeding 20 psi.
** Typical male component engagement, hand tight (L_1 in ANSI B1.20.1 thread spec.) plus 1 1/2 turns.

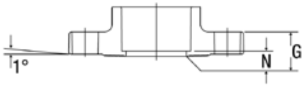
Note: 3/4", 1", 3", and 4" sizes are hex head; 1 1/4", 1 1/2", and 2" are knurled round.
† All Bushings have solid walls.

Class 150 Flanges

For flange dimensions that comply with ANSI B16.5, 150 lb., steel flanges, see page 37.

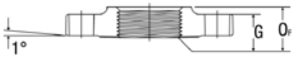
Chemtrol
Fig. No.

6151-H/6251-H Socket Flange (S), One-Piece (Solid)



Nominal Size	Universal Part No. Black	Chem-Pure	Ctn. Qty.	Approx. Lbs./Ea.	Dim G	Dim. N
1/2	2851-H05	7851-H05	10	0.13	0.54	0.23
3/4	2851-H07	7851-H07	10	0.20	0.60	0.20
1	2851-H10	7851-H10	10	0.24	0.67	0.21
1 1/2	2851-H15	7851-H15	10	0.41	0.72	0.23
2	2851-H20	7851-H20	10	0.79	0.90	0.27
3	2851-H30	7851-H30	5	1.50	1.12	0.34
4	2851-H40	7851-H40	5	2.20	1.23	0.33
6	2851-H60	—	2	3.45	1.33	0.28

6151-H-3/6251-H-3 Thread* Flange (FPT), One-Piece (Solid)



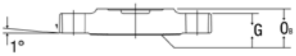
Nominal Size	Universal Part No. Black	Chem-Pure	Ctn. Qty.	Approx. Lbs./Ea.	Dim. G	Dim. OF
1/2	2852-H05	7852-H05	10	0.13	0.54	0.87
3/4	2852-H07	7852-H07	10	0.18	0.60	0.90
1	2852-H10	7852-H10	10	0.24	0.67	1.07
1 1/4	2852-H12	7852-H12	5	0.34	0.65	1.11
1 1/2	2852-H15	7852-H15	5	0.39	0.72	1.07
2	2852-H20	7852-H20	5	0.71	0.90	1.17
3	2852-H30	7852-H30	5	1.22	1.12	1.53
4	2852-H40	7852-H40	5	2.03	1.23	1.65

* Recommended for intermittent service not exceeding 20 psi.

Class 150 Flanges

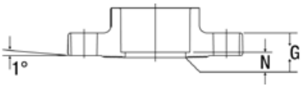
Chemtrol
Fig. No.

6119-H/6219-H Blind Flange, One-Piece (Solid)



Nominal Size	Universal Part No. Black	Chem-Pure	Ctn. Qty.	Approx. Lbs./Ea.	Dim G	Dim. OB
1/2	2853-H05	7853-H05	10	0.13	0.54	0.75
3/4	2853-H07	7853-H07	10	0.20	0.60	0.82
1	2853-H10	7853-H10	10	0.26	0.67	0.87
1 1/4	2853-H12	—	10	0.32	0.65	0.89
1 1/2	2853-H15	7853-H15	10	0.39	0.72	0.98
2	2853-H20	7853-H20	5	0.82	0.90	1.11
3	2853-H30	7853-H30	5	1.74	1.12	1.37
4	2853-H40	7853-H40	5	2.70	1.23	1.49
6	2853-H60	—	2	4.28	1.33	1.53

6151-W/6251-W Socket Flange (S), One-Piece (Webbed Design)



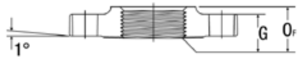
Nominal Size	Universal Part No. Black	Chem-Pure	Ctn. Qty.	Approx. Lbs./Ea.	Dim. G	Dim. N
2	2851-020	7851-020	10	0.61	0.90	0.27
3	2851-030	7851-030	5	1.16	1.12	0.34
4	2851-040	7851-040	5	1.69	1.23	0.33
6	2851-060	7851-060	2	2.66	1.33	0.28

Note: One-piece webbed flanges have oblong bolt holes which permit mating with ANSI B16.5, 150 lb.; BS 1560, class 150; ISO 2084, PN10; and DIN 2532, PN10 flanges.

Class 150 Flanges

Chemtrol
Fig. No.

6151-W-3/6251-W-3 Thread* Flange (FPT), One-Piece (Webbed Design)

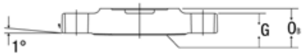


Nominal Size	Universal Part No. Black	Chem-Pure	Ctn. Qty.	Approx. Lbs./Ea.	Dim. G	Dim. O_F
2	2852-020	7852-020	5	0.56	0.90	1.17
3	2852-030	7852-030	5	0.98	1.12	1.53
4	2852-040	7852-040	5	1.62	1.23	1.65

* Recommended for intermittent service not exceeding 20 psi.

Note: One-piece webbed flanges have oblong bolt holes which permit mating with ANSI B16.5, 150 lb.; BS 1560, class 150; ISO 2084, PN10; and DIN 2532, PN10 flanges.

6119-W Blind Flange, One-Piece (Webbed Design)



Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. G	Dim. O_B
2	2853-020	5	0.59	0.90	1.11
3	2853-030	5	1.14	1.12	1.37
4	2853-040	5	1.94	1.23	1.49
6	2853-060	2	3.08	1.33	1.53

Note: One-piece webbed flanges have oblong bolt holes which permit mating with ANSI B16.5, 150 lb.; BS 1560, class 150; ISO 2084, PN10; and DIN 2532, PN10.

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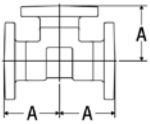
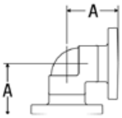
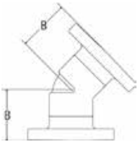
Class 150 Flanges

Chemtrol
Fig. No.

Flanged Fittings*– Fabricated from Molded Components







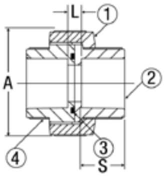
	Flanged Tee		Flanged 90° ELL		Flanged 45° ELL	
Nominal Size	Approx. Lbs./Ea.	Dim. A	Approx. Lbs./Ea.	Dim. A	Approx. Lbs./Ea.	Dim. B
1/2	0.24	2 13/32	0.21	2 13/32	0.21	2 5/32
3/4	0.37	2 23/32	0.31	2 23/32	0.31	2 15/32
1	0.48	3 3/32	0.44	3 3/32	0.43	2 23/32
1 1/2	0.94	3 31/32	0.83	3 31/32	0.76	3 13/32
2	1.64	5 7/32	1.44	4 15/32	1.32	3 27/32
3	4.97	5 15/32	3.04	5 13/32	2.70	4 25/32
4	5.30	7 3/32	4.82	7 3/32	4.43	5 25/32

*Flanged fittings are produced by heat fusion of socket flanges to socket fittings with short plain end pipe nipples.

Unions

Chemtrol
Fig. No.

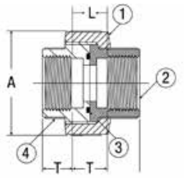
6133/6233 FKM Socket Union (S x S)



Nominal Size	Universal Black	Part No. Chem-Pure	Ctn. Qty.	Approx. Lbs./Ea.	Dim. A	Dim. L	Dim. S*
1/2	2897-005	7897-005	10	0.11	1.98	0.46	0.85
3/4	2897-007	7897-007	10	0.20	2.41	0.50	0.98
1	2897-010	7897-010	10	0.28	2.77	0.48	1.10
1 1/2	2897-015	7897-015	5	0.70	4.04	0.79	1.35
2	2897-020	7897-020	5	1.31	5.20	0.82	1.48

Unions are supplied with FKM O-Rings. EPDM O-Rings may be ordered for field replacement, where required. Socket x Thread is available on request. Threaded fittings are recommended for intermittent service not exceeding 20 psi.
* Socket Depth

6133-3-3/6233-3-3 FKM Threaded* Union (FPT x FPT)



Nominal Size	Universal Part No. Black	Chem-Pure	Ctn. Qty.	Approx. Lbs./Ea.	Dim. A	Dim. L	Dim. T**
1/2	2898-005	7898-005	10	0.12	1.17	1.30	0.43
3/4	2898-007	7898-007	10	0.20	2.41	1.55	0.45
1	2898-010	7898-010	10	0.29	2.77	1.62	0.53
1 1/4	2898-012	7898-012	5	0.67	4.04	2.17	0.55
1 1/2	2898-015	7898-015	5	0.74	4.04	2.39	0.55
2	2898-020	7898-020	5	1.39	5.20	2.63	0.57

Unions are supplied with FKM O-Rings. EPDM O-Rings may be ordered for field replacement, where required. Socket x Thread is available on request.
* Recommended for intermittent service not exceeding 20 psi.
** Thread Joint Engagement

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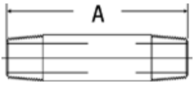
Nipples

Chemtrol
Fig. No.

6129 Threaded* Pipe Nipple (MPT x MPT)



	Length – 2"	
Nom. Size	Ctn. Qty.	Approx. Lbs./Ea.
1/2	10	0.02

Example of part identification
$^1/_2$" x Short PP Nipple – 6129 $^1/_2$" – SH

	Length – Close			Length – Short			Length – 3"	
Nom. Size	Ctn. Qty.	Approx. Lbs./Ea.	Dim. A	Ctn. Qty.	Approx. Lbs./Ea.	Dim. A	Ctn. Qty.	Approx. Lbs./Ea.
1/2	10	0.01	1.13	10	0.01	1.50	10	0.03
3/4	10	0.02	1.38	10	0.03	2.00	10	0.04
1	10	0.03	1.50	10	0.04	2.00	10	0.06
1 1/4	10	0.04	1.63	10	0.06	2.50	10	0.08
1 1/2	10	0.06	1.75	10	0.08	2.50	10	0.10
2	10	0.09	2.00	10	0.11	2.50	10	0.14
3	5	0.21	2.63	5	0.26	3.00	See Short	
4	5	0.35	2.88	5	0.50	4.00	See Close	

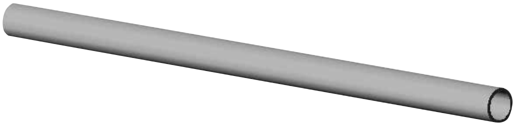
	Length – 4"		Length – 5"		Length – 6"	
Nom. Size	Ctn. Qty.	Approx. Lbs./Ea.	Ctn. Qty.	Approx. Lbs./Ea.	Ctn. Qty.	Approx. Lbs./Ea.
1/2	10	0.04	10	0.05	10	0.06
3/4	10	0.06	10	0.07	10	0.09
1	10	0.08	10	0.10	10	0.12
1 1/4	10	0.12	10	0.14	10	0.18
1 1/2	10	0.14	10	0.18	10	0.21
2	10	0.20	10	0.24	10	0.30
3	5	0.37	5	0.46	5	0.59
4	See Short		5	0.72	5	0.85

*Recommended for intermittent service not exceeding 20 psi.

Pipe

Chemtrol
Fig. No.

6500/6600-80 (1/2”-6”) Plain End Schedule 80 Pipe (20 ft. Lengths)

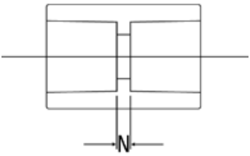


Pipe is ordered and specified with the Chemtrol figure number followed by the nominal size (e.g., 1 1/2" Schedule 80 PVDF Pipe – 6500-80- 1 1/2"). Weights and dimensions for all pipe may be found on page 38 of this catalog.

Couplings

Chemtrol
Fig. No.

6501/6601 Socket Coupling (S x S)

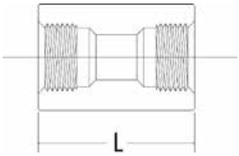


Nominal Size	Universal Part No. Red	Natural	Ctn. Qty.	Approx. Lbs./Ea.	Dim. N
1/2	3829-005	4829-005	5	0.12	0.28
3/4	3829-007	4829-007	5	0.16	0.27
1	3829-010	4829-010	5	0.26	0.26
1 1/2	3829-015	4829-015	2	0.49	0.25
2	3829-020	4829-020	2	0.71	0.24
3	3829-030	4829-030	2	1.43	0.21
4	3829-040	4829-040	2	2.47	0.19
6	3829-060	4829-060	1	5.49	0.21

Couplings

Chemtrol
Fig. No.

6501-3-3/6601-3-3 Thread Coupling (FPT x FPT)

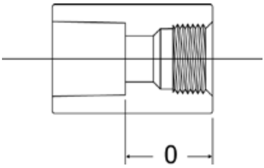


Nominal Size	Universal Part No. Red	Natural	Ctn. Qty.	Approx. Lbs./Ea.	Dim. L
1/2	3830-005	4830-005	5	0.12	1.98
3/4	3830-007	4830-007	5	0.16	2.22
1	3830-010	4830-010	5	0.56	2.46
1 1/2	3830-015	4830-015	2	0.49	2.95
2	3830-020	4830-020	2	0.71	3.19

Adapters

Chemtrol
Fig. No.

6503/6603 Female Adapter Coupling (S x FPT)

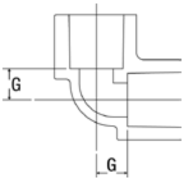


Nominal Size	Universal Part No. Red	Natural	Ctn. Qty.	Approx. Lbs./Ea.	Dim. O
1/2	3835-005	4835-005	5	0.12	1.13
3/4	3835-007	4835-007	5	0.16	1.25
1	3835-010	4835-010	5	0.26	1.36
1 1/2	3835-015	4835-015	2	0.49	1.60
2	3835-020	4835-020	2	0.71	1.72

Elbows

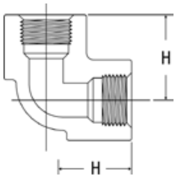
Chemtrol
Fig. No.

6507/6607 Socket 90° Elbow (S x S)

Nominal Size	Universal Part No. Red	Natural	Ctn. Qty.	Approx. Lbs./Ea.	Dim. G
1/2	3806-005	4806-005	5	0.12	0.52
3/4	3806-007	4806-007	5	0.18	0.69
1	3806-010	4806-010	5	0.28	0.74
1 1/2	3806-015	4806-015	2	0.56	1.04
2	3806-020	4806-020	2	0.95	1.23
3	3806-030	4806-030	2	2.51	1.80
4	3806-040	4806-040	2	4.02	2.28
6	3806-060	4806-060	1	9.76	3.39

6507-3-3/6607-3-3 Thread 90° Elbow (FPT x FPT)

Nominal Size	Universal Part No. Red	Natural	Ctn. Qty.	Approx. Lbs./Ea.	Dim. H
1/2	3808-005	4808-005	5	0.13	1.37
3/4	3808-007	4808-007	5	0.20	1.60
1	3808-010	4808-010	5	0.32	1.84
1 1/2	3808-015	4808-015	2	0.64	2.39
2	3808-020	4808-020	2	0.80	2.71

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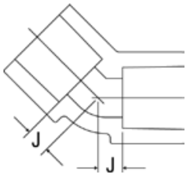
Elbows

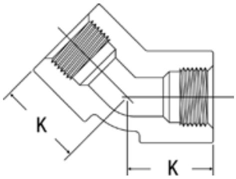
Chemtrol
Fig. No.

6506/6606 Socket 45° Elbow (S x S)



Nominal Size	Universal Part No. Red	Natural	Ctn. Qty.	Approx. Lbs./Ea.	Dim. J
1/2	3817-005	4817-005	5	0.10	0.27
3/4	3817-007	4817-007	5	0.14	0.33
1	3817-010	4817-010	5	0.29	0.37
1 1/2	3817-015	4817-015	2	0.49	0.46
2	3817-020	4817-020	2	0.68	0.59
3	3817-030	4817-030	2	1.53	0.77
4	3817-040	4817-040	2	2.71	0.99
6	3817-060	4817-060	1	6.40	1.69

6506-3-3/6606-3-3 Thread 45° Elbow (FPT x FPT)

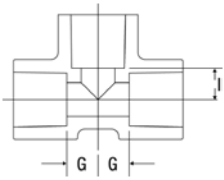


Nominal Size	Universal Part No. Red	Natural	Ctn. Qty.	Approx. Lbs./Ea.	Dim K
1/2	3819-005	4819-005	5	0.12	1.12
3/4	3819-007	4819-007	5	0.18	1.31
1	3819-010	4819-010	5	0.29	1.47
1 1/2	3819-015	4819-015	2	0.55	1.81
2	3819-020	4819-020	2	0.80	2.07

Tees

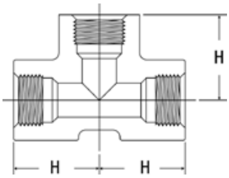
Chemtrol
Fig. No.

6511/6611 Socket Tee (S x S x S)



Nominal Size	Universal Part No. Red	Natural	Ctn. Qty.	Approx. Lbs./Ea.	Dim. G	Dim. I
1/2	3801-005	4801-005	5	0.16	0.52	0.52
3/4	3801-007	4801-007	5	0.29	0.69	0.69
1	3801-010	4801-010	5	0.47	0.74	0.74
1 1/2	3801-015	4801-015	2	0.79	1.04	1.04
2	3801-020	4801-020	2	1.36	1.23	1.23
3	3801-030	4801-030	2	2.61	1.80	1.80
4	3801-040	4801-040	2	4.50	2.28	2.28
6	3801-060	4801-060	1	11.33	3.39	3.39

6512-3-3/6612-3-3 Thread Tee (FPT x FPT x FPT)



Nominal Size	Universal Part No. Red	Natural	Ctn. Qty.	Approx. Lbs./Ea.	Dim. H
1/2	3805-005	4805-005	5	0.18	1.37
3/4	3805-007	4805-007	5	0.30	1.60
1	3805-010	4805-010	5	0.44	1.84
1 1/2	3805-015	4805-015	2	0.92	2.39
2	3805-020	4805-020	2	1.31	2.71

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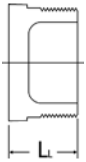
Plugs

Chemtrol
Fig. No.

6516-4/6616-4 Thread Plug (MPT)

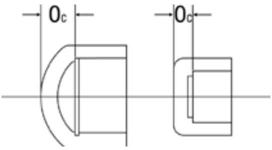


Nominal Size	Universal Part No. Red	Natural	Ctn. Qty.	Approx. Lbs./Ea.	Dim. L_L
1/2	3850-005	4850-005	5	0.03	1.14
3/4	3850-007	4850-007	5	0.08	1.26
1	3850-010	4850-010	5	0.10	1.48
1 1/2	3850-015	4850-015	2	0.18	1.78
2	3850-020	4850-020	2	0.26	1.89

Caps

Chemtrol
Fig. No.

6517/6617 Socket Cap (S)



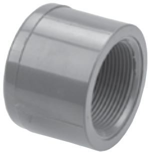
Nominal Size	Universal Part No. Red	Natural	Ctn. Qty.	Approx. Lbs./Ea.	Dim. O_C
1/2	3847-005	4847-005	5	0.07	0.40
3/4	3847-007	4847-007	5	0.10	0.37
1	3847-010	4847-010	5	0.17	0.41
1 1/2	3847-015	4847-015	2	0.29	0.40
2	3847-020	4847-020	2	0.48	0.41

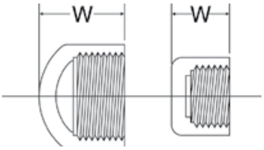
Note: Caps are flat top style.

Caps

Chemtrol
Fig. No.

6517-3/6617-3 Thread Cap (FPT)



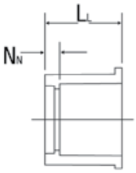


Nominal Size	Universal Part No. Red	Natural	Ctn. Qty.	Approx. Lbs./Ea.	Dim. W
1/2	3848-005	4848-005	5	0.07	1.25
3/4	3848-007	4848-007	5	0.10	1.34
1	3848-010	4848-010	5	0.17	1.51
1 1/2	3848-015	4848-015	2	0.33	1.75
2	3848-020	4848-020	2	0.48	1.88

Bushings

Chemtrol
Fig. No.

6518/6618 Flush Socket Reducer Bushing (SPG x S)



Nominal Size	Universal Part No. Red	Natural	Ctn. Qty.	Approx. Lbs./Ea.	Design Style*	Dim. L_L	Dim. N_N
3/4 x 1/2	3837-101	4837-101	5	0.08	S	1.40	0.55
1 x 1/2	3837-130	4837-130	5	0.16	S	1.52	0.67
1 x 3/4	3837-131	4837-131	5	0.08	S	1.52	0.55
1 1/2 x 1	3837-249	4837-168	5	0.34	S	1.79	0.69
2 x 1	3837-249	4837-249	5	0.63	S	1.89	0.79
2 x 1 1/2	3837-251	4837-251	5	0.50	S	1.89	0.54
3 x 2	3837-338	4837-338	5	0.88	S	2.36	0.88
4 x 3	3837-422	4837-442	5	1.36	S	2.74	0.89
6 x 4	3837-532	4837-532	2	4.67	S	2.98	0.76

* All Bushings have solid walls.

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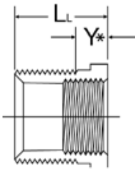
Bushings

Chemtrol
Fig. No.

6518-3-4/6618-3-4 Flush Thread Reducer Bushing (MPT x FPT)



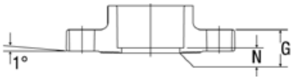
Nominal Size	Universal Part No. Red	Natural	Ctn. Qty.	Approx. Lbs./Ea.	Design Style	Dim. L_L	Dim. Y*
3/4 x 1/2	3839-101	4839-101	5	0.05	S	1.26	0.43
1 x 1/2	3839-130	4839-130	5	0.16	S	1.52	0.43
1 x 3/4	3839-131	4839-131	5	0.08	S	1.52	0.45
1 1/2 x 1	3839-211	4839-211	5	0.19	S	1.79	0.53
2 x 1	3839-249	4839-249	5	0.35	S	1.89	0.53
2 x 1 1/2	3839-251	4839-251	5	0.22	S	1.89	0.55

* Typical male component engagement, hand tight (L_1 in ANSI B1.20.1 thread spec.) plus 1 1/2 turns plus.
** All Bushings have solid walls.

Class 150 Flanges

Chemtrol
Fig. No.

6551-H/6651-H Socket Flange (S), One-Piece (Solid)

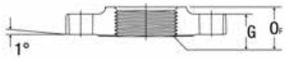


Nominal Size	Universal Part No. Red	Natural	Ctn. Qty.	Approx. Lbs./Ea.	Dim G	Dim. N
1/2	3851-H05	4851-H05	5	0.25	0.53	0.19
3/4	3851-H07	4851-H07	5	0.33	0.59	0.20
1	3851-H10	4851-H10	5	0.48	0.66	0.21
1 1/2	3851-H15	4851-H15	2	0.75	0.72	0.23
2	3851-H20	4851-H20	2	1.16	0.90	0.27
3	3851-H30	4851-H30	2	2.56	1.10	0.34
4	3851-H40	4851-H40	2	3.86	1.21	0.31
6	3851-H60	4851-H60	1	5.89	1.32	0.21

Class 150 Flanges

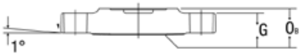
Chemtrol
Fig. No.

6551-H-3/6651-H-3 Thread Flange (FPT), One Piece (Solid)



Nominal Size	Universal Part No. Red	Natural	Ctn. Qty.	Approx. Lbs./Ea.	Dim G	Dim. OF
1/2	3852-H05	4852-H05	5	0.25	0.53	0.87
3/4	3852-H07	4852-H07	5	0.34	0.59	0.88
1	3852-H10	4852-H10	5	0.47	0.66	1.07
1 1/2	3852-H15	4852-H15	2	0.71	0.72	1.11
2	3852-H20	4852-H20	2	1.10	0.90	1.15

6519-H/6619-H Blind Flange, One-Piece (Solid)

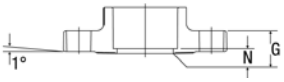


Nominal Size	Universal Part No. Red	Natural	Ctn. Qty.	Approx. Lbs./Ea.	Dim G	Dim. OB
1/2	3853-H05	4853-H05	5	0.25	0.53	0.74
3/4	3853-H07	4853-H07	5	0.37	0.59	0.81
1	3853-H10	4853-H10	5	0.51	0.66	0.87
1 1/2	3853-H15	4853-H15	2	0.82	0.72	0.98
2	3853-H20	4853-H20	2	1.27	0.90	1.10
3	3853-H30	4853-H30	2	2.89	1.10	1.36
4	3853-H40	4853-H40	2	4.20	1.21	1.45
6	3853-H60	4853-H60	1	7.40	1.32	1.58

Class 150 Flanges

Chemtrol
Fig. No.

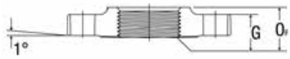
6518-3-4/6618-3-4 Flush Thread Reducer Bushing (MPT x FPT)



Nominal Size	Universal Part No. Red	Natural	Ctn. Qty.	Approx. Lbs./Ea.	Dim G	Dim. N
2	3851-020	4851-020	2	0.89	0.90	0.27
3	3851-030	4851-030	2	1.97	1.10	0.34
4	3851-040	4851-040	2	2.97	1.21	0.31
6	3851-060	4851-060	1	4.54	1.32	0.21

Note: One-piece webbed flanges have oblong bolt holes which permit mating with ANSI B16.5, 150lb.; BS 1560, class 150; ISO 2084, PN10; and DIN 2532, PN10.

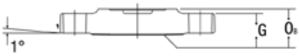
6551-W-3/6651-W-3 Thread Flange (FPT), One-Pc (Webbed Design)



Nominal Size	Universal Part No. Red	Natural	Ctn. Qty.	Approx. Lbs./Ea.	Dim G	Dim. O_F
2	3852-020	4852-020	2	0.88	0.90	1.15

Note: One-piece webbed flanges have oblong bolt holes which permit mating with ANSI B16.5, 150 lb.; BS 1560, class 150; ISO 2084, PN10; and DIN 2532, PN10.

6519-W/6619-W Blind Flange, One-Piece (Webbed Design)



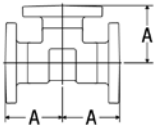
Nominal Size	Universal Part No. Red	Natural	Ctn. Qty.	Approx. Lbs./Ea.	Dim G	Dim. O_B
2	3853-020	4853-020	2	0.91	0.90	1.10
3	3853-030	4853-030	2	2.08	1.10	1.36
4	3853-040	4853-040	2	3.02	1.21	1.45
6	3853-060	4853-060	1	5.33	1.32	1.58

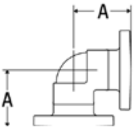
Note: One-piece webbed flanges have oblong bolt holes which permit mating with ANSI B16.5, 150 lb.; BS 1560, class 150; ISO 2084, PN10; and DIN 2532, PN10.

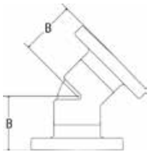
Class 150 Flanges

Chemtrol
Fig. No.

Flanged Fittings*– Fabricated from Molded Components







	Flanged Tee		Flanged 90° ELL		Flanged 45° ELL	
Nominal Size	Approx. Lbs./Ea.	Dim. A	Approx. Lbs./Ea.	Dim. A	Approx. Lbs./Ea.	Dim. B
1/2	0.45	2 13/32	0.41	2 13/32	0.39	2 5/32
3/4	0.68	2 23/32	0.57	2 23/32	0.53	2 15/32
1	1.04	3 3/32	0.85	3 3/32	0.86	2 23/32
1 1/2	1.73	3 31/32	1.50	3 31/32	1.43	3 13/32
2	2.80	4 15/32	2.39	4 15/32	2.12	3 27/32

*Flanged fittings are produced by heat fusion of socket flanges to socket fittings with short plain end pipe nipples.

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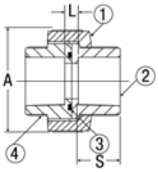
Unions

Chemtrol
Fig. No.

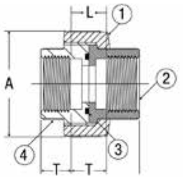
6533/6633 FKM Socket Union (S x S)



Nominal Size	Universal Part No. Red	Natural	Approx. Lbs./Ea.	Dim. A	Dim. L	Dim. S*
1/2	3897-005	4897-005	0.17	1.95	0.43	0.85
3/4	3897-007	4897-007	0.31	2.36	0.48	0.98
1	3897-010	4897-010	0.46	2.75	0.44	1.10
1 1/2	3897-015	4897-015	1.04	3.98	0.78	1.35
2	3897-020	4897-020	2.17	5.13	0.80	1.48

Unions are supplied with FKM O-Rings. EPDM O-Rings may be ordered for field replacement, where required. Socket x Thread is available on request.
*Socket Depth

6533-3-3/6633-3-3 FKM Socket Union (FPT x FPT)



Nominal Size	Universal Part No. Red	Natural	Approx. Lbs./Ea.	Dim. A	Dim. L	Dim. T*
1/2	3898-005	4898-005	0.18	1.95	1.27	0.43
3/4	3898-007	4898-007	0.32	2.36	1.53	0.45
1	3898-010	4898-010	0.47	2.75	1.58	0.53
1 1/2	3898-015	4898-015	1.11	3.98	2.38	0.55
2	3898-020	4898-020	2.24	5.13	2.61	0.57

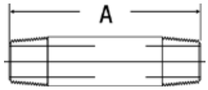
Unions are supplied with FKM O-Rings. EPDM O-Rings may be ordered for field replacement, where required. Socket x Thread is available on request.
* Thread Joint Engagement

Class 150 Flanges

Chemtrol
Fig. No.

6529/6629 Threaded Pipe Nipple (MPT x MPT)

Example of part identification 1/2" x Short PVDF Nipple – 6129 1/2" – SH

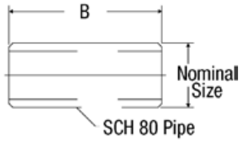


	Length – Close			Length – Short			Length – 3"	
Nom. Size	Ctn. Qty.	Approx. Lbs./Ea.	Dim. A	Ctn. Qty.	Approx. Lbs./Ea.	Dim. A	Ctn. Qty.	Approx. Lbs./Ea.
1/2	5	0.02	1.13	5	0.03	1.50	5	0.06
3/4	5	0.04	1.38	5	0.05	2.00	5	0.08
1	5	0.06	1.50	5	0.07	2.00	5	0.12
1 1/2	5	0.13	1.75	5	0.15	2.50	5	0.19
2	5	0.20	2.00	5	0.23	2.50	5	0.27

	Length – 4"		Length – 5"		Length – 6"	
Nom. Size	Ctn. Qty.	Approx. Lbs./Ea.	Ctn. Qty.	Approx. Lbs./Ea.	Ctn. Qty.	Approx. Lbs./Ea.
1/2	5	0.08	5	0.10	5	0.12
3/4	5	0.11	5	0.14	5	0.17
1	5	0.17	5	0.21	5	0.25
1 1/2	5	0.26	5	0.34	5	0.41
2	5	0.38	5	0.48	5	0.60

6531/6631 Plain End Pipe Nipple (SPG x SPG)

Used for fusion joining flanges to fitting or for joining any Sch. 80 fitting face-to-face.



Used for joining any Sch. 80 PVDF fitting face-to-face.

Nominal Size	Universal Part No.	Ctn. Qty.	Approx. Lbs./Ea.	Dim. B
1/2	↑	12	0.04	1.63
3/4	Use Figure No.	12	0.06	1.86
1	&	12	0.09	2.08
1 1/2	Nom. Size	12	0.16	2.56
2		12	0.28	2.77
3	↓	1	0.78	3.75

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Storage, Handling, Joining Methods for Joining Industrial Thermoplastic Pressure Piping

Storage

Industrial thermoplastic piping components are designed and manufactured for use in systems for severe duty involving the transport of aggressive liquids. In order to ensure their integrity once installed, they must be handled with reasonable care prior to installation.

Pipe

When pipe is received in standard lifts it should remain in the lift until ready for use. Lifts should not be stacked more than eight feet high and should always be stacked wood on wood. Loose pipe should be stored on racks with a minimum support spacing of three to eight feet, depending on size. Pipe should be shaded but not covered directly when stored outside in high ambient temperature. This will provide for free circulation of air and reduce the heat build-up due to direct sunlight exposure.

Fittings and Valves

Fittings and valves should be stored in their original cartons to keep them free of dirt and reduce the potential for damage. If possible, fittings and valves should be stored indoors.

Solvent Cement and Primer

Solvent cement has a definite shelf life and each can and carton is clearly marked with a date of manufacture. Stock should be rotated to ensure that the oldest material is used first. Primer does not have a shelf life, but it is a good practice to rotate this stock also. Solvent cement and primer should be stored in a relatively cool shelter away from direct sun exposure.

CAUTION: Solvent cement and primer are composed of volatile solvents and require special conditions for storage. Because of the flammability, they must not be stored in an area where they might be exposed to ignition, heat, sparks or open flame.

Handling

Pipe, Fittings and Valves

Care should be exercised to avoid rough handling of thermoplastic piping appurtenances. They should not be dragged over sharp projections, dropped or have objects dropped upon them. Before use, pipe ends should be inspected for cracks resulting from such abuse. Whether pipe is transported by closed truck or open trailer, the plane of support must be level and continuous under the wood frames of lifts or bundles of loose pipe and all sharp edges of the truck bed, which may come in contact with the pipe must be padded.

Solvent Cement and Primer

Keep shipping containers of solvent cement and primer tightly closed except when transferring product to applicator containers, and keep a lid – even a piece of flat cardboard – on applicator containers when not in use. After each joint, wipe the respective cement and primer applicator brushes free of excess material on the top inside edge of the applicator containers and temporarily store the applicators in a container of high boiling solvent, such as MEK cleaner. This temporary brush storage container will not require a lid. Avoid prolonged breathing of solvent vapor, and when joints are being made in partially enclosed areas use a ventilating device to attenuate vapor levels. Keep solvent cement, primer and cleaners away from all sources of ignition, heat, sparks and open flames. Avoid repeated contact of the solvents with skin. Application of the cement or primer with rags and bare hands must be severely discouraged. Stiff olefin or polyester crimped-bristle brushes and other suitable applicators are safer and more effective.

DANGER: Extremely flammable. Vapor harmful. May be harmful if swallowed. Direct contact causes eye irritation and may cause skin irritation. Keep away from heat, sparks and open flame. Use only with adequate ventilation. *FIRST AID:* In case of skin contact, flush with water; for eyes, flush with water for at least 15 minutes and seek medical attention. Wash contaminated clothing before reuse. If swallowed, DO NOT INDUCE VOMITING, call physician immediately.

Joining Methods for Pressure Piping

Solvent Weld

The chemical fusion of pipe into a socket fitting is made possible by partial dissolution of the surface materials on pipe and the socket connector with a solvent primer followed by applications of solvent cement to those surfaces before pushing the joint together. Since the solvent cement contains dissolved parent material, there is a commingling of pipe, cement and fitting materials as the joint is made and twisted 90°, such that upon evaporation of the volatile solvents a single residual material is chemically bonded or fused. Traditional cement, or glue, i.e. foreign material carried in an organic solvent or water base and acting as an alien interface for bonding two surfaces together, has not been used for making thermoplastic piping joints. Solvent welding is an easy and inexpensive joining method for pipe. However, in order to be a candidate for this method, the piping material itself must be soluble in relatively volatile organic solvent(s). PVC, CPVC and ABS are such materials commonly used for commercial and industrial piping applications.

Thermo-Fusion (Heat Fusion)

The heat fusion of pipe into a socket fitting is made possible by partial melting of the surface materials on pipe and the socket connector with electrically heated female and male anvils, respectively, applied to those surfaces before pushing the joint together. Since the heated anvils are designed to diametrically interfere with the pipe and socket in matching geometric cones; and the plastic melt swells when passing through the phase change from solid material; there is a commingling of pipe and fitting materials as the joint is stabbed together. Upon cooling a single material is solidly fused. There is a similar joining method called butt fusion where pipe-to-pipe or pipe-to-fitting-face joints are made by partial melting the ends to be joined by holding them against an electrically heated plate, and then pushing the butt ends together. However, because of problems associated with longitudinal alignment, uneven cooling and differential melt pressure during cooling, butt fusion joining should never be used for conveying hazardous liquids, particularly above ground. These joints have been known to shatter without warning too frequently for industrial chemical usage. Butt fusion is an ideal joining method for under ground low-pressure gas piping and high-purity process water systems.

Thread (Tapered National Pipe Threads)

Threaded joints are sometimes used for emergency repairs and when a piping system must be dismantled for occasional cleaning or modifications. Since threading results in a reduction in the effective wall thickness of the pipe, the pressure rating of threaded pipe is reduced to one-half that of unthreaded pipe, i.e. pipe joined by solvent cementing or heat fusion. Because of the serious strength reduction, only Sch. 80 or greater wall thickness of plastic pipe is recommended for threading – never Sch. 40. Threaded joints are not a recommended method for material transition at vessels, equipment and pumps because external mechanical stresses are concentrated at the notch sensitive plastic thread – metals are typically stronger than plastic by five or more orders of magnitude. See the Pipe Union joint section below for the proper solution for material transition. A great difference in the thermal coefficients of expansion, between the materials to be joined, makes the threaded joint more susceptible to leakage. Threaded polypropylene systems are not recommended for pressure piping because of the material's extremely low modulus of elasticity and sensitivity to notching (the joints will leak in time).

Other Mechanical Joints

Flange

Flanges are an old method of joining, but they continue to be used extensively on vessels, equipment and pumps. Particularly in sizes above 3", flanges are the easiest way to disassemble piping for cleaning and modification or maintenance of equipment, so joining method and location within the system are important factors in planning for maintenance efficiency. Socket fittings and valves are flanged with plain-end short nipples by solvent welding or heat fusing (depending on material type) both joints. Flanges are similarly joined to straight pipe runs, or they can be threaded.

Pipe Union

Particularly in sizes 3" and below, unions are the easiest and most reliable way to disassemble piping for cleaning and modification or maintenance of equipment. They are, unfortunately, too often overlooked in planning the design of thermoplastic piping systems. The factors that make threaded joints unrealistic as a method for transition between materials are given in the paragraph above discussing threads. These reasons catalyzed Chemtrol development of: True Union Valves; Pipe Union with end connectors and union nuts that are interchangeable with the True Union Valve; and stainless steel or brass transition end connectors that are interchangeable with plastic end connectors for both the Pipe Unions and True Union

Valves. So, transition end connectors may be affixed to equipment presenting male or female threads, or tank adapters may be used to replace tank connections designed to present threads. As with flanges, we urge the designer to plan the placement of pipe unions in order to enhance maintenance and modification efficiency.

Solvent Cement Joining for PVC & CPVC Pressure Piping Systems

Six Step Application Techniques

Components should be wiped clean, pipe squarely cut, deburred and beveled. Since the solvents in the cement and primer will absorb water, but water is deleterious to the joining process, the joint surfaces must be dry at the time of joining.

Tools and Equipment

- Cutting Tool
- Beveling Tool
- Paper Toweling or Cotton rags
- Solvent Cement and Purple Primer Application Brushes
- Heavy-Bodied Gray Solvent Cement
- Industrial Purple Primer for PVC or CPVC
- Cement and Primer Applicator Containers
- Job Storage Container for Brushes
- Come-Along Pipe Joining Tool
- Pipe Vise (pipe sizes larger than 2")
- Deburring Tool
- Pipe Cleaning solvent
- Notched Boards (pipe sizes 2" or less)
- Tool Tray (transport materials and tool from joint to joint)

Primer Application

1. Using a stiff olefin or polyester crimped-bristle brush, apply purple primer to the fitting and pipe-end in a 3-step process alternating from fitting to pipe. Apply primer to the fitting freely. Wet the sub-strate of the socket surface by maintaining a rapid and vigorous scouring motion of the applicator over the entire inner socket for five to fifteen seconds. Re-dip the applicator and continue as necessary, but avoid puddling inside the fitting beyond the socket.

2. Apply purple primer to the outer pipe-end surface with the same vigorous scouring motion of the brush, re-dipping the applicator every five to fifteen seconds as necessary. Make sure that the evenly primed length of pipe is at least equal to the fitting socket depth. Quickness is of the essence in order to scrub primer into the surfaces and attain moistened substrata. Note that the pipe-end can be cradled and rotated on a notched block of wood, if working alone, to make application easier and to keep the surface clean.

3. Re-apply primer to the fitting socket in the same manner. When a continuous peel of a few thousandths of an inch thickness can be scraped from the primed surface with an edge, such as a knife blade, the substrate has been adequately primed for a joint. With practice one will learn to observe a slight tackiness and swell in the surfaces when priming is adequate. Alternate applications of the primer always start with the female component. Cementing should not begin until priming is adequate.

Solvent Cement Application

4. Before the primer dries, continue the alternating surface approach by applying solvent cement to the pipe and fitting in a 3-step process. Use a second plastic crimped-bristle brush to spread a continuous film of cement on the outer pipe-end surface for a length at least equal to that of the fitting socket depth. The cement film should be such that it does not run as a sheet and drool from the exterior or into the pipe interior. And the film thickness need be only thick enough to trap the continuing penetration of solvent into the pipe substrate.

5. While the moistened substrate of the fitting socket is still soft and swollen from priming, quickly spread a continuous film of solvent cement onto the entire socket surface. Avoid puddling and run-off of the cement anywhere in the fitting, or beyond the socket depth in belled-end pipe. The cement film need be only thick enough to trap the continuing penetration of solvent into the substrate and to provide an immediate and continuous wet filet around the pipe chamfer during its eminent insertion into the fitting socket. Most of this cement will be pushed ahead by the pipe throughout its insertion to the full depth of the socket. A final excess of cement at the bottom of the socket should be avoided because it cannot be removed. Large puddles formed inside the pipe and/or fitting bore serve to dramatically extend the drying time of these solvent affected areas, which translates to reduced strength of the parent material until drying does occur. Mounds of dried cement may also ultimately act as blockages to fluid flow, resulting in unacceptable pressure loss.

6. Put a second coat of solvent cement on the pipe-end. This completes the six steps of alternate surface application for a joint – three of primer and three of cement – starting with the female component. Cement layers on the pipe must be without voids and sufficient to provide an immediate and continuous wet filet around the socket entrance radius/

chamfer during the eminent insertion of pipe into the fitting socket. Excess cement will be pushed off the pipe throughout its insertion to the full depth of the fitting socket. However, it is critical that the two wet beads – an inside one around the pipe chamfer and an outside one around the socket chamfer – be maintained to form vacuum seals while joining. Although much of the cement will be scraped off both the pipe and socket during joint insertion, some must be redrawn, by vacuum, to back-fill the diametrical gap between pipe and fitting socket. Air will back-fill the joint if either of the wet bead dynamic seals is broken during joint insertion, resulting in a loss of bonding area.

Crew Size

Obviously, the 6-step application method has a joining crew size of one in mind. When the crew size is increased to two, the 6-step principals must be modified such that each crewmember has their own set of primer and cement brushes and each would attend to the application of both solutions to a single joint surface. The total time to prime and spread cement to each surface is essentially the same when the 6-step concept is mimicked by a crew of two. A crew of two should be strongly considered for pipe sizes 2" through 4" and should be mandatory for larger sizes. A come-along type pipe-joining tool, similar to that manufactured by Reed Manufacturing, Erie, PA, is required for the 10" and larger sizes

Pipe Insertion

Immediately upon finishing the application of cement, and before it begins to dry, the pipe must be inserted squarely into the fitting socket. Too much time has elapsed if either of the surface films has dried to the point that the film folds in the socket chamfer upon pipe insertion, rather than forming a wet bead at that location. Rotation of the pipe/turn in the socket, following pipe insertion to the full socket depth, completes the joint. This encourages complete distribution of the cement and its commingling with joint surfaces. In addition to a crew size of two being mandatory for 6" and larger pipe, rotation of the pipe in the fitting may be omitted for these sizes.

After completing the joint it must be held together for a brief time while the cement begins to dry. This is to prevent the pipe from squirting back out of the fitting socket. The phenomena occurs because fresh cement is an excellent lubricant and product standards dictate the socket to be tapered, with the minimum entrance diameter equaling the maximum pipe diameter and the diameter at the bottom of the socket creating a statistical interference with the pipe diameter. Therefore, the joint must be held together for a minimum of 10 to 15 seconds – a little longer for larger sizes. For pipe sizes 6" and larger the holding time may be one to three minutes. If any pipe back-out does occur, the potential for joint failure/leakage is unacceptably great.

Excess Cement
Wipe off all excess cement from the circumference of the pipe and fitting immediately after the joint holding period and before the cement begins to harden. The localized quantity of cement will affect solvent evaporation by extending the drying time of the pipe. Then, gently place the joint onto a level surface to complete the hardening stage before further handling.

Joint Drying Time Guidelines
Because of the variety of these unpredictable conditions that may exist from job to job, Chemtrol can only offer the following general recommendations relative to PVC and CPVC joint drying times:

1. It is best if the actual joining is done in atmospheric temperature above 35/40° F and below 90° F when the joint components are exposed to direct sun.

2. It is best if all joints can have 72 hours of drying time elapse for all sizes of pipe and drying temperatures before the joint is subjected to any appreciable pressure on a fulltime basis.

The installation manager must assume the risk of deciding when PVC or CPVC joints are sufficiently dry for movement or handling, initiating low pressure testing, applying high pressure testing and/or subjecting the new system to the maximum allowable fulltime working pressure. Chemtrol offers the following drying times as a guide in aiding the installer, engineer, owner or other interested parties in making these decisions. The drying times are based on a combination of past field experience and laboratory tests.

The installation instructions contained herein are recommendations. It is the responsibility of the installer to follow industry best practices for installation and to comply with all applicable codes and regulations.

Handling
During the initial hardening of the cement, which begins about two minutes after its application (on small sizes), be careful not to move or disturb the joint less the bond of fragile material be broken. A guide for drying times prior to handling a joint appears below.

PVC and CPVC Joint Movement Times

Nominal Pipe Size	Hot Weather* 90° – 150° F Surface Temperature	Mild Weather* 50° – 90° F Surface Temperature	Cold Weather* 10° – 50° F Surface Temperature
1/4" – 1 1/4"	12 Min.	20 Min.	30 Min.
1 1/2" – 2 1/2"	30 Min.	45 Min.	1 Hr.
3" – 4"	45 Min.	1 Hr.	1 Hr. & 30 Min.
6" – 8"	1 Hr.	1 Hr. & 30 Min.	2 Hrs. & 30 Min.
10" – 12"	2 Hrs.	3 Hrs.	5 Hrs.

*The temperatures above are drying temperatures and should not be confused with atmospheric joining temperature recommendations and limitations. See section on "Joint Integrity."

Pressure Testing

CAUTION: Air or compressed gas is not recommended as a media for pressure testing of plastic piping systems.

Initial Low Pressure Joint Testing

Initial hydrostatic testing of PVC or CPVC solvent welded joints could be accomplished at 10% of the largest pipe's maximum non-shock operating pressure rating, corrected for ambient temperature (see page 13) after brief drying times.

PVC and CPVC Joint Drying Times for 10% Pressure Testing

Nominal Pipe Size	Hot Weather* 90° – 150° F Surface Temperature	Mild Weather* 50° – 90° F Surface Temperature	Cold Weather* 10° – 50° F Surface Temperature
1/4" – 1 1/4"	1 Hr.	1 Hr. & 15 Min.	1 Hr. & 45 Min.
1 1/2" – 2 1/2"	1 Hr. & 30 Min.	1 Hr. & 45 Min.	3 Hrs.
3" – 4"	2 Hrs. & 45 Min.	3 Hrs. & 30 Min.	6 Hrs.
6" – 8"	3 Hrs. & 30 Min.	4 Hrs.	12 Hrs.
10" – 12"	6 Hrs.	8 Hrs.	72 Hrs.

*The temperatures above are drying temperatures and should not be confused with atmospheric joining temperature recommendations and limitations. See section on "Joint Integrity."

High Pressure Testing

PVC or CPVC solvent cemented joints can be tested for no more than 15 minutes at 100% of the largest pipe's maximum non-shock operating pressure rating, corrected for ambient temperature (see page 13) after extended drying times.

PVC and CPVC Joint Drying Times for 100% Pressure Testing

Nominal Pipe Size	Hot Weather* 90° – 150° F Surface Temperature	Mild Weather* 50° – 90° F Surface Temperature	Cold Weather* 10° – 50° F Surface Temperature
1/4" – 1 1/4"	4 Hrs.	5 Hrs.	7 Hrs.
1 1/2" – 2 1/2"	6 Hrs.	8 Hrs.	10 Hrs.
3" – 4"	8 Hrs.	18 Hrs.	24 Hrs.
6" – 8"	12 Hrs.	24 Hrs.	48 Hrs.
10" – 12"	18 Hrs.	36 Hrs.	72 Hrs.

*The temperatures above are drying temperatures and should not be confused with atmospheric joining temperature recommendations and limitations. See section on "Joint Integrity."

General Comments and Hints

Do's and Don'ts

DO:
- Clean and prepare pipe and fitting (see Preparation for Joining, page 22).
- Use the proper applicators (see Selection of Applicators for…, page 23).
- Scrub primer into joint surfaces until a lemon peel may be curled with an edge.
- Apply Cement while the primer is still moistened.
- Maintain two wet beads at the pipe and fitting chamfers throughout joint insertion.
- Follow the instructions completely.

DON'T:
- Attempt to solvent weld in wet and/or wind without shielding.
- Solvent weld below 35° or above 90° F under direct sun exposure without precautions (see Hot and Cold Weather Cementing below).
- Discard leftover cans of solvent in trench with piping. Concentrated fumes can cause piping failure.
- Skip any priming or cementing steps.
- Skimp with cement on pipe or overdo cement in sockets, but apply enough for wet bead formation during joint insertion.

Hot Weather Cementing

Hot weather can be the nemesis of solvent cementing. As the temperature and/or wind increase, the rate of solvent evaporation quickens. Hence, it becomes more difficult to keep primed surfaces moistened. Even the cement itself can begin to "film over" prior to joining. Rather than using hot weather as an excuse to compromise the functional elements required for reliable joining, the problem must be overcome by adjusting the approach to priming, cement application and pipe insertion techniques in order to appropriately reduce the lapsed joining time. As corrective measures to combat wind and/or temperature in excess of 90° F, the following may be done:

1. Increase the crew size and organize the team to achieve speed while making no compromise to functional performance.
2. Construct a windscreen from polyethylene film or tenting around the joint and crew.
3. Shade the pipe, fittings, valves and solvent materials from the sun prior to joining in order to eliminate heat absorption by the dark color. Fittings, valves and solvent supplies may be kept in a box. Shading the pipe to be joined may be more difficult, but not impossible. Under adequate lighting, the joining may be done at night or early morning.

Cold Weather Cementing

Solvent in the primer and cement will not evaporate as readily when the temperature is below 35°/40° F. Severe scouring with a stiff bristle brush is required to work the primer solvents into the surfaces. Secondly, it takes appreciably more time for the solvents to evaporate once the joint is made. Therefore, joints must be held together longer to prevent the pipe backing out of the socket. Joints must be left undisturbed longer to prevent breaking the bond by movement. And joints must be given longer drying times before pressurization. We offer the following common sense recommendations if solvent cementing must be done when the temperature approaches freezing:

Store the pipe, fitting, valves and cementing supplies in a heated area until you are ready to use them. Also, water or moisture is an enemy and frost is commonplace at near freezing temperature. So, the pipe and fittings must be kept dry prior to joining and the joints should be kept dry until the cement has had sufficient time to set – not dry, just set so they can be moved without fear of breaking the initial bond.

1. Pre-fab as much of the system as possible in a heated work area. By using flange or union connections for system erection, the number of in-place cemented joints can be minimized.
2. Field joints that must be made outside should be protected with a portable shelter, preferably black to absorb heat from the sun, and otherwise heated indirectly to produce a 40° F surface temperature on the pipe, fittings, valves and cementing supplies. The shelter should remain in place until the joint is set. And you can figure the set time to be roughly twice what it would be for a 70° joint. Good ventilation of the shelter is an absolute safety necessity for worker health and fire prevention reasons.

CAUTION: DO NOT ATTEMPT TO SPEED THE DRYING OF THE CEMENT BY APPLYING DIRECT HEAT TO THE SOLVENT WELDED JOINT. Forced rapid drying by heating with an electric blow drier, for example, will cause the cement solvents to boil off, forming porosity, bubbles and blisters in the cement film.

Joint Integrity

In hot, mild or colder weather, if the basic joining steps are followed with discipline, the chemical fusion joining method for thermoplastic piping is extremely reliable and cost efficient. Because of significant contributions to commercial and industrial construction, both thermoplastic piping and solvent welding are here to stay. By virtue of their permanent resistance to chemical attack and undeniable economic impact, value engineering has reached the stage where even mundane processes, such as water disinfection, or exotic processes, such as bulk and dilute acid feed, are absolutely dependant upon PVC or CPVC piping with solvent cemented joints. In spite of the higher standards of skill required for industrial chemical installations, relative to the marginal standards required for domestic small diameter utility applications, we are beyond the time when joint failure can be excused because of inexperience or poor workmanship. Since the difference between cementing a joint and gluing it is common knowledge today, the 40 plus year-old technology for solvent cementing justifiably demands professional discipline in its execution. As a result, the low bidder for any PVC or CPVC piping installation can reasonably be expected to exercise control over joining performance.

Solvent Cement Usage Estimates

The PVC and CPVC solvent cement usage estimates given in the table below should only be considered as a guideline. Actual usage could vary according to a wide variety of installation conditions. Further, these estimates should in no way be used to restrict the liberal instructions in the Six Step Application Techniques starting on page 24.

Number of Joints per Container Size

Pipe Size	Pint	Quart	Gallon
½"	130	260	1040
¾"	80	160	640
1"	70	140	560
1¼"	50	100	400
1½"	35	70	280
2"	20	40	160
2½"	17	34	136
3"	15	30	120
4"	10	20	80
6"	N/R	8	32
8"	N/R	3	12
10"	N/R	N/R	10
12"	N/R	N/R	6

Thermo-Seal (Socket Fusion) Joining for Polypropylene and PVDF (KYNAR®) Pressure Piping Systems

Within the marketplace, one will find heating anvils for the fusion joining of IPS drainage, metric pressure and IPS Polyethylene gas piping – none of which will satisfactorily join Chemtrol® fittings with pressure pipe for reasons of socket length and/or diametrical fit. Chemtrol Heating Anvils (heating face sets) are designed to diametrically interfere with the pipe, and principally the socket connection, so as to create matching geometric cones as the plastic melt swells when passing through the phase change from solid material. Therefore, NIBCO obviously can not warrant pipe, fittings and valves, which are not joined with Chemtrol Heating Anvils (heating face sets) as well as depth gages and pipe clamps, where applicable.

WARNING: Failure to use Chemtrol heating face sets could result in improperly fused joints and damage to property.

The heating tool must be kept clean at all times. Wipe away residual material from heat faces with a clean rag. Periodic applications of silicone spray to heat faces will assist in maintaining performance. Chemtrol recommends 3M Company's Aerosol Spray (Product #62-4678-4930-3) "food grade." 3M Technical Customer Service Center can be reached at 800-362-3550.

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Six Steps of Joining Mechanics for Hand-Held Heat-Tools

Crew Size

For the sake of clarity of these instructions, we are assuming the usual installation crew of two, while prefabricating at a workbench. The first installer is in charge of the socket connection and will be referenced as installer #1, for simplicity. The second team member is in charge of the pipe end during the joining process and he shall be referenced as installer #2.

Tools and Equipment

- Pipe Cutting Tool
- Pipe Beveling tool
- Hand-Held Heat-Tools
- Depth Gauges
- Pipe Clamps w/inserts
- Heating Anvils for male and female piping components
- Timer
- Thermal Blanket
- Auxiliary Handle for Heat-Tool
- Hex-Key wrenches for Heating Anvils and Pipe Clamp inserts
- Thermostat Adjustment tool
- Joining Instructions
- Deburring tool
- Pipe Cleaning solvent
- Paper Toweling or Clean Wipes
- Silicone Lubricant

1. Installer #2 gives the Heating Anvils (heat face sets) a light fogging of silicone spray, making sure that the spray is directed into the Pipe Anvil and that some of the fog is directed at the top, bottom and both sides of the Fitting Anvil. Meanwhile, installer #1 grasps the pipe and inserts the pipe end to the bottom of the Pipe Gauge. Wipe excess spray from the Anvils with a clean paper towel.

2. Installer #1 may need to adjust the clamp screw on the pliers, which governs the clamp opening. The Pipe Clamp must snuggly grasp the pipe, but not crush it out-of-round. He should then attach the Pipe Clamp w/insert to the pipe by butting the flush surface against the face of the Depth Gauge while installer #1 continues holding the Gauge against the pipe end. Installer #2 should use his index and middle fingers to push both halves of the Pipe Clamp to insure they are flush against the Depth Gauge face.

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3. Simultaneously, installer #1 should place the pipe and installer #2 should place the socket connection squarely on the Heating Anvils (heat face sets) so that the ID of the connection and the OD of the pipe are in contact with the heating surfaces. Care should be taken to insure that neither the pipe or socket connection are cocked as they are pushed in/on the Anvils. The Pipe Clamp's simple job is to precisely mark the location of socket depth on the pipe, so installer #1 should not use the tool as a push bar. Don't allow the clamp to slip on the pipe and lose the opportunity for making a quality joint. The socket connection will always have more initial interference with its Anvil than the pipe, so the force applied by installer #2 will probably be less than the force required from installer #1 as they match insertion rates on/in their respective Anvils. The plastic components will only slide on/in the Anvils when the plastic melts and allows forward progress. Therefore, the plastic components should not be moved by rocking or twisting them on their Anvils in an effort to hasten penetration. A solid steady force is all that is required. It is the responsibility of installer #2 to penetrate at the same rate as installer #1 so that both arrive at the same time at the home position on the Anvils. Progress is good when both installers see that the plastic melt bead forming on the male Anvil at the entrance radius/chamfer of the socket is uniform around the socket entrance.

4. Home positions on the Heating Anvils (heat socket set) are when the melt bead in the entrance radius/chamfer of the socket connection touches the mounting flange of the male Heating Anvil and the Pipe Clamp uniformly touches the face of the female Heating Anvil. **DO NOT SQUEEZE THE MELT BEAD. YOU ARE IN THE HOME POSITION.** With practice, installers will learn that the melt bead is an excellent reference for proper alignment. As the joint components of the installers approach their respective home positions of insertion on/in the Heating Anvils the installer #1 should make sightings of his bead distance from home position on top, bottom and both sides of the mounting flange. Installer #1 should insure the bead touches the Anvil flange – completely around the fitting – all at once. As the touch is made, he should stop. Installer #2, equaling the rate of his pipe penetration with the rate of fitting penetration in/on the respective Anvils, should also make 360° sightings of his distance from the Pipe Clamp to Anvil face. Installer #2 must insure the face of his Anvil touches the Pipe Clamp – completely around the pipe – all at once. This is the first reason for insuring that one end of the Pipe Clamp w/inserts is a true surface. As the touch is made he should also stop. Both installers should hold their positions for the prescribed time in the Table of Thermo-Fusion Socket Heating Times. Installer #1 must continue to monitor the melt bead, while holding the socket connection in the home position. Installer #2 must concentrate on holding the Pipe Clamp flush against the face of the female Heating Anvil to allow heat to transfer into the pipe and fitting surfaces to be fusion bonded.

NOTE: The dwell time in the home position on the Heating Anvils at 500° F, for both PP and PVDF in pipe sizes 1/2" through 2", is five seconds. Use a timer, watch or voice count to control the duration of this step. It is critical that this time be maintained.

5. As soon as the proper time in the home position has expired, simultaneously remove the pipe and fitting straight away from the Heating Anvils. Only a thin layer of melt actual melt will exist on the heated surfaces. Avoid mashing the melt to one side or the other on either the pipe or socket connection while removing them from the Anvils. Upon removal from the Heating Anvils installer #1 should immediately push the socket connection, squarely and fully and without purposeful rotation, onto the pipe. The pipe must be held steady and in the horizontal plane by installer #2. This assumes that prefabrication will normally be attached to the other pipe end. It is unproductive for both installers to actively push the components together. The ease of making straight joints is much greater when one team member blocks his component and the other team member aggressively pushes his component in/on the other stationary component. The joining team must mutually decide which shall block and which shall push the joint together before attempting the joint, because speed is of the essence in removal of the components from the Heating Anvils and insertion of the pipe in the socket connection.

   As the pipe is steadily inserted into the socket connection, the flush faces of the Pipe Clamp may again be used as the reference plane to sight against the approaching melt bead at the face of the fitting. Be sure to maintain the forward motion of pipe insertion into the socket, because once stopped, rapid melt cooling will prevent any restart of insertion. The team member acting as the pusher must insure that the melt bead around the fitting uniformly touches the flush Pipe Clamp – all at once. **DO NOT SQUEEZE THE MELT BEAD. THE JOINT IS IN THE HOME POSITION.**

6. Hold the completed joint in the home position for about 10 seconds – a little longer for larger sizes – to permit cooling of the plastic bond. This will prevent the pipe from moving back in the tapered socket while the inner surfaces are fluid. Now that the joint is completed, remove the Pipe Clamp and begin preparations for the next joint. It is important that the Heating Anvils be kept as clean as possible. Any residue left on the Anvils should be removed immediately by wiping with a paper towel. (See Selection of Lubricant for Heating Anvils and Cleaning Towels; pg. 28.) Check the Heat-Tool temperature to make sure that that it is stable at the prescribed setting. (See Hand-Held Heat-Tool Set-Up; pg. 29.) If residue

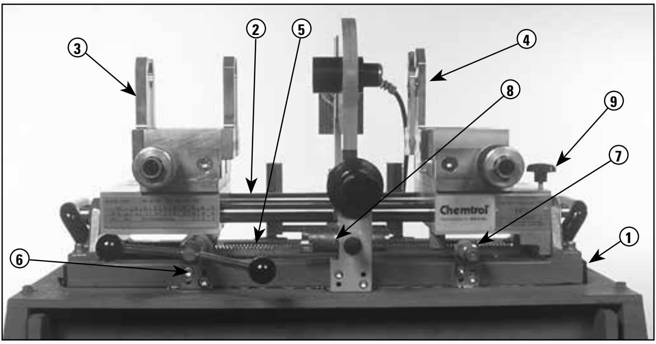
deposits on the Heating Anvils following the making of joints persists, try increasing the silicone spray to thoroughly coat the applicable surfaces and/or reduce the prescribed heating time by increments of 10 – 20%. Be cautious in the reduction of time for sizes 2" and below. Do not waver from the prescribed temperature settings. (See Thermo-Fusion Socket Heating Times.)

CAUTION: Molten plastic material can cause severe burns. Avoid contact with the hot plastic and heat-tool. It is always a good idea to drape a thermal blanket over a hot heat-tool – Hand-held or bench-mount – when the installers must leave the work area. A – Caution Hot – sign posted on the workbench should be out at all times during and after use.

Superior Design and Construction Features of Bench-Mount Joining Machine

Description of Basic Components

Bench-Mount Joining Machines are an outgrowth of the prefabrication concept. Each of the three Chemtrol® machines have a temperature controlled heat-plate attached to the machine, which can be swung from centerline of the machine to a rear position that does not interfere with machine travel perpendicular to the heat-plate. The PTFE clad Anvils (heat face sets), which heat pipes and socket connections, are used interchangeably for Hand-Held heat-plates and Bench-Mount heat-plates. All sizes of Heating Anvils (heat face sets) mount to Bench-Mount heat-plates with 3/8" standard bolts that pass through a clearance hole in the dead center of its heat-plate.



Features Forming the Foundation of Machines

No.	Name / Element
1	Machine base, Aluminum casting for rigidity and minimum weight during movement
2	Two Steel Rods with hard chrome finish, which are firmly attached to each end of machine base, act as the machine ways.
3	Pipe Sled, rides freely and precisely toward or away from center on ways through Bushings
4	Fitting Sled, rides freely and precisely toward or away from center on ways through Bushings
5	Rack and Pinion provides in-and-out movement of the sleds on the machine ways
6	Hand-Wheel, machine-tool spoke type, turned by operator clockwise or counter clockwise respectively, to drive both sleds together or apart at same rate – each a slave to the other.
7	Depth Gauge Stroke-Limiter, spring-loaded plunger with latch on operator's right, which he can depress to engage the fitting sled as the operator brings both sleds together. This position correctly measures pipe projection from the entrance of a socket connection to the Prismatic Pipe Clamping Jaws
8	Joint Insertion Stroke-Limiter assembly, passes through the pedestal block that holds the heat-plate handle. It is located in front of the operator. An indexable steel tube having notches cut into the periphery at the end of the tube, which correspond to the joint insertion lengths for each pipe size, will be caught by an arresting arm, mounted on the bottom of the pipe sled.
9	Knob Handle for set-screw, which locks the pipe sled in place by bearing on the front machine Steel Rod way.

The tops of the fitting and pipe sleds are finished flat, relative to their bushing bearing holes. Each sled has mounted upon it a miniature Vise, which simultaneously advances or retracts the Holder-Blocks on each sled by the operator turning a Lead-Screw, fitted through Brass Bushings in each Holder-Block. Each Vise is centered on its sled by means of a slot in the sled and a dovetail projecting from the bottom of the Vice Base. This locating concept also insures that the independent action of each Vise is perfectly perpendicular to the transverse line of movement for the sleds.

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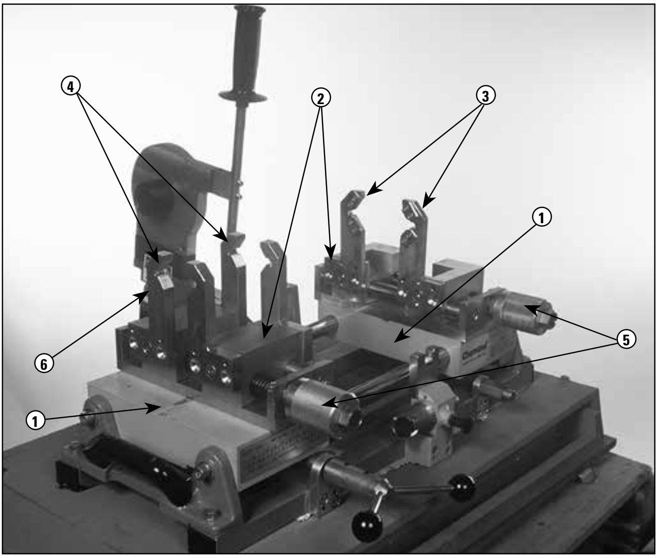


Features of the Pipe and Fitting Clamping Vises

No.	Name / Element
1	Transverse Fitting and Pipe Vise Bases, permanently located in the longitudinal and horizontal planes by a slot in the top of the sleds and a dovetail projecting from the bottom of Vise Bases
2	Two Pair of Vice Holder-Blocks, each pair forming the Fitting Vise on the operator's right or the Pipe Vise on the operators left. The Clamping Jaws mount to the Holder-Blocks such that the four tangent points on each set of Jaws grasping the product (pipe or fitting) have equal radii to the dead center of the product, which coincides with the centerline of the machine
3	Pair of Fitting Prismatic (vee type) Clamping Jaws with stops for locating the face of the fitting and insuring alignment of socket connection within the clamping Jaws – operator's right on the machine. Each set of Jaws handles a range of fitting sizes; 1/2"-2", 2"-4", 4' flange-only for 3500 machine and 4"-6" respectively
4	Dual Pair of Pipe Prismatic Clamping Jaws, insuring alignment of pipe within the Clamping Jaws – operator's left on machine. Each set of Jaws handles a range of sizes; 1/2"-2", 2"-4" and 4"-6"
5	Two Handles, which the operators uses to advance or retract the pair of Holder-Blocks via the Lead-Screw, one each for the fitting and pipe Vises
6	Electronic Temperature Controller for the heat-plate permits setting the temperature directly, which the Controller can be expected to hold within several degrees

Six Steps of Joining Mechanics for Bench-Mount Joining Machines

Crew Size

As with the prefabrication of joints with a Hand-Held Heat-Tool clamped into a bench vise, the crew size will be two. One team member (the machine operator) will locate and clamp the fitting socket connection into the machine and attend to joint-making operation. The other team member (operator's assistant) will support the opposite end of pipe to be joined while the operator is clamping the end of pipe to be joined in the machine and attending to joint-making operation. There will be in-and-out motions of the joined pipe in the joint-making process; therefore the assistant must coordinate the movement of the machine with his supporting duty for the prefabricated module. If there is a prefabrication module already attached to the assistant's pipe end, he must make sure he holds his prefabrication to face the proper direction so that the orientation of the end to be joined has the correct relationship with the fitting to be joined.

As begun above, we will refer to the machine operator and his assistant to distinguish how a crew of two makes joints on a Bench-Mount Joining Machine.

1. The operator gives the Heating Anvils (heat face sets) a light fogging of silicone spray, making sure that the spray is directed into the pipe Anvil and that some of the fog is directed at the top, bottom and both sides of the socket connection Anvil. Should the operator overspray, such that droplets have formed, he should wipe the Anvils with a clean paper towel

   Then the operator must drive the pipe and fitting sleds apart, using the spoke type machine tool hand-wheel at his left on the machine. With his right index finger he should depress the plunger of the Depth Gage Stroke-Limiter until the button on the other end of the plunger is free to fully project beyond the slotted arresting arm at the bottom of the fitting sled. While continuing to depress the plunger, he should now use the hand-wheel to advance the sleds toward each other until the button head of the plunger is inside the slot in the arresting arm. At this point the plunger may be released to pop outward and catch against the arm slot. Finally, when the Depth Gauge Stroke-Limiter arresting arm firmly rests against the shank of the plunger, the inward motion of the sleds will be stopped. Now, he may tighten the knob handle of the set-screw on the far rear top of the fitting sled in order to lock the sleds in the ideal Stroke-Limiting position.

2. The operator sets the socket connection of the fitting his assistant has prepared for joining into the Pair of Fitting Prismatic Clamping Jaws. He must square the face of the socket connection against the stop-plates at the end of the Jaws closest to center machine while he tightens the Fitting Vise with the Handle on the front of that Vise. Concurrently he must make sure that the orientation of other connections of the fitting agrees with the piping design relative to the design orientation of the fitting that will/has be/been placed on that opposite pipe end. Once the operator is confident that he has good alignment of the socket connec-

tion in its Vise, he must cinch the Vise Handle as strongly as he can with one hand, so that the fitting will not slip under joining force.

3. The assistant lifts and maneuvers the opposite end of the pipe he/she has prepared for joining. Meanwhile, the operator sets the pipe end to be joined into the Dual Pair of Pipe Prismatic Clamping Jaws. The operator must place the square cut, beveled, deburred and cleaned pipe end against the radius/chamfer of the socket connection in the Fitting Vice while he tightens the Pipe Vise with the Handle on the front of that Vise. Concurrently, he must instruct his assistant with maneuvers that assure alignment of the pipe in its Vise such that there is 8-point contact with the Pipe Vise Clamping Jaws, as well as contact with the entrance of the socket connection. Once the operator is sure that he has good alignment of pipe in its Vise, he must cinch the Vise Handle as strongly as he can with one hand, so that the pipe will not slip under joining force.

   The positioning of pipe against the fitting in this step eliminates the need for a Pipe Clamp and Depth Gauge, which is required for Hand-Held Heat-Tool joining. Perfect alignment of pipe and fitting in the Clamping Jaws of the Bench-Mount Machine insures perfect finished joint alignment, which is the most difficult outcome to learn when using a Hand-Held Heat-Tool.

4. To make the joint, the operator must release the set-screw clamping the fitting sled to the travel rod by turning the knob on top of the outer front of the sled. Next, he should back the pipe and fitting sleds away from each other with the machine tool hand-wheel. As both sleds move away from the machine center, the noise made by the plunger of the Depth Gauge Stroke-Limiter may be heard as its nose button is released by the slotted arresting arm and the plunger is sprung to its released position.

   After full retraction of the sleds, the operator must grasp the handle of the machine's Heat-Tool and swing the assembly into the centerline of the machine and rest the handle in the slot of the pedestal at the center front of the machine.

   Now, the operator must turn the machine tool hand-wheel in the clockwise direction to bring the pipe and socket connection toward the center of the machine. The male and female Heating Anvils (heat face sets) should have nearly perfect alignment with pipe and socket connection. If not, there is some latitude for horizontal movement by pushing or pulling on the Heat-Tool handle to make the necessary adjustment. Once the Heating Anvils and products to be joined are lined up, the assistant continues to work in coordination with the operator as he exerts reasonable force on the hand-wheel to drive the Anvils in/on the products to be joined. The operator should continue the steady hand-wheel force, accompanied by movement of the sleds as plastic melting takes place, until the melt bead, formed in the radius/chamfer of the socket connection, touches the mounting flange of the male Heating Anvil. **THIS IS THE HOME POSITION. DO NOT SQUEEZE THE MELT BEAD.** The operator must continue to remember to not squeeze the melt bead, while holding the Hand-Wheel steady in the home position to allow heating of the surfaces to be joined for the prescribed time in the Table of Thermo-Fusion Socket Heating Times; pg. 29.

Note: The dwell time in the home position on the Heating Anvils at 500° F, for both PP and PVDF in pipe sizes ½" through 2", is five seconds. This time sequence is so short that it is impractical to reach the home position on these sizes and instantly start the Timer to count down five seconds. After minimal practice with a timer or watch, an installer can learn to speak the football quarterback's cadence of, hut – one, hut – two, hut – three, etc. to count off five seconds even more accurately than moving the hand on command to activate a Timer and properly measure the time interval. Or, the juvenile cadence of, one-thousand-and-one, one-thousand-and-two, etc. works equally well for others. Certainly the cadence count would not be more accurate for 13 seconds or more. We leave it up to you, which method to use, for eight seconds, but by all means, adopt the discipline of using the Timer for longer time intervals.

Thermo-Fusion Socket Heating Times

Polypropylene				PVDF			
Size	Time (sec)	Temp ° F	Temp ° C	Size	Time (sec)	Temp ° F	Temp ° C
1/2"	5	495–505	257–263	1/2"	5	495–505	257–263
3/4"	5	495–505	257–263	3/4"	5	495–505	257–263
1"	5	495–505	257–263	1"	5	495–505	257–263
1-1/2"	5	495–505	257–263	1-1/2"	5	495–505	257–263
2"	5	495–505	257–263	2"	5	495–505	257–263
3"	7–9	500–510	260–266	3"	25–35	510–530	266–277
4"	12–15	500–510	260–266	4"	40–50	510–530	266–277
6"	15–20	500–520	260–271	6"	50–60	540–560	282–293

Heating times start after pipe and fitting are completely on heater faces (fitting face not to touch base of male heat face).

5. As soon as the proper time in the home position has expired, the operator must again coordinate with his assistant to move the heated product back from the Heating Anvils. The operator does this by quickly turning the Hand-Wheel counterclockwise. As soon as the pipe and fitting sleds have been retracted, the operator must quickly lift the Heat-Tool handle and swing it from the machine centerline to its resting place behind the machine.

   Now the machine has been cleared for the operator and his assistant to move the pipe sled forward again to make the fusion joint. The operator does this by quickly turning the Hand-Wheel clockwise again. As resistance is met from the pipe being inserted into the socket, the operator must never let the forward motion stop. If the motion stops, it can be next to impossible to start again in order to complete the joint. Do not worry though. The force required for pipe insertion is no greater than the force to push the products onto the Heating Anvils. Quickness and steady force are the secrets for success. The machine's joining stroke will be terminated when the arresting arm on the pipe sled strikes the variable length tube of the Joint Insertion Stroke-Limiter assembly. You will recall that the notch on the tube, corresponding to joint pipe size, was selected in Step 1.

6. Hold the completed joint in the home position for about 10 seconds – a little longer for larger sizes – to permit cooling of the plastic bond. This will prevent the pipe from moving back in the tapered socket while the inner surfaces are fluid. If the operator would prefer to start making preparations for the next joint before cooling is complete, he can again

tighten the Knob of the set-screw, on the far right of the fitting sled, which locks the sleds in place. Just remember to loosen the Knob before resetting the machine for the next joint, as in Step 2.

It is important that the Heating Anvils (heat face sets) be kept as clean as possible. Any residue left on the Anvils should be removed immediately by wiping with a paper towel. Check the Heat-Tool temperature to make sure that it is stable at the prescribed setting. If residue deposits on the Heating Anvils – following the making of joints – persists, try increasing the silicone spray to thoroughly coat the applicable surfaces and/or reduce the prescribed heating time by increments of 10-20%. Be cautious in the reduction of time for sizes 2" and below. Do not waver from the prescribed temperature settings.

Now that the joint has sufficiently cooled, the operator should remove it from the machine by loosening the Fitting Vise first and then the Pipe Vise.

Flanged Joints

Scope

Flanging is used extensively for process lines that require periodic dismantling. Plastic flanges and factory flanged valves and fittings in PVC, CPVC, PVDF and polypropylene are available in a full range of sizes and types for joining to pipe by solvent welding, threading or socket fusion as in the case with polypropylene and PVDF.

Gasket seals between the flange faces should be an elastomeric full flat faced gasket with a hardness of 50 to 70 durometer A. Chemtrol can provide polychloroprene (CR) gaskets in the 1/2" through 12" range having a 1/8" thickness. For chemical environments too aggressive for polychloroprene (CR) another resistant elastomer should be used. When it is necessary to bolt plastic and metal flanges – use flat face metal flanges – not raised face, and use recommended torques shown in table under "Installation Tips."

Dimensions

Bolt circle and number of bolt holes for the flanges are the same as Class 150 metal flanges per ANSI B16.5. Threads are tapered iron pipe size threads per ANSI B1.20.1. The socket dimensions conform to ASTM D2467 which describes 1/2" through 8" sizes and ASTM D439 for Schedule 80 CPVC which gives dimensional data for 1/2" through 6". Internal Chemtrol specifications have been established for the 10" and 12" PVC patterns and 8" CPVC design, as well as socket designs for polypropylene and PVDF.

Pressure Rating

As with all other thermoplastic piping components, the maximum non-shock operating pressure is a function of temperature. Maximum pressure rating for Chemtrol® valves, unions and flanges is 150 psi. Above 100° F refer to the chart on page 13.

Sealing
The faces of flanges are tapered back away from the orifice area at a 1/2 to 1 degree pitch so that when the bolts are tightened the faces will be pulled together generating a force in the water way area to improve sealing.

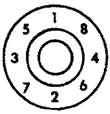
Installation Tips
Once a flange is joined to pipe, the method for joining two flanges together is as follows:

1. Make sure that all the bolt holes of the mating flanges match up. It is not advisable to twist the flange and pipe to achieve this.
2. Use flat washers under bolt heads and nuts.
3. Insert all bolts. (Lubricate bolts.)
4. Make sure that the faces of the flanges mate snuggly prior to tightening of the bolts.
5. The bolts on the plastic flanges should be tightened by pulling down the nuts diametrically opposite each other using a torque wrench. (See diagram below) Complete tightening should be accomplished in stages. The final torque values are shown in the table below. Uniform stress across the flange will prevent leaky gaskets.
6. If the flange is mated to a rigid and stationary flanged object, or to a metal flange, the adjacent plastic pipe must be supported or anchored to eliminate excessive stress on the flange joint.

Flange Size	Recommended Torque*
1/2 - 1 1/2"	10 - 15 ft.lbs.
2 - 4"	20 - 30 ft.lbs.
6 - 8"	33 - 50 ft.lbs.
10"	53 - 75 ft.lbs.
12"	80 - 110 ft.lbs.

***For a well lubricated bolt with flat washers under bolt head and nut.**

The following tightening pattern is suggested for the flange bolts:



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Repairing Thermoplastic Pipe Joints

Scope

The most common method for repairing faulty and leaking joints is hot gas welding at the fillet formed by the fitting socket entrance and the pipe. Fillet welding of thermoplastic is quite similar to the acetylene welding or brazing process used with metals. The fundamental differences are that the plastic rod must always be the same basic material as the pieces to be joined; and heated gas, rather than burning gas, is used to melt the rod and adjacent surfaces.

Welding with plastics involves only surface melting because plastics unlike metals must never be “puddled." Therefore, the resulting weld is not as strong as the parent pipe and fitting material. This being the case, fillet welding as a repair technique is recommended for minor leaks only. It is not recommended as a primary joining technique for pressure rated systems.

Welding Tools and Materials

- Plastic welding gun with pressure regulator, gauge and hose.
- Filler rod
- Emery cloth
- Cotton rags
- Cutting pliers
- Hand grinder (optional)
- Compressed air supply or bottled nitrogen (see Caution next page)
- Source of compressed air

Weld Area Preparation

Wipe all dirt, oil and moisture from the joint area. A very mild solvent may be necessary to remove oil.

CAUTION: Make sure that all liquid has been removed from the portion of the piping system where the weld is to be made.

Welding Faulty Joints

1. Remove residual solvent cement from the weld area using emery cloth. When welding threaded joints, a file can be used to remove threads in the weld area.

2. Wipe the weld area clean of dust, dirt and moisture.

3. Determine the mount of the correct filler rod (see Table, page 36) necessary to make one complete pass around the joint by wrapping the rod around the pipe to be welded. Increase this length enough to allow for handling the rod at the end of pass.

4. Make about a 60° angular cut on the lead end of the filler rod. This will make it easier to initiate melting and will insure fusion of the rod and base material at the beginning of the weld.

5. Welding temperatures vary for different thermoplastic materials (500° F - 550° F for PVC and CPVC, 550° F - 600° F for PP, 575° F - 600° F for PVDF). Welding temperatures can be adjusted for the various thermoplastic materials as well as any desired welding rate, by adjusting the pressure regulator (which controls the gas flow rate) between 3 and 8 psi.

CAUTION: For welding guns which require compressed gas, nitrogen is preferred when the compressed plant air system does not contain adequate drying and filtrations.

Because of its economy, compressed air is normally the gas of choice for most plastic welding. A welding gun which generates its own air supply is frequently desirable for field-made pipe joints where ultimate weld strength is not required. For welding guns which require compressed gas, nitrogen is preferable when the compressed plant air system does not contain adequate drying and filtration. (Presence of moisture in the gas stream causes premature failure in the heater element of the welding gun. Impurities in the gas stream, particularly those in oil, may oxidize the plastic polymer, resulting in loss of strength. Polypropylene is known to be affected in this manner.)

6. With air or inert gas flowing through the welding gun, insert the electrical plug for the heating element into an appropriate electrical socket to facilitate heating of the gas and wait approximately 7 minutes for the welding gas to reach the proper temperature.

CAUTION: The metal barrel of the welding gun houses the heating element so it can attain extremely high temperatures. Avoid contact with the barrel and do not allow it to contact any combustible materials.

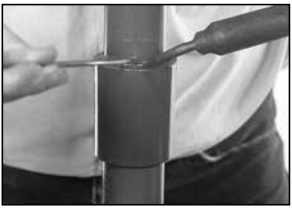
Filler rod size and number of weld passes required to make a good plastic weld are dependent upon the size of the pipe to be welded as presented below:

Pipe Sizes	Rod Sizes	Number of Passes
1/2"- 3/4"	3/32"	3
1"- 2"	3/32"	3
2 1/2"- 4"	1/8"	3
6"- 8"	1/8" or 5/32"	5
10"- 12"	5/32" or 3/16"	5

Do not use filler rod larger than 1/8" in diameter when welding CPVC.

7. Place the leading end of the filler rod into the fillet formed by the junction of the pipe and fitting socket entrance. Holding the filler rod at an angle of 90° to the joint for PVC, CPVC and PVDF, 75° to the joint for polypropylene, preheat the surfaces of the rod and base materials at the

weld starting point by holding the welding gun steady at approximately 1/4" to 3/4" from the weld starting point and directing the hot gas in this area until the surfaces become tacky. While preheating, move the rod up and down slightly so that the rod lightly touches the base material. When the surfaces become tacky, the rod will stick to the base material.



8. Advance the filler rod forward by applying a slight pressure to the rod. Simultaneously applying even heat to the surfaces of both the filler rod and base material by moving the gun with a fanning or arcing motion at a rate of about 2 cycles per second. The hot gas should be played equally on the rod and base material (along the weld line) for a distance of about 1/4" from the weld point.

9. Since the starting point for a plastic weld is frequently the weakest part of the weld, always terminate a weld by lapping the bead on top of itself for a distance of 3/8" to 1/2". Never terminate a weld by overlapping the bead side by side.

IMPORTANT: If charring of the base or rod material occurs, move the tip of the gun back slightly, increase the fanning frequency or increase the gas flow rate. If the rod or base materials do not melt sufficiently reverse the previously discussed corrective procedures. Do not apply too much pressure to the rod because this will tend to stretch the weld bead causing it to crack and separate after cooling.

10. When welding large diameter pipe, three weld passes may be required (see table above). The first bead should be deposited at the bottom of the fillet and subsequent beads should be deposited on each side of the first bead. When making multiple pass welds, the starting points for each bead should be staggered and ample time must be allowed for each weld to cool before proceeding with additional welds.

11. Properly applied plastic welds can be recognized by the presence of small flow lines or waves on both sides of the deposited bead. This indicates that sufficient heat was applied to the surfaces of the rod and base materials to effect adequate melting and that sufficient pressure was applied to the rod to force the rod melt to fuse with base material melt. If insufficient heat is used when welding PVC, CPVC, or PVDF, the filler rod will appear in its original form and can easily be pulled away from the base material. Excessive heat will result in a brown or black discoloration of the weld. In the case of polypropylene, excessive heat will result in a flat bead with oversized flow lines.

12. Always unplug the electrical connection to the heating element and allow the welding gun to cool before shutting off the gas to the gun.

Welding Principles

The procedures for making good thermoplastic welds can be summarized into four basic essentials:

- Correct Heating - Excessive heating will char or overmelt. Insufficient heating will result in incomplete melting.
- Correct Pressure - Excessive pressure can result in stress cracking when the weld cools. Insufficient pressure will result in incomplete fusion of the rod material with the base material.
- Correct Angle - Incorrect rod angle during welding will stretch the rod and the rod material with the base material.
- Correct Speed - Excessive welding speed will stretch the weld bead and the finished weld will crack upon cooling.

Threading Instructions for Thermoplastic Pipe

Threading and Joining

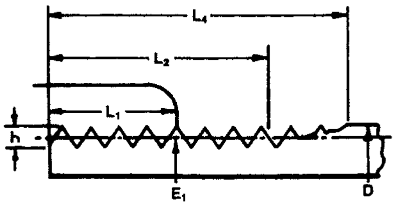
1. Hold pipe firmly in a pipe vise. Protect the pipe at the point of grip by inserting a rubber sheet or other material between the pipe and vise.
2. A tapered plug must be inserted in the end of the pipe to be threaded. This plug provides additional support and prevents distortion of the pipe in the threaded area. Distortion of the pipe during the threading operation will result in eccentric threads, non-uniform circumferential thread depth or gouging and tearing of the pipe wall. See the following Table for approximate plug O.D. dimensions.

Table: **Reinforcing Plug Dimensions***

Pipe Size	Plug O.D.
1/2"	.526
3/4"	.722
1"	.935
1 1/4"	1.254
1 1/2"	1.476
2"	1.913
2 1/2"	2.289
3"	2.864
4"	3.786

*These dimensions are based on the median wall thicknesses and average outside diameter for the respective pipe sizes. Variations in wall thicknesses and O.D. dimensions may require alteration of the plug dimensions.

3. Use a die stock with a proper guide that is free of burrs or sharp edges, so the die will start and go on square to the pipe axis.
4. Push straight down on the handle, avoiding side pressure that might distort the sides of the threads. If power threading equipment is used, the dies should not be driven at high speeds or with heavy pressure. Apply an external lubricant liberally when cutting the threads. Advance the die until the trailing end of the cutting chases approximately pass the end of the pipe.



DO NOT THREAD SCHEDULE 40 PIPE

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Do not overthread because all threads between the end of the pipe and the trailing end of the chases will be straight and not tapered as indicated in the sketch above.

5. Periodically check the threads with a ring gauge to ensure that proper procedures are being followed. The gauging tolerance is ± 1 1/2 turns and diametrical adjustment to the cutting chases within the die may be required.
6. Brush threads clean of chips and ribbons. Then starting with the second full thread tape in the direction of the threads. Overlap each wrap by one half the width of the tape. NIBCO does not recommend the use of any thread lubricant/sealant other than PTFE tape.
7. Thread the fitting onto the pipe and tighten by hand. Using a strap wrench only, further tighten the connection an additional one to two threads past hand tightness. Avoid excessive torque as this may cause thread damage or fitting damage.

Pressure Testing

Threaded piping systems can be pressure tested up to 100% of the hydrostatic pressure rating as soon as the last connection is made.

CAUTION: Air or compressed gas is not recommended and should not be used as a media for pressure testing of plastic piping systems.

The installation instructions contained herein are recommendations. It is the responsibility of the installer to follow industry best practices for installation and to comply with all applicable codes and regulations.

Ultraviolet Radiation of Thermoplastic Piping Materials

The presence of Ultraviolet (UV) must at least be considered for every material because of the effect of its radiation of pipe on the medium carried within the pipe depends upon the basic material as well as the pigmentation (colorant) package in the material.

PVC and CPVC
Both materials are attacked by UV radiation, resulting in degradation of the polymeric chains. Embrittlement is the first sign of deterioration, followed by loss of strength and general deterioration of all other physical properties. Industrial CPVC Sch. 80 piping components are traditionally colored light gray while PVC products are dark gray. The coloration for both systems of products is achieved by a blend of Titanium Dioxide (white) and Carbon Black (black). In order to maintain a consistent tone of color, a pigmentation package of approximately 2.5% by weight is required. Through many years of experience it has been shown that the irradiation is blocked by pigment at the surface. B. F. Goodrich conducted one controlled experiment of PVC cooling tower piping on the roof of a motel in Orlando, Florida for over 30 years. Typically, after several years' exposure the gray color, particularly on the pipe top that bears the brunt from the sun, washed out to a lighter gray with white showing through. But when the surface was scratched with the edge of a knife blade the rich dark gray was present, indicating that radiation had not penetrated below the surface. Samples of pipe were taken from the installation at five-year intervals so that coupons could be extracted for physical property testing. After 30 years the testing was stopped with the conclusion that 25 years service could be expected because no statistical difference in results had been noted. Although in most applications involving schedule 80 gray piping, painting or covering the system to prevent exposure to UV radiation may not be a necessity, in instances where such systems may be routinely or continuously exposed to degradation due to environmental conditions, supplementary protection may be recommended. Consult NIBCO Technical Services with questions in such applications.

PVC Sch 40 and SDR water and sewer piping, which are traditionally white in color, may be another story. There is no requirement for the amount of Titanium Dioxide to be included in the plastic compound for white coloration. As a result, minimal amounts of pigment may be present in these very cost competitive high volume products, and the commercial white piping products should be suspect under long-term direct exposure to sun without some UV protection, painting being one option.

Polypropylene
All polyolefins are severely degraded by UV radiation. However, the black PP used in Chemtrol products is formulated with a minimum of 2.5% carbon black being suitable for long-term outdoor service.

PVDF (Kynar®)
PVDF, absent of any color pigment, is transparent to UV, so it is not degraded by sunlight. Direct sunlight can frequently adversely affect the fluid medium stability; therefore, Chemtrol PVDF piping is available with an FDA-approved red pigment.

Painting
Although the slick hard surfaces of the thermoplastic piping systems listed above are not ideal for paint adhesion they may be effectively painted for facilities color coding, cosmetic enhancement or added UV protection. The paint should be a water-based 100% acrylic emulsion system for exterior use. The system will include a primer coat and one topcoat. If the reason for painting is to provide UV protection, white or another light color is the best choice. These contain a greater amount of pigment, principally Titanium Dioxide. Use any brand of high quality house or industrial paint because these have the higher concentration of pigment and it is the pigment that provides the UV protection. There are two hints, which will greatly contribute to adhesion. First, wash the entire exterior with solvent to clean and degrease it. Axial-grease and caked mud are obvious, but small particles of sand, dust, printing and body oil (fingerprints) are less obvious impurities that require removal. Therefore, do not get the cleaning process too far ahead of painting. Use Methyl Ethyl Ketone (MEK) (available as a plastic pipe cleaner from many distributors of industrial plastic piping) or Isopropyl Alcohol, although more elbow grease will be required with the later. Do not overlook the need for good ventilation when using solvents. Second, insure a continuous film of paint over the entire piping surface. The cohesion of the paint films themselves will help the coating to adhere to the piping. It becomes apparent that painting is not an inexpensive addition to the piping system. However, to specify it correctly the first time will reduce maintenance costs in the long run.

General Underground Installation Procedures for PVC and CPVC Solvent Welded Pipe

The general installation procedures detailed here apply to polyvinyl chloride (PVC) and chlorinated polyvinyl chloride (CPVC) pressure pipe that has solvent welded joints up through 8" in size. These procedures are applicable for all liquids that are conveyed at pressures up to the maximum hydrostatic pressure rating of the pipe or of any component in the piping system, whichever is lowest.

Chemtrol Technical Services should be consulted for installation guidance and recommendation on all sizes of pipe 10" and above and where the installer has had no experience in the installation of PVC or CPVC piping. For additional information, refer to ASTM D2774, “Underground Installation of Thermoplastic Pressure Piping."

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Inspection
Before installation, all lengths of PVC or CPVC pipe and fittings should be thoroughly inspected for cuts, scratches, gouges, buckling, kinking and any other imperfections (such as splits on I.D. or ends of pipe due to impact) which may have been imparted to the pipe during shipping, unloading, storing and stringing. Any pipe or precoupled fittings containing harmful or even questionable defects should be removed by cutting out the damaged section as a complete cylinder.

Trenching
The trench should be of adequate width to allow convenient installation of PVC or CPVC pipe, at the same time being as narrow as possible. The following trench sizes have been used with success. However, actual sizes may vary with terrain and specific application.

Minimum trench widths may be utilized by joining pipe outside of the trench and lowering it into the trench after adequate joint strength has been obtained. Trench widths will have to be wider where the pipe is joined in the trench, or where thermal expansion and contraction is a factor. See section titled "Snaking of Pipe."

Pipe Size	Trench Width	Light Traffic Ground Cover Minimum	Heavy Traffic Ground Cover Minimum
3" & Under	8"	12" - 18"	24" - 30"
4" & 6"	12"	18" - 24"	30" - 36"
8"	16"	24" - 30"	36" - 42"

The trench bottoms should be continuous, relatively smooth and free of rocks. Where ledge rock, hardpan or boulders are encountered, it is advisable to pad the trench bottom using a minimum of four (4) inches of tamped earth or sand beneath the pipe as a cushion and for protection of the pipe from damage.

Sufficient cover must be maintained to keep external stress levels below acceptable design stress. Reliability and safety of service may assume major importance in determining minimum cover. Local, state and national codes may also govern.

Pipe intended for water service should be buried at least 12" below the maximum expected frost penetration.

Size of Joining Crew
Field practice has shown that the size of the joining crew will depend upon a number of variables, such as, size and length of the pipe, the atmospheric temperature, construction conditions, construction time element, amount of pipe to be layed, construction workers' experience in laying PVC or CPVC pipe, etc. Although it is possible for one man to join the smaller sizes of pipe (2" and under) by himself, it is not necessarily practical to do so. Therefore, the crew sizes presented here are intended as a guide for those PVC or CPVC pipe users who have not had a great deal of experience in the installation of such buried pipe:

1 MAN	Size Pipe 1 1/4" and under. Size Pipe 1 1/2" and 2" maximum 20' lengths.
2 MEN	1 1/2" and 2" where lengths are over 20' or atmospheric temperature temperature is over 90° F. 2 1/2" and 3" pipe in maximum lengths of 20'
3 MEN*	2 1/2" and 3" pipe where lengths are over 20' or atmospheric temperature is over 90° F. 4" through 8" size pipe.
4 MEN**	6" and 8" size pipe where atmospheric temperature is over 90° F.

* Two men do the priming and solvent welding while the third man is positioned at the end of the pipe in order to assist in pushing it into its fully bottomed position in the fitting socket.

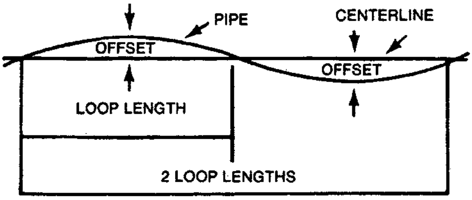
** Two men do the priming and apply the cement to the pipe surface while the third man does the same to the fitting socket. The fourth man is positioned at the end of the pipe in order to assist in pushing it into its fully bottomed position in the fitting socket.

NOTE: The need for an extra man when the temperature is above 90° F, is necessary in order to quickly complete the solvent cement application and joining process before rapid evaporation of the cement's solvent causes it to prematurely set.

Snaking of Pipe

After the PVC and CPVC pipe has been solvent welded, it is advisable to snake the pipe beside the trench according to the following recommendation. **BE ESPECIALLY CAREFUL NOT TO APPLY ANY STRESS THAT WILL DISTURB THE UNDRIED JOINT.** This snaking is necessary in order to allow for any anticipated thermal contraction that will take place in the newly joined pipeline.

Pipe Snaking



Loop Offset in Inches for Contraction

Maximum Temperature Variation, ° F, Between Time of Solvent and Final Use										
Loop Length	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°
20 Feet	3"	4"	5"	5"	6"	6"	7"	7"	8"	8"
50 Feet	7"	9"	11"	13"	14"	16"	17"	18"	19"	20"
100 Feet	13"	18"	22"	26"	29"	32"	35"	37"	40"	42"

Snaking is particularly necessary on the lengths that have been solvent welded during the late afternoon of a hot summer's day, because their drying time will extend through the cool of the night when thermal contraction of the pipe could stress the joints to the point of pull out. This snaking is also especially necessary with pipe that is layed in its trench (necessitating wider trenches than recommended) and is back-filled with cool earth before the joints are thoroughly dry.

Bending of Plastic Pipe

Whenever a change of direction is required in a pipeline, it is best accomplished using straight lengths of pipe and factory-made fittings. Bending of pipe leaves residual stresses and consequently bending is not recommended as a normal practice, particularly if the line is intended to operate at or near maximum temperatures and/or pressure.
If field bending is required to meet special conditions the following techniques should be employed to give the best pressure carrying capability of the installed system.

1. Heating Media: The heating media may be hot air in a circulating oven operating at approximately 360° F. The heating media may also be radiant heat in which case the pipe surface in the area of the bend or the pipe may be immersed in hot oil. An open flame should never be used. Heating times will range from approximately one to five minutes or until it becomes soft and pliable to bend, depending upon pipe size and type of heat source.
2. To maintain the cross sectional area of the I.D. of the pipe in the area of the bend, it must be supported during the bending operations.

   There are three suggested methods for supporting the pipe.
   a. The I.D. can be supported by filling with preheated sand and plugging both ends.
   b. A heated reinforcing spring can be placed inside of the pipe after it has been heated to a soft, pliable condition. The spring should be made with 3/32" diameter wire and the O.D. of the spring should be slightly less than the nominal I.D. of the pipe to be bent. Springs can be custom made by any local spring manufacturer.
   c. When the pipe becomes soft and pliable it can be placed in forming jig or form and bent as quickly as possible to prevent weakening or deforming of the pipe.
3. The minimum radius to which a bend should be made, measured from the inner edge of the curve, should be 8 pipe diameter for 3/4" pipe size and below and 6 pipe diameters for larger pipe. The initial forming bend will have to be slightly greater to allow for spring back.
4. The bend should be kept in the bent form until the pipe cools and becomes rigid enough to be handled without deforming. It should then be immediately immersed in water to complete the cooling process. The sand or spring should not be removed until final cooling is completed. When plastic pipe is heated and then bent, it will shrink with the degree of shrinkage depending on the size of the pipe and the radius of the bend. Therefore, the pipe should be cut to lengths slightly greater than the total length of the bend and the tangents.
5. A straight section of at least two pipe diameters should be left at either side of the bend to insure a round, low stress section with which to make joints.

NOTE: Highly crystalline thermoplastics such as PVDF should never be formed in this way due to the potential detrimental effect of the process on the molecular structure and properties of the material.

The above discussion covers only the basics involved with bending plastic pipe. Experience and some trial-and-error will be required to develop an expertise in bending pipe. Contact the pipe manufacturer with further questions.

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Cleaning

Even though care should be exercised at all times to prevent the entry of dirt, water, and other foreign material into the PVC or CPVC pipe fittings, it is advisable that the pipeline be thoroughly cleaned before working pressure is applied.

Backfilling

Ideally, backfilling should only be done early in the morning during hot weather when the line is fully contracted and there is no chance of insufficiently dried joints being subject to contraction stresses.

The pipe should be uniformly and continuously supported over its entire length on firm, stable material. Blocking should not be used to change pipe grade or to intermittently support pipe across excavated sections.

Pipe is installed in a wide range of sub-soils. These soils should not only be stable but applied in such a manner so as to physically shield the pipe from damage. Attention should be given to local pipe laying experience which may indicate particular pipe bedding problems.

Backfill materials free of rocks with a particle size of 1/2" or less should be used to surround the pipe with 6" to 8" of cover. It should be placed in layers. Each solid layer should be sufficiently compacted to uniformly develop lateral passive soil forces during the backfill operation. It may be advisable to have the pipe under pressure, 15 to 25 psi during the backfilling.

Effects of ground freezing should be considered when pipe is installed at depths subject to frost penetration.

Vibratory methods are preferred when compacting sand or gravels. Best results are obtained when the soils are in nearly saturated condition. Where water flooding is used, the initial backfill should be sufficient to insure complete coverage of the pipe. Additional material should not be added until the water flooded backfill is firm enough to walk on. Care should be taken to avoid floating the pipe.

Sand and gravel containing a significant proportion of fine-grained material, such as silt and clay, should be compacted by hand or, preferably by mechanical tamper.
The remainder of the backfill should be placed and spread in approximately uniform layers in such a manner to fill the trench completely so that there will be no unfilled spaces under or about rocks or lumps of earth in the backfill. Large or sharp rocks, frozen clods and other debris greater than 3" in diameter should be removed. Rolling equipment or heavy tampers should only be used to consolidate the final backfill.

Additional information on underground installation is given in ASTM D2321 "Underground Installation of Flexible Thermoplastic Pressure Piping."

Connecting Pipe Sections

Sections of PVC or CPVC pipe that have been backfilled or plowed in during the heat of the day should be sufficiently overlapped to allow for contraction and not joined up to one another or any stable connection or fitting until the morning following their night of cooling and thermal contraction.

See the section "Expansion and Thermal Contraction of Plastic Pipe" page 18 for calculating anticipated contraction.

Pipe Locating
The location of all PVC and CPVC pipelines should be accurately and precisely recorded. Conductive wire can be trenched or plowed in with the pipe as an aid for future locating purposes.

Below Grade Valves, Anchors or other Connections
As a rule of thumb in designing and installing a PVC or CPVC underground piping system, it is pointed out that pipe made from these materials is not designed to be used for any structural applications beyond withstanding normal soil loads and internal pressures up to its hydrostatic pressure rating.

Anchors, valve boxes, etc. must be independently supported so as to not introduce additional bending or sheer stress on the pipe.

Roadways and Railroad Tracks
It is recommended that plastic pipe be run within a metal or concrete casing when it is installed beneath surfaces that are subject to heavyweight or constant traffic; such as roadways, railroad tracks, etc.

Concrete Anchors
Concrete anchors can be poured around PVC or CPVC pipe at direction changes. If the purpose for anchoring is to restrain axial movement of the pipe, this can be done by solvent welding split collars around the pipe O.D. to provide a shoulder against the concrete wall. Solvent welded surface between collar and pipe O.D. must dry 48 hours prior to pouring of concrete.

Risers
Although PVC or CPVC pipe has excellent weathering resistance, it should not be brought above grade under the following circumstances:

1. If it is expected to provide structural strength, such as supporting an above-grade metal valve. The metal valve should be installed with an independent support.
2. If it is subject to external damage. This could be remedied by sleeving the pipe with an independently and rigidly supported steel pipe.
3. If it is subject to high temperature environments; i.e. summer sun that could lower the pipe's pressure rating below an acceptable level. Such a situation might be remedied by insulating the PVC or CPVC pipe.

The installation instructions contained herein are recommendations. It is the responsibility of the installer to follow industry best practices for installation and to comply with all applicable codes and regulations.

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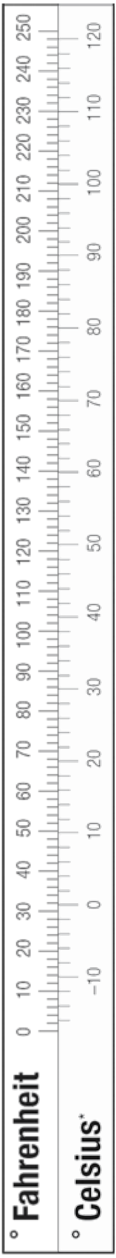
Metric Equivalent Charts



* Formerly known as Centigrade.

Temperature Conversion

F = C x 1.8 + 32

C= (F-32) ÷ 1.8

Linear Conversion Table From Fractional Inches to Millimeters

inches		mm	inches		mm
1/64	.016	.397	33/64	.516	13.097
1/32	.031	.794	17/32	.531	13.494
3/64	.047	1.191	35/64	.547	13.891
1/16	.063	1.588	9/16	.563	14.288
5/64	.078	1.984	37/64	.578	14.684
3/32	.094	2.381	19/32	.594	15.081
7/64	.109	2.778	39/64	.609	15.478
1/8	.125	3.175	5/8	.625	15.875
9/64	.141	3.572	41/64	.641	16.272
5/32	.156	3.969	21/32	.656	16.669
11/64	.172	4.366	43/64	.672	17.066
3/16	.188	4.763	11/16	.688	17.463
13/64	.203	5.519	45/64	.703	17.859
7/32	.219	5.556	23/32	.719	18.256
15/64	.234	5.953	47/64	.734	18.653
1/4	.250	6.350	3/4	.750	19.050
17/64	.266	6.747	49/64	.766	19.447
9/32	.281	7.144	25/32	.781	19.844
19/64	.297	7.541	51/64	.797	20.241
5/16	.313	7.938	13/16	.813	20.638
21/64	.328	8.334	53/64	.828	21.034
11/32	.344	8.731	27/32	.844	21.431
23/64	.359	9.128	55/64	.859	21.828
3/8	.375	9.525	7/8	.875	22.225
25/64	.391	9.922	57/64	.891	22.622
13/32	.406	10.319	29/32	.906	23.019
27/64	.422	10.716	59/64	.922	23.416
7/16	.438	11.113	15/16	.938	23.813
29/64	.453	11.509	61/64	.953	24.209
15/32	.469	11.906	31/32	.969	24.606
31/64	.484	12.303	63/64	.984	25.003
1/2	.500	12.700	1	1.000	25.400

English to Metric Conversion Table

Units	Change to	Multiply by
Inches	Millimeters	25.4
Inches	Centimeters	2.54
Inches	Meters	0.0254
Feet	Meters	0.3048
Miles	Kilometers	1.609347
Sq. Inches	Sq. Centimeters	6.452
Sq. Feet	Sq. Meters	0.0929
Cu. Inches	Cu. Centimeters	16.3872
Cu. Feet	Cu. Meters	0.02832
U.S. Gallons	Liters	3.7854
Pounds	Kilograms	0.45359

Pressure Conversion Factors

Pressure measurements are based on the standardized weight of water expressed in a variety of English and metric units.

1 psig (gauge)	=	2.3068	foot of water head
	=	2.036	inch of mercury head
	=	0.0689	bar
	=	0.0703	kgm/cm^2 (kilograms/centimeter^2)
	=	6894.757	N/m^2 (newton/meter^2)
	=	6.8948	kPa (kilopascal)
1 foot of water	=	0.4335	psig
	=	0.0305	kgm/cm^2 (kilograms/centimeter^2)
	=	2988.8837	N/m^2 (newton/meter^2)
	=	0.33457	kPa (kilopascal)
	=	0.02989	bar
1 bar	=	100000.0	N/m^2 (newton/meter^2)
	=	14.50377	psig
	=	100.0	kPa (kilopascal)
	=	10197.1621	kgm/cm^2 (kilograms/centimeter^2)
	=	33.456	foot of water head
1 N/m^2 (newton/meter^2)	=	1.0	Pa (pascal) = 0.001 kPa (kilopascal)
	=	0.000010197	kgm/cm^2
	=	0.000145	psig (gauge)
1 kilogram/centimeter^2	=	98066.5	N/m^2 (newton/meter^2)
	=	14.2233	psig

Vacuum Conversion Factors

Vacuum may be thought of as the absence of pressure. It is the measure of negative pressure between standardized atmospheric pressure and a theoretically perfect vacuum.

1 Std. Atmosphere	=	14.6959	psia (absolute)
	=	760.0	mm (millimeter) of mercury head
	=	1.0332276	kgm/cm^2 (kilograms/centimeter^2)
	=	1.01325	bar
	=	101.325	kPa (kilopascal)
1 mm	=	0.03937	inch
1 micron of mercury	=	0.001	mm (millimeter) of mercury head
	=	0.000019336	psig (gauge)
1 mm of mercury	=	1000.0	micron of mercury head
1 inch	=	25.4	mm (millimeter)
1 inch of mercury	=	25400.0	micron of mercury head
	=	0.4912	psig
1 inch of water	=	0.0361	psig
	=	1868.2742	micron of mercury head
1 psig (gauge)	=	27.6817	inch of water head

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Specific Gravity of Liquids

Liquid	Specific Gravity
Acetic Acid, 50%	1.06
Acetic Anhydride	1.08
Acetone	.79
Alcohol Amyl	.82
Alcohol, Butyl	.81
Aniline	1.02
Benzene	.88
Brine (25% NaCl)	1.18
Butyl Acetate	.88
Calcium Chloride, 25%	1.23
Carbon Tetrachloride	1.60
Chlorobenzene	1.12
Chromic Acid, 10%	1.07
Chromic Acid, 50%	1.50
Cyclohexanone	.94
Ethylene Bromide	2.18
Ethylene Chloride	1.25
Ferric Chloride, 20%	1.18
Fuel Oil No. 1 and 2	.95
Heptane	.68
Hydrogen Peroxide, 30%	1.11
Hydrochloric Acid, 37%	1.18
Keroxene (85°F)	.82
Methyl Ethyl Ketone (MEK)	.81
Nitric Acid, 30%	1.18
Oil Lubricating SAE 10-20-30 (@115°F)	.94
Oleic Acid	.89
Phenol	1.07
Phosphoric Acid, 50%	1.34
Propionic Acid	.99
Pyridine	.98
Sodium Hydroxide, 50%	1.53
Sulfuric Acid, 20%	1.14
Sulfuric Acid, 50%	1.40
Sulfuric Acid, 85%	1.79
Trichloroethylene	1.47
Toulene	.87
Urea	1.36
Water	1.00
Water (Sea)	1.02-1.03
Xylene	.86
Zinc Chlroide, 50%	1.61

Drill Sizes for Pipe Taps

Size of Tap in Inches	Number of Threads Per Inch	Diam. of Drill	Size of Tap in Inches	Number of Threads Per Inch	Diam. of Drill
1/8	27	11/32	2	11 1/2	2 3/16
1/4	18	7/16	2 1/2	8	2 5/8
3/8	18	37/64	3	8	3 1/4
1/2	14	23/32	3 1/2	8	3 3/4
3/4	14	59/64	4	8	4 1/4
1	11 1/2	1 5/32	4 1/2	8	4 3/4
1 1/4	11 1/2	1 1/2	5	8	5 5/16
1 1/2	11 1/2	1 23/32	6	8	6 3/8

Tap and Drill Sizes (American Standard Coarse)

Size of Drill	Size of Tap	Threads Per Inch	Size of Drill	Size of Tap	Threads Per Inch
7	1/4	20	49/64	7/8	9
F	5/16	18	53/64	15/16	9
5/16	3/8	16	7/8	1	8
U	7/16	14	63/64	1 1/8	7
27/64	1/2	13	1 7/64	1 1/4	7
31/64	9/16	12	1 7/32	1 3/8	6
17/32	5/8	11	1 11/32	1 1/2	6
19/32	11/16	11	1 29/64	1 5/8	5 1/2
21/32	3/4	10	1 11/16	1 3/4	5
23/32	13/16	10	1 9/16	1 7/8	5
			1 25/32	2	4 1/2

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Useful Formulas

Where:

A = Area

A_S = Surface area of a solid

V = Volume

C = Circumference

$\propto$ = Angle

r = radius

d = diameter

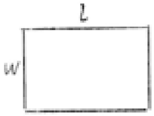
Mathematical References:

$\pi = 3.14$

$r^2 = \mathrm{r} \times \mathrm{r}$

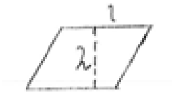
Rectangle:

$$A = wl$$



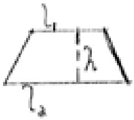
Parallelogram:

$$A = hl$$



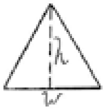
Trapezoid:

$$A = h \times \frac{l_1 + l_2}{2}$$



Triangle:

$$A = \frac{wh}{2}$$



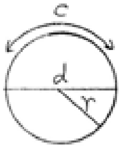
Circle:

$$A = \pi r^2$$

$$C = \pi d$$

$$r = \frac{d}{2}$$

$$d = 2r$$



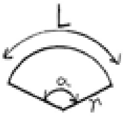
Sector of a Circle:

$$A = \frac{\pi r^2 \propto}{360}$$

$$L = .01745 r \propto$$

$$\propto = \frac{L}{.01745 r}$$

$$r = \frac{L}{.01745 \propto}$$

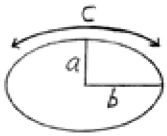


Useful Formulas

Elipse:

$$A = \pi ab$$

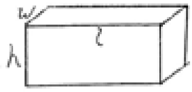
$$C \approx 2\pi \sqrt{\frac{a^2 + b^2}{2}}$$



Rectangle Solid:

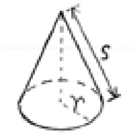
$$A_s = 2(wl + wh + hl)$$

$$V = wlh$$



Cone:

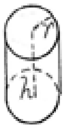
$$A_s = (\pi rs) + (\pi r^2)$$



Cylinder:

$$A_s = 2\pi rh + 2\pi r^2$$

$$V = \pi r^2 h$$



Elliptical Tanks:

$$V = \pi abh$$

$$A_s = 2\pi ab + 2\pi h \sqrt{\frac{a^2 + b^2}{2}}$$

Sphere:

$$A_s = 4\pi r^2$$

$$V = \frac{4}{3}\pi r^3$$

Capacity in gallons:

When V is in cubic inches

$$\text{Gallons} = \frac{V}{231}$$

When V is in cubic feet

$$\text{Gallons} = 7.48 \times V$$

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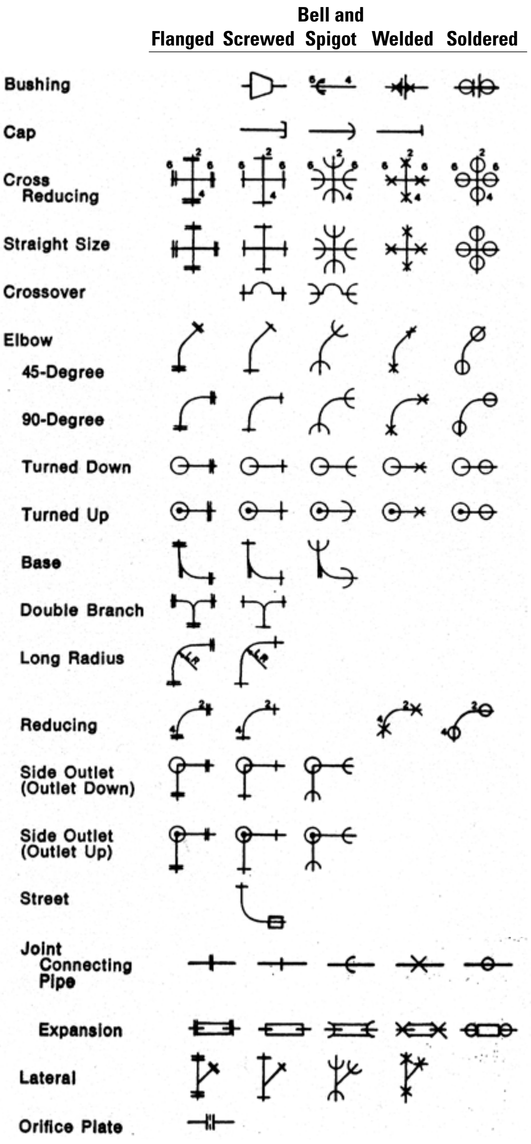
Symbols for Pipe Fittings Commonly Used in Drafting

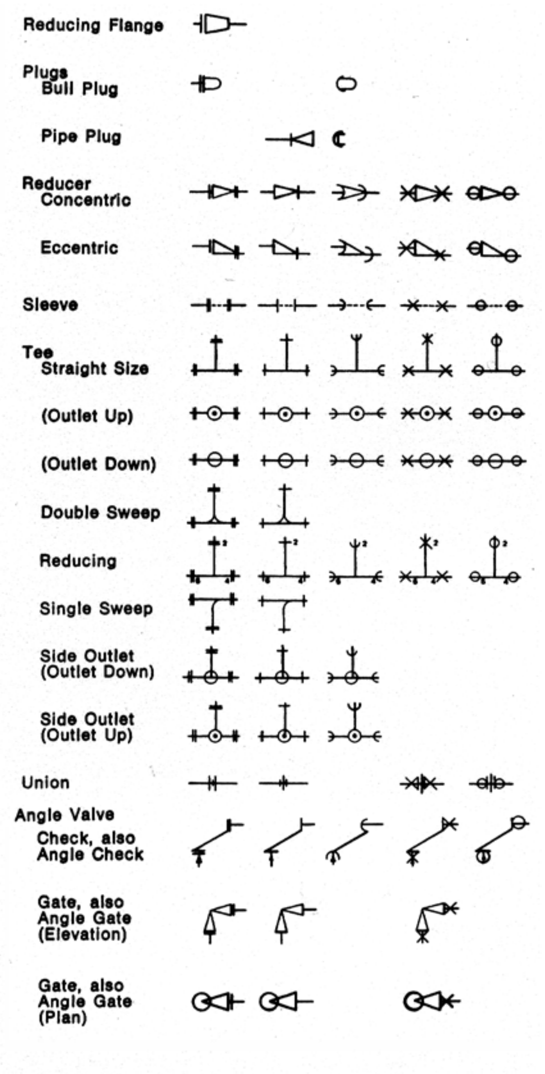
Symbols courtesy of Mechanical Contractors Association of America, Inc.



Symbols for Pipe Fittings Commonly Used in Drafting

Symbols courtesy of Mechanical Contractors Association of America, Inc.

Flanged | Screwed | Bell and Spigot | Welded | Soldered



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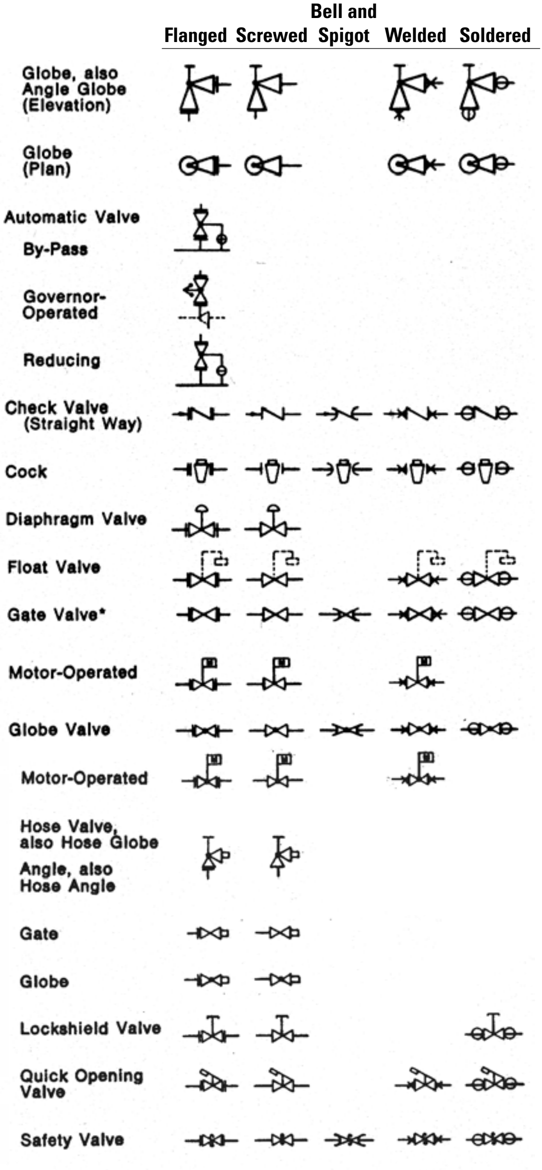

*Also used for General Stop Valve Symbol when amplified by specification.

Abbreviations

ANSI — American National Standards Institute
ASTM — American Society for Testing and Materials
CPVC — Chlorinated Poly (Vinyl Chloride) plastic or resin
IAPMO — International Association of Plumbing and Mechanical Officials
ISO — International Standards Organization
NSF — NSF International
PP — Polypropylene plastic or resin
PPI — Plastics Pipe Institute
psi — Pounds per square inch
PVC — Poly (Vinyl Chloride) plastic or resin
PVDF — Poly (Vinylidene Fluoride) plastic or resin
SPI — The Society of the Plastics Industry, Inc.

Glossary of Terms

Adhesive — a substance capable of holding materials together by surface attachment.

Adhesive, solvent — an adhesive having a volatile organic liquid as a vehicle. See Solvent Cement.

Aging, n. — (1) The effect on materials of exposure to an environment for an interval of time. (2) The process of exposing materials to an environment for an interval of time.

Antioxidant — a compounding ingredient added to a plastic composition to retard possible degradation from contact with oxygen (air), particularly in processing at or exposures to high temperatures.

Artificial weathering — the exposure of plastics to cyclic laboratory conditions involving changes in temperature, relative humidity and ultraviolet radiant energy, with or without direct water spray, in an attempt to produce changes in the material similar to those observed after longterm continuous outdoor exposure.

NOTE: The laboratory exposure conditions are usually intensified beyond those encountered in actual outdoor exposure in an attempt to achieve an accelerated effect. This definition does not involve exposure to special conditions such as ozone, salt spray, industrial gases, etc.

Bell end — the enlarged portion of a pipe that resembles the socket portion of a fitting and that is intended to be used to make a joint by inserting a piece of pipe into it. Joining may be accomplished by solvent cements, adhesives or mechanical techniques.

Beam loading — the application of a load to a pipe between two points of support, usually expressed in pounds and the distance between the centers of the supports.

Glossary of Terms *(Cont.)*

Burst strength — the internal pressure required to break a pipe or fitting. The pressure will vary with the rate of build-up of the pressure and the time during which the pressure is held.

Cement — See adhesive and solvent cement.

Chemical resistance — (1) the effect of specific chemicals on the properties of plastic piping with respect to concentration, temperature and time of exposure. (2) the ability of a specific plastic pipe to render service for a useful period in the transport of a specific chemical at a specified concentration and temperature.

Chlorinated Poly (Vinyl Chloride) Plastics — plastics made by combining chlorinated poly (vinyl chloride) with colorants, fillers, plasticizers, stabilizers, lubricants and other compounding ingredients.

Cleaner — Medium strength organic solvent such as Methylethyl ketone to remove foreign matter from pipe and fitting joint surfaces.

Compound — the intimate admixture of a polymer or polymers with other ingredients such as fillers, softeners, plastics, catalysts, pigments, dyes curing agents, stabilizers, antioxidants, etc.

Copolymer — See Polymer

Creep, n. — the time-dependent part of strain resulting from stress, that is, the dimensional change caused by the application of load over and above the elastic deformation and with respect to time.

C_V — See Flow Coefficient

Deflection temperature — the temperature at which a specimen will deflect a given distance at a given load under prescribed conditions of test. See ASTM D648. Formerly called heat distortion.

Degradation, n. — a deleterious change in the chemical structure of a plastic. See also Deterioration.

Deterioration — a permanent change in the physical properties of a plastic evidenced by impairment of these properties.

NOTE: Burst strength, fiber stress, hoop stress, hydrostatic design stress, long-term hydrostatic strength, hydrostatic strength (quick) long-term burst, ISO equation, pressure, pressure rating, quick burst, service factor, strength stress and sustained pressure test are related terms.

Elasticity — that property of plastics materials by virtue of which they tend to recover their original size and shape after deformation.

NOTE: If the strain is proportional to the applied stress, the material is said to exhibit Hookean or ideal elasticity.

Elastomer — a material which at room temperature can be stretched repeatedly to at least twice its original length and upon immediate release of the stress, will return with force to its approximate original depth.

Glossary of Terms *(Cont.)*

Elevated temperature testing — tests on plastic pipe above 23°C (73°F).

Environmental stress cracking — cracks that develop when the material is subjected to stress in the presence of specific chemicals.

Extrusion — a method whereby heated or unheated plastic forced through a shaping orifice becomes one continuously formed piece.

NOTE: This method is commonly used to manufacture thermoplastic pipe.

Failure, adhesive — rupture of an adhesive bond, such that the plane of separation appears to be at the adhesive-adherend interface.

Fiber stress — the unit stress, usually in pounds per square inch (psi), in a piece of material that is subjected to an external load.

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

Flow Coefficient or C_V — valve coefficient of flow representing the flow rate of water in gallons per minute which will produce a 1 psi pressure drop through the valve.

Full Port Valve — one in which the resistance to flow, in the open position, is equal to an equivalent length of pipe.

Fungi resistance — the ability of plastic pipe to withstand fungi growth and or their metabolic products under normal conditions of service or laboratory tests simulating such conditions.

Heat joining — making a pipe joint by heating the edges of the parts to be joined so that they fuse and become essentially one piece with or without the addition of additional material.

Hoop stress — the tensile stress, usually in pounds per square inch (psi), in the circumferential orientation in the wall of the pipe when the pipe contains a gas or liquid under pressure.

Hydrostatic design stress — the estimated maximum tensile stress in the wall of the pipe in the circumferential orientation due to internal hydrostatic pressure that can be applied continuously with a high degree of certainty that failure of the pipe will not occur.

Hydrostatic strength (quick) — the hoop stress calculated by means of the ISO equation at which the pipe breaks due to an internal pressure build-up, usually within 60 to 90 seconds.

Impact, Izod — a specific type of impact test made with a pendulum type machine. The specimens are molded or extruded with a machined notch in the center. See ASTM D256.

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Glossary of Terms *(Cont.)*

ISO equation — an equation showing the interrelations between stress, pressure and dimensions in pipe, namely

$$S = \frac{P\,(ID + t)}{2t} \text{ or } \frac{P\,(OD - t)}{2t}$$

where S = stress
P = pressure
ID = average inside diameter
OD = average outside diameter
t = minimum wall thickness

Reference: ISO R161-1960 Pipes of Plastics Materials for the Transport of Fluids (Outside Diameters and Nominal Pressures) Part I, Metric Series.

Joint — the location at which two pieces of pipe or a pipe and a fitting are connected together. The joint may be made by an adhesive, a solvent-cement or a mechanical device such as threads or a ring seal.

Long-term burst — the internal pressure at which a pipe or fitting will break due to a constant internal pressure held for 100,000 hours (11.43 years).

Long-term hydrostatic strength — the estimated tensile stress in the wall of the pipe in the circumferential orientation (hoop stress) that when applied continuously will cause failure of the pipe at 100,000 hours (11.43 years). These strengths are usually obtained by extrpolation of log-log regression equations or plots.

Molding, injection — a method of forming plastic objects from granular or powdered plastics by the fusing of plastic in a chamber with heat and pressure and then forcing part of the mass into a cooler chamber where it solidifies.

NOTE: This method is commonly used to manufacture thermoplastic fittings.

Outdoor exposure — plastic pipe placed in service or stored so that it is not protected from the elements of normal weather conditions, i.e., the sun's rays, rain, air and wind. Exposure to industrial and waste gases, chemicals, engine exhausts, etc., are not considered normal "outdoor exposure."

Permanence — the property of a plastic which describes its resistance to appreciable changes in characteristics with time and environment.

Plastic, n. — a material that contains as an essential ingredient an organic polymeric substance 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.

Glossary of Terms *(Cont.)*

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. See plastic tubing.

Plastic tubing, n. — a particular size of plastics pipe in which the outside diameter is essentially the same as that of copper tubing. See plastic pipe.

Polypropylene, n. — a polymer prepared by the polymerization of propylene as the sole monomer.

Polypropylene plastics — plastics based on polymers made with propylene as essentially the sole monomer.

Poly (vinyl chloride) — a polymer prepared by the polymerization of vinyl chloride as the sole monomer.

Poly (vinyl chloride) plastics — plastics made by combining poly (vinyl chloride) with colorants, fillers, plasticizers, stabilizers, lubricants, other polymers and other compounding ingredients. Not all of these modifiers are used in pipe compounds.

Pressure — when expressed with reference to pipe the force per unit area exerted by the medium in the pipe.

Pressure rating — the estimated maximum pressure that the medium in the pipe can exert continuously with a high degree of certainty that failure of the pipe will not occur.

Primer — strong organic solvent, preferably tetrahydrofuran, used to dissolve and soften the joint surfaces in preparation for and prior to the application of solvent cement. Primer is usually tinted purple.

PVDF — a crystalline, high molecular weight polymer of vinylidene fluoride, containing 59 percent fluorine by weight.

Quick burst — the internal pressure required to burst a pipe or fitting due to an internal pressure build-up, usually within 60 to 90 seconds.

Schedule — a pipe size system (outside diameters and wall thicknesses) originated by the iron pipe industry.

Self-extinguishing — the ability of a plastic to resist burning when the source of heat or flame that ignited it is removed.

Service factor — a factor which is used to reduce a strength value to obtain an engineering design stress. The factor may vary depending on the service conditions, the hazard, the length of service desired and the properties of the pipe.

Solvent cement — in the plastic piping field, a solvent adhesive that contains a solvent that dissolves or softens the surfaces being bonded so that the bonded assembly becomes essentially one piece of the same type of plastic.

Solvent cementing — making a pipe joint with a solvent cement. See Solvent Cement.

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Glossary of Terms *(Cont.)*

Stress — when expressed with reference to pipe the force per unit area in the wall of the pipe in the circumferential orientation due to internal hydrostatic pressure.

Sustained pressure test — a constant internal pressure test for 1,000 hours.

Thermoplastic — a plastic which is thermoplastic in behavior. Capable of being repeatedly softened by increase of temperature and hardened by decrease of temperature.

Throttling valve — a valve that is used for control of flow rate.

Union — a device placed in a pipeline to facilitate disassembly of the system.

Vinyl chloride plastics — plastics based on polymers of vinyl chloride or copolymers of vinyl chloride with other monomers, the vinyl chloride being in greatest amount by mass.

Weld-or Knit-line — a mark on a molded plastic part formed by the union of two or more streams of plastic flowing together.

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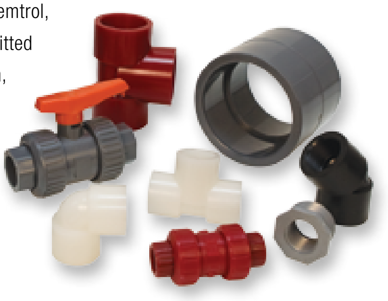

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