Volume IV: Duraplus™ ABS Industrial Piping System

Industrial Technical Manual Series

FIFTH EDITION

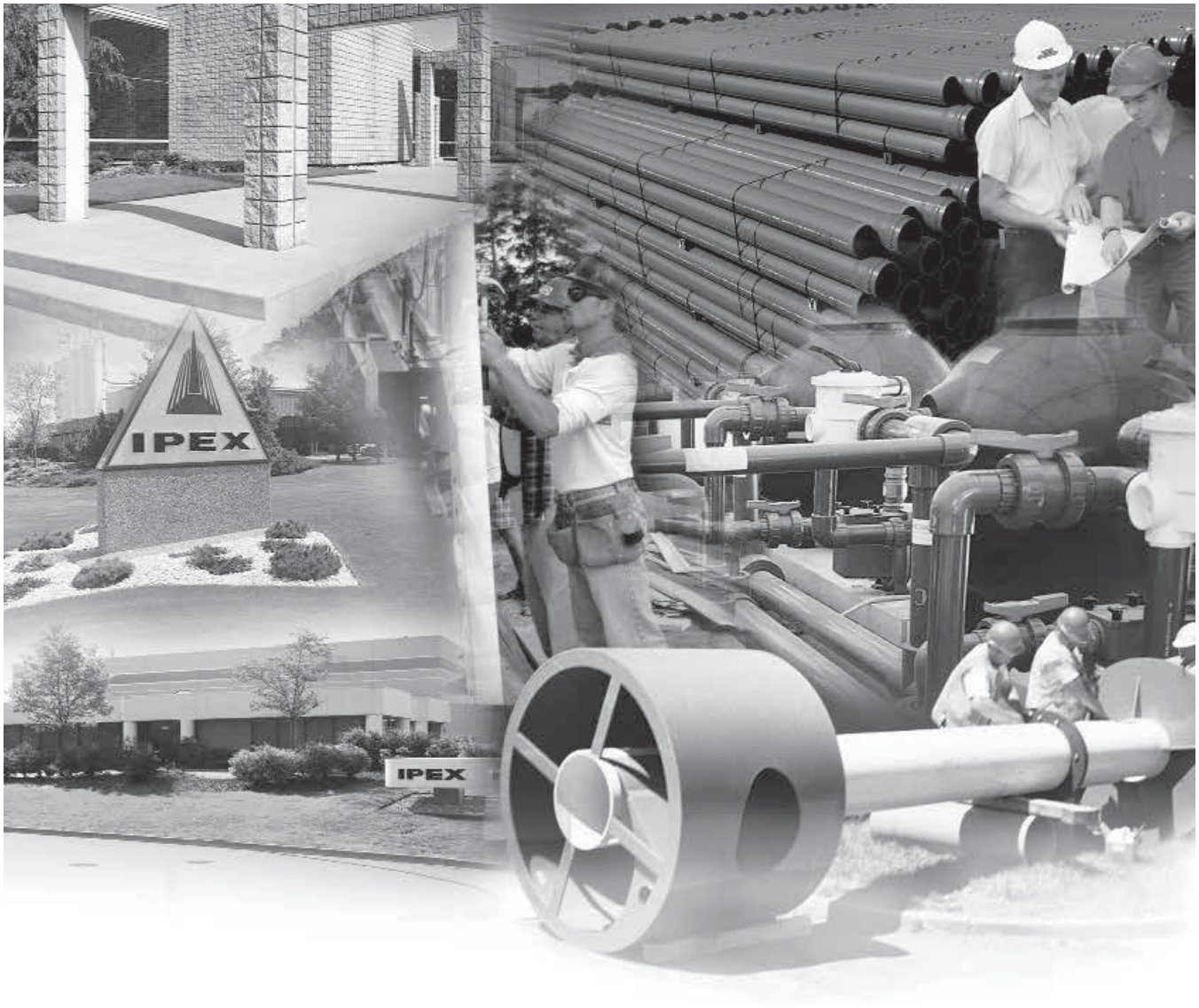
IPEX DURAPLUS™ ABS INDUSTRIAL PIPING SYSTEMS

IPEX by aliaxis

Duraplus™ ABS Industrial Piping System

Industrial Technical Manual Series

Vol. IV, 5th Edition



ABOUT IPEX

At IPEX, we have been manufacturing non-metallic pipe and fittings since 1951. We formulate our own compounds and maintain strict quality control during production. Our products are made available for customers thanks to a network of regional stocking locations throughout North America. We offer a wide variety of systems including complete lines of piping, fittings, valves and custom-fabricated items.

More importantly, we are committed to meeting our customers' needs. As a leader in the plastic piping industry, IPEX continually develops new products, modernizes manufacturing facilities and acquires innovative process technology. In addition, our staff take pride in their work, making available to customers their extensive thermoplastic knowledge and field experience. IPEX personnel are committed to improving the safety, reliability and performance of thermoplastic materials. We are involved in several standards committees and are members of and/or comply with the organizations listed on this page.

For specific details about any IPEX product, contact our customer service department.

SAFETY ALERTS

Engineered thermoplastics are safe inert materials that do not pose any significant safety or environmental hazards during handling or installation. However, improper installation or use can result in personal injury and/or property damage. It is important to be aware of and recognize safety alert messages as they appear in this manual.

The types of safety alert messages are described below.

This safety alert symbol indicates important safety messages in this manual. When you see this symbol be alert to the possibility of personal injury and carefully read and fully understand the message that follows.

WARNING

"WARNING" identifies hazards or unsafe practices that can result in severe personal injury or death if instructions, including recommended precautions, are not followed.

CAUTION

"CAUTION" identifies hazards or unsafe practices that can result in minor personal injury or product or property damage if instructions, including recommended precautions, are not followed.

Note: The use of the word "NOTE" signifies special instructions which are important but are not related to hazards.

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Contents

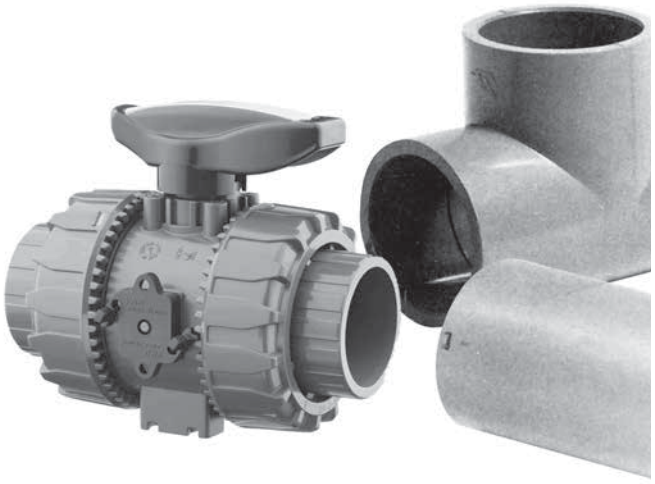
SECTION ONE: GENERAL INFORMATION

OVERVIEW

The Duraplus™ Industrial Piping System by IPEX offers a complete range of ABS pressure pipe, valves and fittings that are ideal for demanding applications ranging from abrasive slurries and separation reagents to caustic processes and low temperature glycol systems. These rugged Duraplus components operate over a wide range of temperatures while delivering excellent material properties including:

- Exceptional Toughness
- Non-Toxicity
- Corrosion Resistance

This design and installation manual provides the most up-to-date comprehensive information about IPEX's Duraplus ABS Industrial Piping System. By combining IPEX's laboratory test results with over 50 years of field experience, we have produced a manual suited to engineers, contractors and distributors alike. All aspects of Duraplus are described here – from basic raw material properties through to installation procedures of the finished product.



Matched pipe, fittings and valves – all supplied by a single manufacturer.

BENEFITS

IPEX offers matched Duraplus pipes, fittings and valves in IPS sizes ranging from 1/2" to 8" nominal diameter, suitable for pressures up to 230 psi at 73°F (23°C) (depending on the size). Besides its operating flexibility, Duraplus offers customers other benefits such as lower costs, durability and performance.

- **Low Installation Costs**

  Duraplus ABS pipe reduces costs on a typical installation not only for materials but also for labor and transportation costs when compared to traditional materials. The reason? Its lightweight construction and simple assembly procedures. Like all thermoplastics, Duraplus is easily handled, stored, cut, joined and installed. As a result, project costs for installed Duraplus systems are generally significantly lower. Requirements for heavy equipment are also eliminated.

- **Corrosion Resistance**

  Duraplus ABS Industrial Systems are immune to damage from both naturally corrosive soil conditions and from electrochemical and galvanic corrosion. This is particularly advantageous in underground installations where galvanic reactions often cause damage to metal piping products. These non-corroding properties ensure a long performance life, low maintenance costs and improved flow.

- **Improved Life Expectancy**

  Duraplus is virtually ageless and impervious to normal weather conditions. Systems that are properly selected for the application, and correctly installed, will provide years of maintenance-free service. Duraplus ABS piping systems have operated successfully in a variety of demanding applications for many years.

  During maintenance and equipment upgrades, examinations of original plastic materials have demonstrated both excellent physical and hydraulic wear characteristics. Our materials will not rust, pit, scale or corrode on either interior or exterior surfaces. Unlike other types of piping, Duraplus is not adversely affected by aggressive soil or atmospheric conditions.

- **Improved Flow Characteristics**

  Duraplus ABS Systems exhibit a substantially lower roughness factor than metals and other materials. In addition, Duraplus does not rust, pit, scale or corrode. As a result, the interior walls of the piping system will remain smooth under virtually all service conditions. These smooth walls allow higher carrying capacities and may enable the use of flatter grades or smaller pipe diameters for a more streamlined design.

  Important: Only the correct Duraplus Cement will provide a reliable joint. All warranties are null and void if another cement is used. Although a range of threaded fittings is available, note that threading thermoplastic pipe is not always recommended because threading weakens the material. In general, threaded fittings are rated for 180 psi at 73°F (23°C).

APPLICATIONS

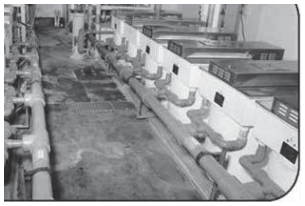
Duraplus Industrial ABS is an extremely versatile process piping system that combines ruggedness, chemical resistance, light weight and ease of installation.

The most common applications for Duraplus Industrial ABS utilizes its outstanding impact resistance, ductility and abrasion resistance at both low and high temperatures.

Applications that utilize these unique characteristics:

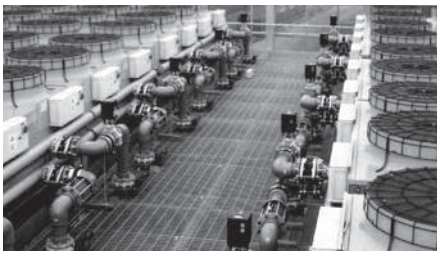
- **Chilled Water/HVAC**
  - Chilled Water Lines
  - Cooling Tower Pipes
  - Condensate Drain Lines
  - Humidification Supply Lines

- **Off Shore Applications**
  - "Mud" Systems –Topside (low pressure) Operations
  - Vacuum Systems (Drill Cuttings Transport)
  - Deck Wash System – Supply & Drainage
  - Deluge Systems (Emergency Showers/Eye Baths)
  - Chilled Water (Air Conditioning)
  - Potable Water
  - Black Water Drainage



- **Mining**
  - Slurries
  - Water Lines
  - Vent Piping
  - Chemical Treatment
  - Tailing Lines

- **Secondary Loop Refrigeration**
  - Glycol Chilled Lines



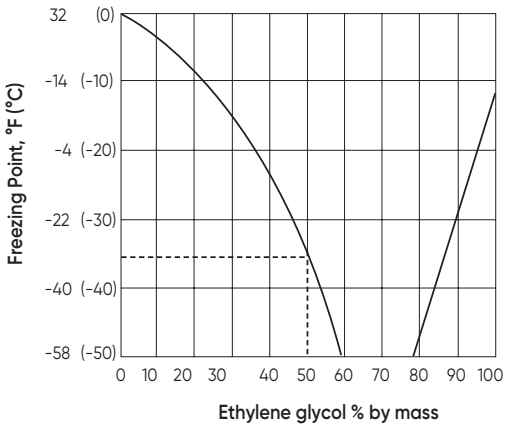
Secondary Refrigerants Used With Duraplus Industrial ABS

The use of glycols in refrigeration is quite extensive. Many industrial and commercial applications require secondary refrigerant systems capable of providing continuous cooling. The list of users is extensive, including hockey arenas, grocery stores, freezers, skating rinks, cold storage facilities, isothermal storage, etc. The selection of a thermoplastic piping system for these demanding applications is critical to the success of any cooling project.

Depending on the cooling application, glycol is generally mixed with water (e.g. 50%) allowing the cooling system to operate at temperatures lower than water alone.

The concentration of glycol in water will determine the maximum cooling capabilities of the mixture. It should be noted, for all mixtures where glycol is added to water there is an increase in pressure drop and a decrease in heat transfer. A good operating rule, therefore, is to concentrate the mixture no more than is necessary to prevent freezing. In a cooling application, for example, Figure 1 shows the freezing point of ethylene glycol – water solutions. At 50% glycol by mass the freezing point of the solution is –36.4°F (–38°C). In systems with temperatures this low, care must be taken during the selection of the thermoplastic pipe material. There is currently only one piping material suitable for this type of application, Duraplus™ ABS Industrial. This ABS piping system has a temperature operating range from –40°F to 140°F (–40°C to 60°C). Duraplus ABS Industrial has exceptional resistance to accidental damage and remains ductile even at these extremely low temperatures.

Figure 1 – Freezing Point of Ethylene Glycol



Selecting Compatible Glycols for Use with Duraplus Industrial ABS

What are Glycols?

Glycols are common Heat Transfer Fluids (HTF)/ antifreeze/ secondary refrigerants used in low temperature applications. Secondary refrigerants are fluids that carry heat from a substance being cooled to the evaporator of a refrigeration system. These secondary refrigerants experience a change in temperature when they absorb the heat and then liberate the heat at the evaporator.

Below are two types of glycols currently used in HTF/antifreeze refrigerant systems.

Ethylene Glycol (EG)

The majority of antifreeze produced uses EG. EG is less expensive and provides a lower freeze point at a 50% ratio for water to glycol when compared to propylene glycol.

Generally, ethylene glycol is clear, colorless but usually has color added before being sold. It has syrupy-like properties at room temperature. It is also very toxic and is not recommended for use in applications where it can come into contact with food or people.

Propylene Glycols (PG)

Propylene glycols ($C_3H_8O_2$) are colorless, odorless liquids. They are highly hygroscopic and miscible in all ratios with water, alcohols, esters, ketones and amines. It has limited miscibility with halogenated hydrocarbons and is not miscible with aliphatic hydrocarbons. Propylene glycols are generally more environmentally friendly.

Organic Salts

The following table facilitates the examination of glycol based and organic salt heat transfer chemicals that may or may not be used in cooling applications and allows the user to determine if a particular heat transfer chemical is suitable with our Duraplus Industrial ABS system. This can be done by checking the chemical name, CAS number and chemical nomenclature

Suitability of Glycols for Use with ABS

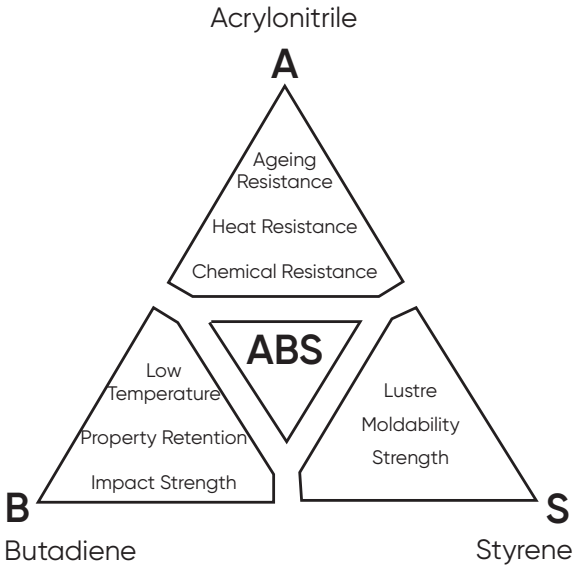
Heat Transfer Chemical	Chemical Nomenclature	Operating Temperature Range	Maximum Antifreeze Concentration	Suitable Piping System	CAS Number
Ethylene Glycol / Monoethylene Glycol	$C_2H_6O_2$	-40°F to 140°F (-40°C to 60°C)	Up to 100%	Duraplus ABS Industrial	107-21-1
Diethylene Glycol	$O(CH_2CH_2OH)_2$	unsuitable	unsuitable	unsuitable	111-46-6
Triethylene Glycol	CH_2-CH_2-O-CH_2-CH_2-O-CH_2-CH_2 OH OH	unsuitable	unsuitable	unsuitable	112-27-6
Propylene Glycol / Monopropylene Glycol / 1, 2 Propanediol	$CH_3CH(OH)$-CH_2OH	-40°F to 140°F (-40°C to 60°C)	Up to 100%	Duraplus ABS Industrial	57-55-6
1, 3 Propanediol	$CH_2(CH_2OH)_2$	-40°F to 140°F (-40°C to 60°C)	Up to 100%	Duraplus ABS Industrial	504-63-2
Dipropylene Glycol	$HOC_3H_6OC_3H_6OH$ or $H(OC_3H_6)_2OH$	unsuitable	unsuitable	unsuitable	25265-71-8
Tripropylene Glycol	$H(OC_3H_6)_3OH$	unsuitable	unsuitable	unsuitable	24800-44-0
Polypropylene Glycol	$H[OCH(CH_3)CH_2]nOH$	unsuitable	unsuitable	unsuitable	25322-69-4
Potassium Formate	KO_2CH	-76°F to 122°F (-60°C to 50°C)	Up to 100%	Duraplus ABS Industrial	590-29-4
Potassium Acetate	$C_2H_3KO_2$	-60°F to 122°F (-51°C to 50°C)	Up to 100%	Duraplus ABS Industrial	127-08-2
Calcium Chloride	$CaCl_2$	-60°F to 23°F (-51°C to -5°C)	Up to 100%	Duraplus ABS Industrial	10035-04-8

Notes:

1. Propylene glycol, Monopropylene glycol and 1, 2 Propanediol are the same chemical. These are three different names currently used in industry for PG.
2. Do not use Diethylene glycol and Triethylene glycol under any circumstances with Duraplus ABS Industrial.
3. Do not use Dipropylene glycol and Tripropylene glycol under any circumstances with Duraplus ABS Industrial.
4. Do not use Polypropylene glycol under any circumstances with Duraplus ABS Industrial.
5. 1, 3 Propanediol, although suitable for refrigerant cooling applications, is not commonly used in this industry.
6. Only use Duraplus ABS Industrial at an operating temperature range of -40°F to 140°F (-40°C to 60°C).

Material Composition

Acrylonitrile-Butadiene-Styrene (ABS) identifies a broad family of engineering thermoplastics with a range of performance characteristics.



The copolymeric ABS material (resin) can be blended to yield the optimum balance of properties suited to a selected end use. Acrylonitrile imparts chemical resistance and rigidity. Butadiene endows the product with impact strength and toughness, particularly at low temperatures, while Styrene contributes to ease of processing.

The formulation used by IPEX is designed for industrial pressure pipe applications. It has been selected to optimize performance with respect to tensile strength, chemical resistance, ductility, weatherability, heat stability and processability from raw material to finished product.

The resulting pressure piping system is tough, rigid and highly ductile over its recommended operating temperature range of – 40°F (-40°C) to +140°F (60°C).

In addition, the material has good chemical resistance and is easily joined by solvent welding, which allows fast system assembly and modification.

The outstanding properties of Duraplus ABS are:

- **High-Impact Strength and Ductility** (which combine to give exceptional toughness)
- **Non-Toxicity**
- **Abrasion Resistance**
- **Broad Operating Temperature Range**
- **Good Chemical Resistance**

Material Property	Unit	Value
Ultimate Tensile Strength (strain rate 2 inches/min)		
73°F (22.79°C)	lbf/in^2	5,500
176°F (80°C)	lbf/in^2	3,150
Modulus of Elasticity 73°F (22.79°C)	lbf/in^2	240,000
176°F (80°C)	lbf/in^2	185,000
Izod Impact Strength (notched) 73°F (22.79°C)	ft. lb/in notch	6
Specific Gravity	_	1.04

* The properties listed in this table represent general material properties and should be used as a guideline only.

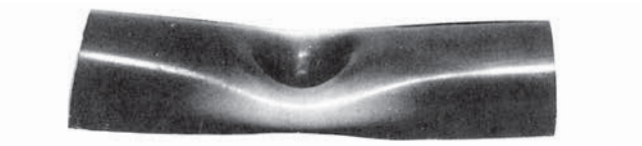
Impact Strength

The impact strength of a material is a measure of its ability to absorb impact energy without failure. Standardized testing methods comply with ASTM, British and ISO standard requirements and involve dropping a tup of known weight onto the pipe from a specified height.

Impact Energy is defined as $E^I = wh$
where, w = weight, lbs.
h = height, ft.

70 ft.lb impact energy is similar to striking the pipe with a 14 lb. hammer from 5 feet.

Duraplus ABS is significantly better than most other thermoplastics at retaining high levels of impact strength at sub-zero temperatures.



Duraplus Industrial Pipe test specimen demonstrates ductility and impact strength during destructive testing.

Toxicity

Duraplus ABS is free of heavy metallic stabilizers such as lead and chromium. Thus, there are no toxic heavy metals to leach out into the liquid being conveyed.

Thermal Properties

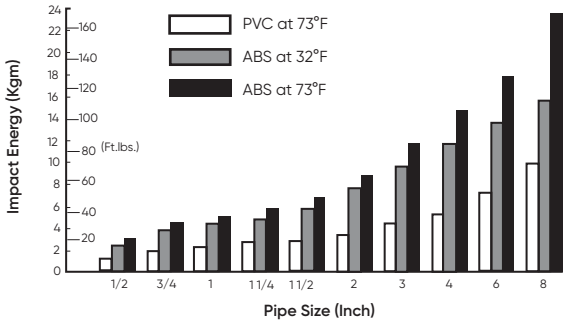
Thermal properties in chilled water and secondary loop refrigeration are very important to a systems efficiency. Traditional materials like copper or steel are very good conductors and have a thermal conductivity of 2,780 and 305 Btu/in/ft²°F/hr, respectively. This inherent material property causes them to conduct heat very effectively, diminishing the efficiency of a cooling system.
Another common problem when using conductive materials for cooling applications is the need for lagging or wrapping to prevent the pipe from sweating. ABS is a non-conductive material and actually acts as an insulator with a thermal conductivity of 1.7 Btu/in/ft²°F/hr. This material property allows for greater process efficiency when used in a cooling system and often eliminates the need for lagging to prevent the pipe from sweating. When a large temperature difference is found between the cooling liquid and the outside temperature, and/or there is a high relative humidity, lagging may be needed even for ABS.

Mode of Failure

Duraplus ABS is a ductile material with a mode of failure that resembles soft copper. Failure is by ductile distortion and tearing and is localized in nature, which minimizes the loss of the pipe contents.

In contrast, the failure of rigid materials (PVC, CPVC, etc.) is accompanied by rapid crack propagation and hazardous material fragmentation.

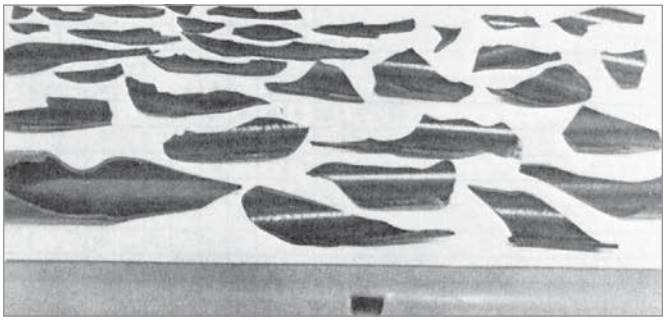
Depending on the conditions involved, this rapid fragmentation type of failure can rip through many lengths of pipe, including valves and fittings. This mode of failure can be accentuated by adverse conditions such as water hammer, prolonged exposure to sunlight, cold contents or cold ambient temperatures and non-compatibility of the pipe with its contents (eg. compressed air, gases or unsuitable chemicals).



The graph shows the relatively small reduction in impact strength between ABS at 73°F and 32°F using PVC as a reference point.

Chemical Resistance

Chemical Group	Relative Strength	Resistance
Acids	Weak Medium Strong	Good Good Limited
Alkalis	Weak Medium	Good Good
Solvents	Strong Organic	Fair No



Localized ductile failure of Duraplus pipe sample in foreground, compared with explosive, failure of PVC pipe. (Both samples charged to 80 psi)

SECTION THREE: DESIGN DATA

System Sizes and Pressure Ratings

The Duraplus Industrial System is manufactured in IPS sizes from 1/2" through 8" and has the same outside diameters as standard Schedule pipes. There are several different pressure ratings available from 145 psi to 230 psi.

Diameter	Class C 145	Class E 230	Class T*
1/2		● ■	●
3/4		● ■	●
1	●	● ■	●
1-1/4	●	● ■	●
1-1/2	●	● ■	●
2	●	● ■	●
3	●	● ■	
4	●	● ■	
6	●		
8	● ■		

Key:

- ● Pipe sizes available.
- ■ Fitting sizes available.
- * Class T pipe has a thick wall to allow for threading. After threading, Class T pipe and matching fittings must not be used in excess of 180 psi at 73°F.
- * Pipe Class is equal to the pressure rating of the product to 73°F.
- * Fabricated Wyes (3" to 8") are not pressure rated.

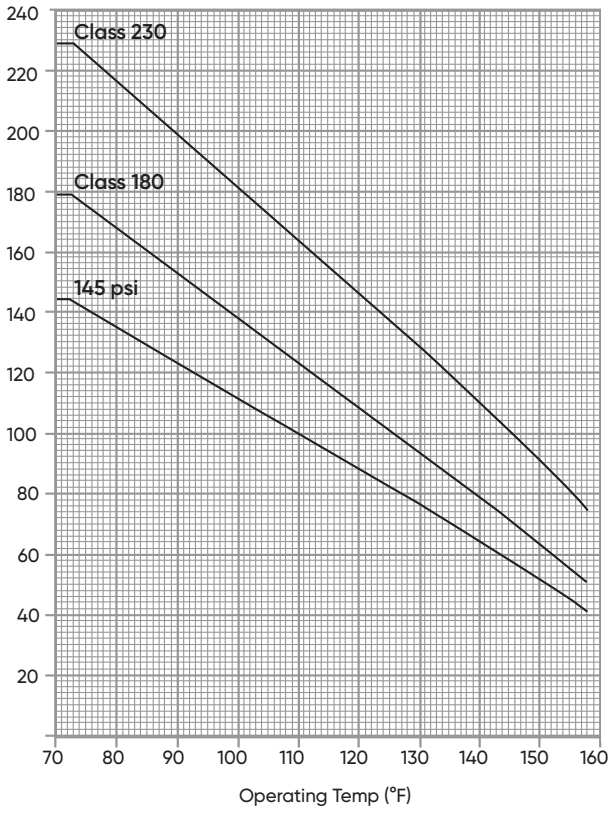
Pressure/Temperature Relationship

All thermoplastics show a reduction in tensile strength with an increase in temperature. Therefore, there is a corresponding reduction in the maximum continuous pressure rating of the piping system at elevated temperatures.

The graphs indicate the allowable continuous working pressure of each class of pipe based on an extrapolated 50 year life.

Note:

1. Graphs are based on an ambient temperature of 73°F.
2. For higher ambient temperatures, decrease the calculated working pressure by 5% for every 20°F above 73°F ambient.
3. The Duraplus Industrial System should not be used at temperatures in excess of 140°F.
4. In circumstances where the anticipated pressure could exceed the maximum rating of the pipe obtained from the graphs, it may still be possible to use the pipe – but with a reduced life expectancy. Please contact IPEX with specific details.
5. For temperatures below ambient to a minimum of -40°F, the working pressure remains constant. However, impact resistance will be reduced.



GENERAL PRINCIPLES OF DESIGN AND SUPPORT

Thermoplastics have very different mechanical and physical properties compared to metals. Special attention should be given to ways of dealing with their inherent higher thermal expansion rates and lower pipe stiffness.

If the principles used for design and support of metal pipe systems are applied directly to thermoplastic pipes, severe problems may arise. Therefore, all warranties are contingent upon adopting the following support procedures and recommendations.

Supporting Pipes

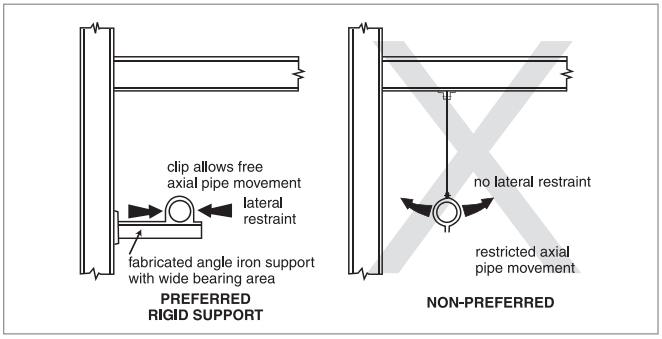
The high coefficient of thermal expansion of plastic compared with metals may result in considerable expansion and contraction of the pipe runs as the temperature changes.

The principle is to control expansion by restraining the pipe in the lateral direction while allowing free axial movement.

A hanger-type support does not provide lateral restraint to the pipe, but it does encourage snaking and should be avoided whenever possible.

The diagram below illustrates preferred and non-preferred support arrangements.

In some cases, it may be physically impossible or impractical to install a rigid support in-between two widely spaced columns. In this event hanger rods with loose fitting clips should be used.



The frequency of supports for plastic pipes is greater than for metal pipes. The recommended maximum distance between supports for pipes filled with water is given in the table and applies to pipes and contents at the temperature stated. This table is based on the thinnest wall pipe in each size.

Pipe Class	Correction Factor
230 psi	1.18

Support Centers

Size Diameter (in)	Support Distance (ft.)		
	73°F (23°C)	122°F (50°C)	158°F (70°C)
1/2	3.0	2.3	1.5
3/4	3.3	2.6	2.0
1	3.3	2.8	2.3
1-1/4	3.8	3.0	2.3
1-1/2	4.0	3.3	2.5
2	4.5	3.5	2.5
3	5.5	4.5	3.0
4	6.3	5.0	3.3
6	7.0	6.0	3.5
8	7.9	6.5	4.0

For thicker pipes the distances may be increased by using the correction factors shown below.

Note: Support spacing for applications below 73°F may use the same spacing as 73°F.

Note: Always check with the local code or authority having jurisdiction for specific support requirements. Horizontal support distance for pipe based on water at 73°F.

Note: When the fluid has a specific gravity greater than water (1.0) the hanging distance must be decreased by dividing the recommended support distance by the fluid's specific gravity.

Pipe Clips

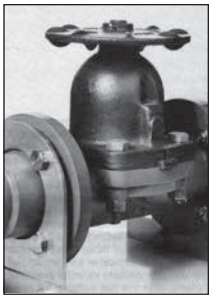
All pipe clips should permit free axial pipe movement at all temperatures and should provide adequate bearing support to the pipe.

Metal clips and supports should be free of sharp edges to prevent damaging the pipe.

It is important that the composition of pipe clips and their linings do not include substances which might have a detrimental effect upon the ABS pipe. Please check for suitability before use. We strongly recommend the use of Durapipe Cobra clips wherever circumstances allow.

Supporting Valves

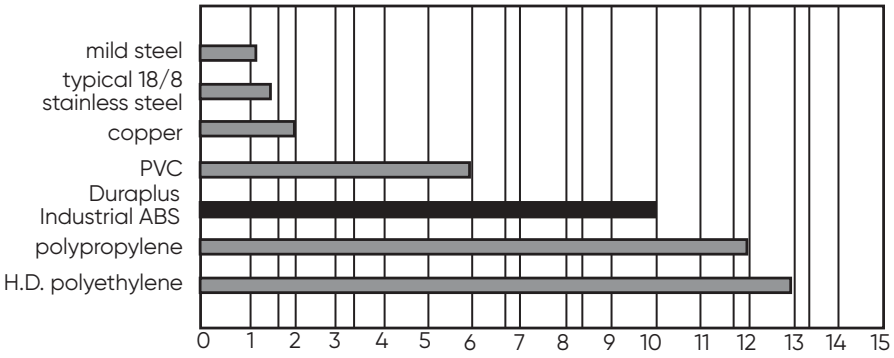
Heavy valves or meters should always be supported independently to prevent distorting the system. Valve support plates are readily available for this purpose. They provide a neat and economical solution (see photograph).



All steel brackets used for valve support that come in contact with the plastic system should be free of sharp edges to avoid damaging the piping system.

EXPANSION AND CONTRACTION

As illustrated in the chart, thermoplastics expand and contract much more than metals do; however, plastics exhibit lower thermal conductivity rates. So, in practice, unless a plastic pipe is immersed at the same temperature, both inside and out, the entire pipe wall will not reach the same temperature as its contents. This means expansion occurs less often than expected because the mean pipe wall temperature is lower than the temperature of its contents.



Coefficient of Expansion inch/inch/°C temperature change

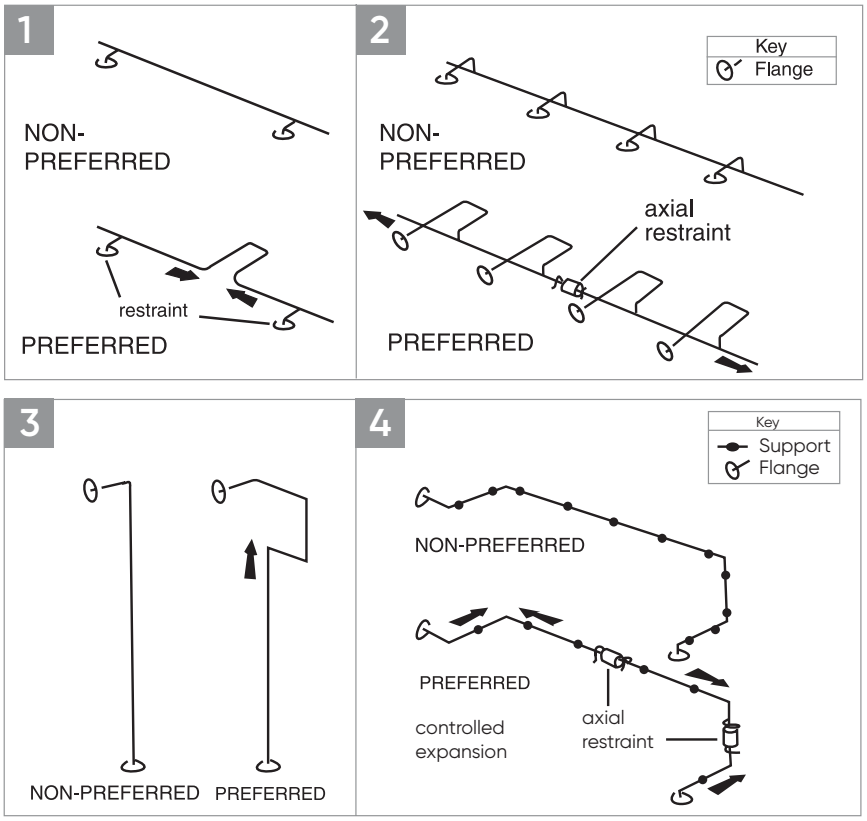
Expansion Loops

Above-ground systems should be designed to include the maximum practical number of changes in direction with anchors at intermediate points. The support method described previously will ensure that any movement is directed into those areas of flexibility, as shown in the illustrations.

If changes in direction cannot conveniently be introduced, flexibility can be achieved by means of loops or proprietary expansion units.

The correct methods shown in Diagrams 1, 2, and 3 introduce flexibility to accommodate expansion which occurs in the direction of the arrows.

The pipe shown in diagram 4 has the required flexibility but expansion is constrained by supports fitted too close to the bends. Movement can be controlled by adding restraints and flexing the bends allowed by moving the supports.



All piping products expand and contract with changes in temperature. Linear expansion and contraction of any given length of pipe on the longitudinal axis relates to the coefficient of thermal expansion for the specific material used and the variation in temperature ΔT. It should be noted that change in pipe diameter or wall thickness with piping material properties remaining constant does not effect a change in rates of thermal expansion or contraction.

Approximate coefficiency of thermal expansion for Duraplus ABS is shown below.

Duraplus Material	"e" Coefficient in/in/°F	"y" Constant in/100ft/10°F
ABS	5.6×10^{-5}	0.67

The following formula can be used to calculate expansion and contraction of duraplus piping systems.

$$\Delta L = y \times \frac{\Delta T}{10} \times \frac{L}{100}$$

where:

ΔL = expansion in inches

y = constant factor expressing inches of expansion per 10°F temperature change per 100 ft. of pipe

L = length of pipe run in feet

ΔT = change in average temperature of pipe wall °F

Symbol	Item
ΔT_L	Maximum temperature change in pipe contents, °F
ΔT_A	Maximum temperature change of external air, °F

To calculate pipe wall temperature change, use the equation $\Delta T = 0.65\,\Delta TL + 0.10\,\Delta TA$

If insufficient data is available to calculate the actual pipe wall temperature change, use min. and max. ambient temperature values to determine ΔT (max ambient temp – min ambient temp).

Example A

How much expansion can be expected in a straight 3 inch ABS pipe with a leg length of 60 feet: (water flows through the pipe at temperatures varying from 68°F to 104°F and the external air temperature varies between 40°F and 77°F)?

1. To calculate mid pipe wall temperature change (DT)

   Use the equation:
   $\Delta T = 0.65\Delta TL+0.10\Delta TA$

   therefore
   $\Delta T = 0.65x(104-68)+0.10x(77-40)$

i.e. $\Delta T = 0.65x36+0.10x37=27.1°F$

NOTE: The common error when calculating ΔT is to use extremes of temperature, in this case 40°F for air and 104° for contents. 95°F would then be used for ΔT in the next calculation instead of the correct 27°F.

2. Use the equation:

   $$\Delta L = y \times \frac{\Delta T}{10} \times \frac{L}{100}$$

   therefore
   $$\Delta L = 0.67 \times \frac{36}{10} \times \frac{60}{100} = 0.67 \times 2.7 \times 0.6$$

   $\Delta L = 1.08$ inches

Example B (only ambient data is available)

1. To calculate ΔT
   Max ambient temp = 104°F, Min ambient temp = 68°F

   therefore
   $\Delta T = 104 - 68 = 36$

2. Use the equation:
   $$\Delta L = y \times \frac{\Delta T}{10} \times \frac{L}{100}$$

   therefore
   $$\Delta L = 0.67 \times \frac{36}{10} \times \frac{60}{100}$$

   $\Delta L = 0.67 \times 3.6 \times 0.6 = 1.44$ inch

ΔL change in Pipe Length (in)

ΔT	10	20	30	40	50	60	70	80	90	100
20	0.13	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.17	1.30
30	0.20	0.40	0.60	0.80	1.00	1.20	1.40	1.60	1.80	2.00
40	0.27	0.54	0.81	1.08	1.35	1.62	1.89	2.16	2.43	2.70
50	0.34	0.68	1.02	1.36	1.70	2.04	2.83	2.72	3.06	3.40
60	0.40	0.80	1.20	1.60	2.00	2.40	2.80	3.20	3.60	4.00
70	0.47	0.94	1.41	1.88	2.35	2.82	3.29	3.76	4.23	4.70
80	0.54	1.08	1.62	2.16	2.70	3.24	2.78	4.32	4.86	5.40
90	0.60	1.20	1.80	2.40	3.00	3.60	4.20	4.80	5.40	6.00
100	0.67	1.34	2.01	2.68	3.35	4.02	4.67	5.36	6.03	6.70

When total temperature change is less than 30°F, special provisions for accommodating thermal expansion are not generally required,especially when the line includes several directional changes and thus provides considerable inherent flexibility. Caution should be exercised with threaded connections, as they are more vulnerable to failure by bending stresses. Where such conditions exist, it is advisable to use a flanged connection.

However, when this is not the case or when there is reasonable doubt as to adequate flexibility of the system or in straight pipe lines longer than 650 feet expansion, loops or units must be used if the expansion rate exceeds 1 in 2,500.

If an expansion loop (fabricated with 90° elbows and straight pipe as depicted) is used, the length R should be determined by using the following formula to ensure it is of sufficient length to absorb expansion and contraction movement without damage.

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

where:

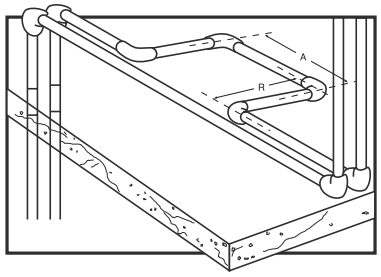
R = Expansion loop leg length (ft.)
D = Nominal outside diameter of pipe (in.)
ΔL = Dimensional change due to thermal expansion or contraction (in.)

For 3" ABS pipe, ΔT = 70°F, run = 100', ΔL = 4.7

How long should the expansion loop legs be in order to compensate for the expansion?

$R = 1.44\sqrt{3.50 \times 4.7} = 1.44\sqrt{16.45} = 5.84$ ft.

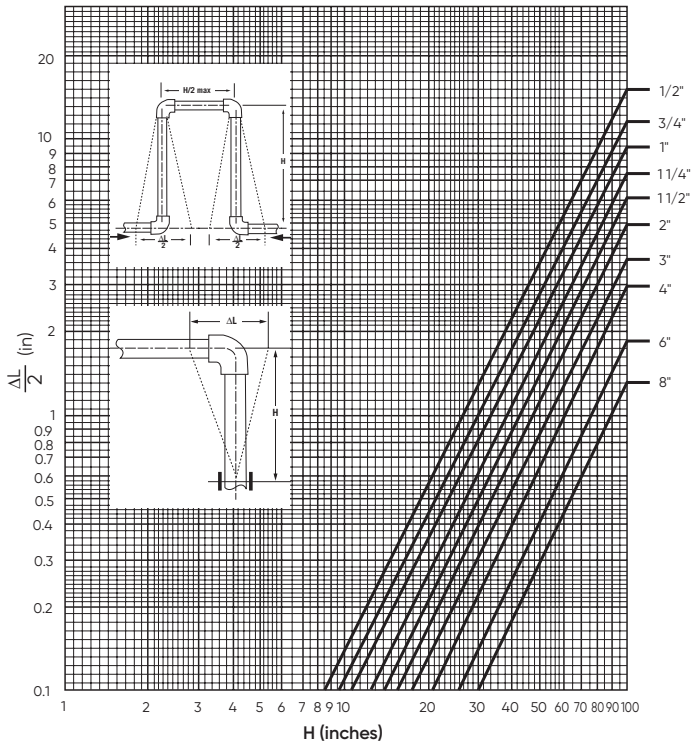
In situations where straight runs of pipe are long or the ends of a straight run are restricted from movement or where the system is restrained, flexibility must be inserted into a pipe system through the introduction of flexural offsets. An example of a method for inserting flexibility in these situations is graphically presented. In each case, rigid supports or restraints should not be placed within the leg length of an expansion loop, offset or bend.



NOTE: A = 1/2 R

It is also possible to determine the correct size of an expansion loop using the following graph:

ABS — EXPANSION LOOPS



To calculate loop size

Using the value of ΔL/2 draw a horizontal line on the graph from expansion scale to meet the 3 inch pipe gradient line. Drop a perpendicular from the intersection point to the loop offset scale. The figure obtained (38 inch) is the length of loop offset required.

The distance between loop legs should not exceed H/2, i.e. in this case 19 in.

PIPE SIZING

The processes used to manufacture thermoplastic pipes and fittings result in products with very smooth internal surfaces.

This means lower frictional resistance to flow than found in most other pipe systems, which in turn either reduces pumping costs or permits the use of smaller piping.

The smooth interior of thermoplastic pipe also permits higher velocities of flow than is normally acceptable for other material pipe systems.

Velocities up to 12ft./sec. can be achieved with acceptable pressure loss.

Please note at high velocity, proper design must account for potentially damaging waterhammer issues.

Friction Loss Through Piping

As fluid flows through a piping system, it will experience friction resistance between the fluid and the pipe wall resulting in a pressure loss. This pressure loss is a result of fluid:

- Density
- Viscosity
- Velocity
- Temperature
- Type of Flow
- Smoothness of the Pipe Wall

Friction loss can be determined by referring to published tables, (on pages 16 -19) or it can be calculated. The most widely used equation to calculate friction loss in pressure systems is the Hazen-Williams equation.

Hazen-Williams Equation

$$f = 0.2083 \times \left(\frac{100}{C}\right)^{1.852} \times \frac{Q^{1.852}}{D_i^{4.8666}}$$

where:

f = friction loss (ft. of H2O/100 ft.)

Q = flow rate (gpm)

D_i = pipe inside diameter (in.)

C = flow coefficient

Flow Coefficient Constants (C)

Type of Pipe	Flow coefficient C
ABS	150
Copper	140
Cast Iron – Unlined	90 – 120
Galvanized Steel	110
Corrugated Steel Pipe	60

Example

An ABS system has a flow rate of 400 U.S. gallons per minute. What is the friction loss in 6" Class 145 pipe?

Known:

Q = 400 US gpm

$$f = 0.2083 \times \left(\frac{100}{150}\right)^{1.852} \times \frac{(400)^{1.852}}{(5.805)^{4.8666}}$$

C = 150 (from the above Flow Coefficient Constants Table)

D_i = 5.805" (from Section Six: Dimensional Data)

f = 0.2083 x 0.472 x 12.644

f = 1.243 ft. per 100 ft.

Note: Conversion tip (1 psi = 2.31 ft of H_2O)

HEAD LOSS IN PIPE CONVEYING HIGH VISCOSITY LIQUIDS

In applications where fluid viscosity is high, frictional head loss in piping systems becomes a concern. One such application is the use of glycol solutions. To calculate the pressure loss in Duraplus ABS piping conveying high viscosity fluids, the Darcy Weisbach equation is used.

$$h = 2fV^2/gdi$$

Where
h = hydraulic loss (ft/ft)
f = friction factor
V = flow velocity (ft/s)
g = gravity (ft/s^2)
d*i* = pipe inside diameter (ft)

To calculate the friction factor you must first find the Reynolds number:

$$Re = Vdi/\nu$$

Where
Re = Reynolds number
ν = Kinematic viscosity (ft^2/s)

The friction factor can then be found using:

$$f = 0.079/Re^{0.25}$$

Example

An ABS system has a flow rate of 95 U.S. gallons per minute of 30% propylene glycol solution operating at 23F. What is the friction loss in 3" class 230 pipe?

Known:
Q = 95 US GPM
V = 5.08 ft/s (from Friction Loss Table on pg 16)
g = 32.2ft/s^2
d*i* = 2.838 in (from Section Six: Dimensional Data)
ν = 1.04e^{-4} ft^2/s (provided by glycol manufacturer)

The Reynolds number must first be calculated to find the friction factor:

$$Re = Vdi / \nu$$

$$= \frac{5.08 \times \left(\frac{2.838}{12}\right)}{1.04e^{-4}}$$

$$= 11552$$

Now the friction factor can be calculated:

$$f = 0.079 / (11552)^{0.25}$$

$$= 7.62e^{-3}$$

Finally the frictional loss can be calculated:

$$h = \frac{2 \times (7.62e^{-3}) \times (5.08^2)}{32.2 \times \left(\frac{2.838}{12}\right)}$$

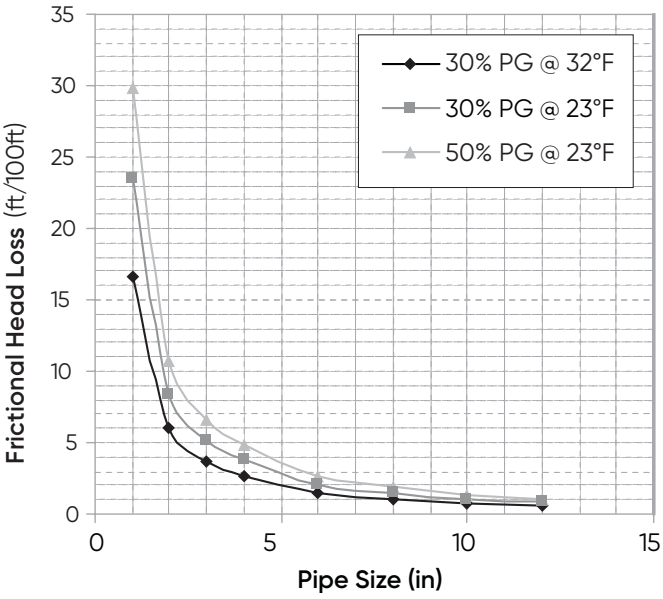
= 0.3933 / 7.6153
= 0.05 ft/ft × 100
= 5 ft / 100ft

The following graph looks at three scenarios, all of which are running at 5ft/s flow velocity inside of Duraplus ABS Industrial pipe.

1. 30% Propylene glycol solution at 32°F
2. 30% Propylene glycol solution at 23°F
3. 50% Propylene glycol solution at 23°F

If specific frictional data is needed that is not provided please contact IPEX Industrial technical customer service for assistance.

Frictional Head Loss for Propylene Glycol Solution at 5ft/s in ABS



NOTE:
As temperature is decreased or glycol concentration is increased viscosity also increases. This in turn increases frictional head loss through a piping system. A good operating rule, therefore, is to concentrate the mixture no more than is necessary to prevent freezing.

HEAD LOSS IN FITTINGS – EQUIVALENT PIPE LENGTH

Flow Formula for Fittings

Pressure head loss through fittings is calculated by equating each fitting to a length of straight pipe using the flow formula **L = k x d**, where:

Symbol	Item	Unit
L	Equivalent Pipe Length	ft.
d	Mean Pipe Inside Diameter	in.
k	Fitting Constant	See Chart Below

Fitting	k, Constant
bend 90°	0.9
elbow 90°	2.5
elbow 45°	1.2
tee, in-line flow	0.9
tee, line-to-branch flow	0.9

Head Loss in Fittings

Pipe Size (in.)	Equivalent Pipe Length – FT.				
	Bend 90°	Elbow 90°	Elbow 45°	Tee, in line	Tee, branch
1/2	0.61	1.70	0.82	0.61	3.40
3/4	0.77	2.13	1.02	0.77	4.26
1	0.96	2.68	1.29	0.96	5.36
1-1/4	1.22	3.38	1.62	1.22	6.76
1-1/2	1.39	3.85	1.85	1.39	7.70
2	1.74	4.84	2.32	1.74	9.68
3	2.56	7.12	3.42	2.56	14.24
4	3.30	9.17	4.40	3.30	18.34
6	5.06	14.07	6.75	5.06	28.14
8	6.86	19.07	9.15	6.86	38.14

* These equivalent lengths of pipe are based on the highest pressure class of pipe in each case.

Head Loss in Valves

Size of Valve (in)	Equivalent Pipe Length – FT.		
	Size of Valve (mm)	Cv Ball Check Valve	Cv Diaphragm Valve
1/2	20	3.2	1.2
3/4	25	5.9	2.3
1	32	8.2	3.5
1-1/4	40	12.6	5.3
1-1/2	50	17.6	8.5
2	63	36.7	15.5
3	90	122.3	36.1

PRESSURE DROP ACROSS VALVES

True Union Ball Valves

In the fully open position, single and double union ball valves can be assumed to be equivalent to a section of pipe of the same diameter and length as the valve.

Diaphragm and Ball Check Valves

$$\delta p = \frac{1.09\ Q^2 \times S.G.}{Cv^2}$$

Where:

δp = pressure drop across valves (psi)
Q = flow rate (gal/min)
S.G. = specific gravity of fluid
Cv = value constant (given in table on Head Loss in Valves, (pg 14)

Frictional Loss Class 230

GPM	cu ft/sec	3" Velocity (ft/s)	3" Friction Head (ft H20/100 ft)	3" Friction Loss (psi/100 ft)	1/2" Velocity (ft/s)	1/2" Friction Head (ft H20/100 ft)	1/2" Friction Loss (psi/100 ft)	3/4" Velocity (ft/s)	3/4" Friction Head (ft H20/100 ft)	3/4" Friction Loss (psi/100 ft)	1" Velocity (ft/s)	1" Friction Head (ft H20/100 ft)	1" Friction Loss (psi/100 ft)	1 1/4" Velocity (ft/s)	1 1/4" Friction Head (ft H20/100 ft)	1 1/4" Friction Loss (psi/100 ft)	1 1/2" Velocity (ft/s)	1 1/2" Friction Head (ft H20/100 ft)	1 1/2" Friction Loss (psi/100 ft)	2" Velocity (ft/s)	2" Friction Head (ft H20/100 ft)	2" Friction Loss (psi/100 ft)
1	0.002				0.99	0.84	0.36															
2	0.004				1.97	3.02	1.31	1.20	0.89	0.39												
5	0.011				4.93	16.48	7.13	2.99	4.88	2.11	1.90	1.62	0.70	1.19	0.52	0.23						
7	0.016				6.90	30.73	13.30	4.18	9.10	3.94	2.66	3.01	1.30	1.67	0.97	0.42	1.28	0.51	0.22			
10	0.022				9.85	59.49	25.75	5.98	17.62	7.63	3.79	5.83	2.52	2.38	1.88	0.81	1.82	0.98	0.43	1.16	0.33	0.14
12	0.027				11.83	83.38	36.10	7.17	24.69	10.69	4.55	8.17	3.54	2.86	2.63	1.14	2.19	1.38	0.60	1.40	0.46	0.20
15	0.033							8.96	37.33	16.16	5.69	12.36	5.35	3.57	3.98	1.72	2.74	2.08	0.90	1.75	0.70	0.30
20	0.045										7.59	21.05	9.11	4.76	6.78	2.94	3.65	3.54	1.53	2.33	1.19	0.51
25	0.056	1.34	0.27	0.12							9.48	31.82	13.78	5.95	10.26	4.44	4.56	5.36	2.32	2.91	1.80	0.78
30	0.067	1.60	0.38	0.16										7.14	14.38	6.22	5.47	7.51	3.25	3.49	2.52	1.09
35	0.078	1.87	0.51	0.22										8.34	19.12	8.28	6.38	9.99	4.33	4.07	3.35	1.45
40	0.089	2.14	0.65	0.28										9.53	24.49	10.60	7.29	12.79	5.54	4.66	4.29	1.86
45	0.100	2.41	0.81	0.35	1.46	0.24	0.10							10.72	30.46	13.19	8.21	15.91	6.89	5.24	5.34	2.31
50	0.111	2.67	0.98	0.42	1.62	0.29	0.12										9.12	19.34	8.37	5.82	6.48	2.81
55	0.123	2.94	1.17	0.51	1.78	0.34	0.15										10.03	23.08	9.99	6.40	7.74	3.35
60	0.134	3.21	1.37	0.59	1.94	0.40	0.17													6.98	9.09	3.93
65	0.145	3.48	1.59	0.69	2.10	0.47	0.20													7.56	10.54	4.56
70	0.156	3.74	1.83	0.79	2.27	0.54	0.23													8.15	12.09	5.23
75	0.167	4.01	2.07	0.90	2.43	0.61	0.26													8.73	13.74	5.95
80	0.178	4.28	2.34	1.01	2.59	0.69	0.30													9.31	15.49	6.70
85	0.189	4.55	2.62	1.13	2.75	0.77	0.33													9.89	17.33	7.50
90	0.201	4.81	2.91	1.26	2.91	0.86	0.37													10.47	19.26	8.34
95	0.212	5.08	3.21	1.39	3.07	0.95	0.41													11.06	21.29	9.22
100	0.223	5.35	3.53	1.53	3.24	1.04	0.45															
125	0.279	6.69	5.34	2.31	4.04	1.57	0.68															
150	0.334	8.02	7.49	3.24	4.85	2.20	0.95															
175	0.390	9.36	9.96	4.31	5.66	2.93	1.27															
200	0.446				6.47	3.75	1.63															
250	0.557				8.09	5.68	2.46															
300	0.668				9.71	7.96	3.44															
350	0.780																					
400	0.891																					
450	1.003																					
500	1.114																					
600	1.337																					
700	1.560																					
800	1.782																					
900	2.005																					
1000	2.228																					

Frictional Loss Class 145

GPM	cu ft/se	1" Velocity (ft/s)	1" Friction Head (ft H20/100 ft)	1" Friction Loss (psi/100 ft)	1 1/2" Velocity (ft/s)	1 1/2" Friction Head (ft H20/100 ft)	1 1/2" Friction Loss (psi/100 ft)	2" Velocity (ft/s)	2" Friction Head (ft H20/100 ft)	2" Friction Loss (psi/100 ft)	3" Velocity (ft/s)	3" Friction Head (ft H20/100 ft)	3" Friction Loss (psi/100 ft)	4" Velocity (ft/s)	4" Friction Head (ft H20/100 ft)	4" Friction Loss (psi/100 ft)	6" Velocity (ft/s)	6" Friction Head (ft H20/100 ft)	6" Friction Loss (psi/100 ft)	8" Velocity (ft/s)	8" Friction Head (ft H20/100 ft)	8" Friction Loss (psi/100 ft)
1	0.002																					
2	0.004																					
5	0.011	1.59	1.05	0.45																		
7	0.016	2.22	1.96	0.85	1.01	0.29	0.12															
10	0.022	3.18	3.79	1.64	1.44	0.56	0.24	0.98	0.21	0.09												
12	0.027	3.81	5.31	2.30	1.73	0.78	0.34	1.17	0.30	0.13												
15	0.033	4.77	8.03	3.48	2.16	1.18	0.51	1.46	0.45	0.20												
20	0.045	6.36	13.69	5.93	2.89	2.00	0.87	1.95	0.78	0.34	0.90	0.12	0.05									
25	0.056	7.95	20.69	8.96	3.61	3.03	1.31	2.44	1.17	0.51	1.12	0.18	0.08									
30	0.067	9.53	29.01	12.56	4.33	4.25	1.84	2.93	1.64	0.71	1.35	0.25	0.11									
35	0.078				5.05	5.65	2.45	3.42	2.19	0.95	1.57	0.33	0.14									
40	0.089				5.77	7.24	3.13	3.91	2.80	1.21	1.80	0.42	0.18	1.09	0.12	0.05						
45	0.100				6.49	9.00	3.90	4.39	3.48	1.51	2.02	0.53	0.23	1.22	0.15	0.07						
50	0.111				7.21	10.94	4.74	4.88	4.23	1.83	2.25	0.64	0.28	1.36	0.19	0.08						
55	0.123				7.94	13.05	5.65	5.37	5.05	2.18	2.47	0.76	0.33	1.49	0.22	0.10						
60	0.134				8.66	15.34	6.64	5.86	5.93	2.57	2.70	0.90	0.39	1.63	0.26	0.11						
65	0.145				9.38	17.79	7.70	6.35	6.88	2.98	2.92	1.04	0.45	1.76	0.31	0.13						
70	0.156				10.10	20.40	8.83	6.83	7.89	3.41	3.15	1.19	0.52	1.90	0.35	0.15						
75	0.167							7.32	8.96	3.88	3.37	1.36	0.59	2.04	0.40	0.17						
80	0.178							7.81	10.10	4.37	3.59	1.53	0.66	2.17	0.45	0.19						
90	0.201							8.79	12.56	5.44	4.04	1.90	0.82	2.44	0.56	0.24	1.13	0.09	0.04			
100	0.223							9.76	15.27	6.61	4.49	2.31	1.00	2.71	0.68	0.29	1.25	0.10	0.04			
125	0.279										5.62	3.49	1.51	3.39	1.03	0.44	1.57	0.16	0.07			
150	0.334										6.74	4.90	2.12	4.07	1.44	0.62	1.88	0.22	0.09			
175	0.390										7.86	6.52	2.82	4.75	1.91	0.83	2.19	0.29	0.13			
200	0.446										8.99	8.34	3.61	5.43	2.45	1.06	2.51	0.37	0.16	1.48	0.10	0.04
250	0.557													6.79	3.70	1.60	3.13	0.56	0.24	1.84	0.16	0.07
300	0.668													8.14	5.19	2.25	3.76	0.79	0.34	2.21	0.22	0.09
350	0.780													9.50	6.91	2.99	4.38	1.05	0.46	2.58	0.29	0.13
400	0.891													10.86	8.84	3.83	5.01	1.35	0.58	2.95	0.37	0.16
450	1.003																5.64	1.68	0.73	3.32	0.46	0.20
500	1.114																6.26	2.04	0.88	3.69	0.56	0.24
600	1.337																7.52	2.85	1.24	4.43	0.79	0.34
700	1.560																8.77	3.80	1.64	5.17	1.05	0.45
800	1.782																10.02	4.86	2.11	5.90	1.34	0.58
900	2.005																			6.64	1.67	0.72
1000	2.228																			7.38	2.03	0.88
1250	2.785																			9.22	3.07	1.33
1500	3.342																					
2000	4.456																					

NOTES

WARNING

IPEX cannot accept responsibility for accidents arising from the misuse of its products due to poor system design, installation, or incorrect application.

Unless the procedures and recommendations set out in this manual have been strictly followed, all warranties are null and void.

Solvent Cement Welding

Duraplus™ ABS solvent cement is specially formulated to withstand the same working conditions as the rest of the Duraplus Industrial components.

The cement operates by chemically attacking the outside of the pipe and the inside of the fittings and therefore the efficiency is greatly reduced if these surfaces are not absolutely clean and properly prepared.

NOTE: All warranties are contingent upon the use of the correct Duraplus™ ABS Industrial Cleaner and Solvent Cement.

IPEX takes no responsibility for any Duraplus System constructed with other primers or solvent cements, or not fabricated with the instructions contained herein.

Precautions

- Do not thin solvent cement with cleaner.

  NOTE: Solvent cement and cleaners contains toxic and flammable solvents. Suitable precautions must be taken to safeguard the health of the installers.
- Do not join near open flames and avoid smoking in the working area – all cements and cleaners are flammable.
- Do not use cements or cleaners in confined spaces – under these conditions, solvents may have a narcotic effect.
- Special care should be taken if solvent cementing is done in the rain or in wet conditions.
- Always use clean applicators and do not use the same applicator for different types of cement.
- Always use a clean rag and applicator with the IPEX supplied cleaner and solvent cement.
- Make sure cement cans are closed after use – solvents evaporate and the cement efficiency may be impaired if the container is left open.
- IPEX does not recommend the solvent cement joining of the Duraplus Industrial system to PVC. If necessary, this transition is best accomplished through the use of flanges.

Joining Pipe & Fittings

1

Before beginning, assemble proper materials for the job (IPEX MEK cleaner, Duraplus Industrial ABS cement, and applicator for the size of pipe and fittings to be assembled).

Assemble proper Personal Protective Equipment (PPE) for the job (Respirator, safety glasses, gloves and protective clothing).

2

To make sure that the pipe is cut as square as possible. Use a miter box saw, a power saw with a blade designed to cut plastic or a pipe tube cutter. The blade must be kept sharp. Use a square on the cut end of the pipe to make sure it has been cut squarely. If plastic tubing cutters are used any, raised bead at the end of the pipe must be removed with a file or deburring tool. If not removed it may scrape the cement away during pipe insertion into the fitting during the solvent cementing process.

3

Use a knife, plastic pipe deburring tool, or file to remove burrs from the end of small diameter pipe. Be sure to remove all burrs from around the inside as well as the outside of the pipe. A slight chamfer (bevel) of about 15° should be added to the end to permit easier insertion of the pipe into the fitting. Failure to chamfer the edge of the pipe may remove cement from the fitting socket, causing the joint to leak. For systems of 2" and above, the pipe must be end-treated with a 15° chamfer cut to a depth of approximately 3/32" (2.5mm). If burrs are not removed, they can scrape channels into surface of the fitting socket during solvent welding.

4

Remove all dirt, grease and moisture. A thorough wipe with a clean dry rag is usually sufficient. (Moisture will retard cure of the solvent cement; dirt or grease can also prevent adhesion).

5

Before solvent welding make sure there is an interference fit between the pipe and fitting socket. Pipe should be able to be inserted 1/3 to 2/3 the way into the socket before an interference fit is encountered.

If the pipe goes all the way into the socket do not use. Set aside and use another fitting. Contact your pipe and fitting supplier for replacement.

6

Measure the fitting socket depth.

This distance will then be used to draw a line on the OD of the pipe.

Mark this distance (fitting socket depth) on the pipe OD, **1ST Mark**.

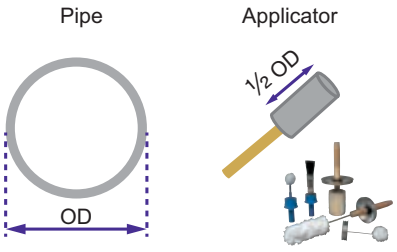
Cleaner and solvent cement will eventually cover the end of the pipe up to this line.

Make a **2nd Mark** on the pipe OD. The distance, from the second mark to the 1st Mark should be the same as the fitting socket depth.

This is used to check that the pipe is bottomed out (properly inserted) in the fitting socket after solvent welding.

7

It is critical that the right size applicator be used on the pipe and fitting being solvent welded. The applicator should be 1/2 the size of the pipe diameter (for example; use a 2" applicator on a 4" pipe). The right size applicator will ensure that sufficient quantity of cement is applied to the pipe and fitting socket.



8

Using a clean dry rag, or applicator to apply the cleaner into fitting socket, keeping the surface and applicator wet until the surface has been cleaned. When the surface is cleaned, quickly remove any puddles of cleaner from the socket.

9

Next, apply the cleaner to the end of the pipe. Cleaner should be applied approximately 1/2" beyond the **1st mark** (1/2" beyond the depth of the fitting socket).

10

Using right size of applicator, and while surfaces are still wet, apply the Duraplus industrial ABS solvent cement on the outside of the pipe.

NOTE: Do not add primers, cleaners or other thinners into the tin of solvent cement.

11

Without delay apply **a full, even layer of solvent cement** to the pipe-end equal to the depth of the fitting socket (**1st mark**) – do not brush it out to a thin paint type layer, as this will dry too quickly.

12

Immediately apply a **medium even layer of solvent cement** into the fitting socket; aggressively work the solvent cement into the socket wall without allowing the cement in the socket to puddle.

13

Immediately, apply a second, **full even layer of solvent cement** on the pipe wall.

NOTE: The majority of joint failures are a result of improper or insufficient application of solvent cement.

14

Without delay, while cement is still wet, insert the pipe into the fitting socket. While inserting the pipe in the fitting socket, twist the pipe 1/8 to 1/4 turn until reaching socket bottom.

NOTE: If cement coatings have hardened, cut off pipe end and dispose of fitting and start over. Do not attempt to assemble pipe or fittings with partially cured surfaces.

Do not continue to rotate after the pipe has reached the socket bottom.

Securely hold the pipe and fitting assembly together, for a minimum of 30 seconds to eliminate push-out or movement.

NOTE: After assembly, a joint should have a clean ring or bead of cement completely around the mouth of the fitting socket. Note, if voids (gaps) in this ring are present, sufficient cement was not applied which can be an indicator of a weak joint.

15

Remove excess cement from the pipe and fitting. This can be done using a clean dry rag. Pay special attention to the ring or bead of solvent cement around the socket entrance, as it will needlessly soften the pipe and fitting, and does not add to joint strength. Excess cement around the socket entrance will also unnecessarily extend the cure time of the solvent cement. Avoid disturbing or moving the joint.

16

Measure the distance from the **2nd mark** on the pipe to the mouth of the socket. If the pipe has been fully inserted into the socket, the distance should equal the socket depth previously measured.

17

Exercise care when handling newly assembled joints until initial set has taken place. Strictly follow set and cure times before handling or hydro-testing the piping system (for joint and cure times refer to page 29).

Recommended Procedure for Joining Large Diameter Pipe & Fittings (6" diameter and larger)

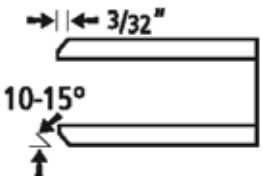
As pipe diameter increases, so does the difficulty in installing it. Using the Solvent Welding instructions listed previously along with the following additional recommendations, the professional installer should be able to successfully assemble large diameter pipe and fittings.

1

Using the correct size applicator is extremely important to ensure enough cement is applied to fill the larger gap that exists between the pipe and fittings. For example, a 3" applictor is required for 6" joint.

2

End of pipe must be cut square and chamfered (beveled).



Courtesy of IPS Corporation

3

Increase size of joining crew:

- 6" – 8": 2-3 people per joint

It is important in large diameter joining that the cement be applied simultaneously to the pipe and fittings.

4

Make sure to apply a second, full even layer of solvent cement to the pipe.

5

IT IS VERY IMPORTANT TO HAVE PIPE FULLY INSERTED INTO THE FITTING SOCKET (BOTTOMED OUT).

Large diameter pipe is heavy and can develop significant resistance during insertion into the fitting socket, before reaching socket bottom. It is for this reason that we recommend above 4" diameter the use of a pipe-puller such as the one pictured. (Available at IPS® Corporation).

Courtesy of IPS Corporation

6

Large diameter pipe and fittings require longer set and cure times.
(In cold weather, a heat blanket may be used to speed up the recommended set and cure times).

7

Prefabricate as many joints as possible in a conditioned space.

8

Never bury empty MEK cleaner or solvent cement cans, rags, brushes, applicators, or anything else containing wet cement, or cleaner, next to the pipe.

Joint Curing Time

The drying time for joints will vary with the following variables; joint fit (between the pipe and fitting), amount of solvent cement applied, environmental conditions, and required working pressure of the piping system. Although full rated pressure and test pressure should not be applied for 24 hours, joints in smaller systems can sometime be put into service within hours of being made. Please refer to Joint Cure Schedule on page 29 for complete table of cure times.

JOINT CURING TIME

Cold Weather

Although normal installation temperatures are between 40°F (4°C) and 110°F (43°C), high strength joints have been made at temperatures as low as -15°F (-26°C).

In cold weather, solvents penetrate and soften the plastic pipe and fitting surfaces more slowly than in warm weather. Be aware that because of slower evaporation, a longer cure time is necessary.

Tips for solvent cementing in cold weather:

- Prefabricate as much of the system as is possible in a heated work area.
- Store cements and cleaners in a warmer area when not in use and make sure they remain fluid.
- Take special care to remove moisture including ice and snow from the surfaces to be joined.
- Ensure that the temperatures of the materials to be joined (ie. pipe and fittings) are similar.
- Use an IPEX Cleaner to prepare the joining surfaces before applying cements. More than one application may be necessary.
- Allow a longer cure period before the system is used. Note: A heat blanket may be used to speed up the set and cure times.

An indication of the time to make a joint and number of joints likely to be made per quart of Duraplus cement is indicated in the table that follows:

Size (in.)	Joints per Quart	Time per Joint (min)
1/2 – 1	290	5
1-1/4 – 2	144	7
3	48	10
4	32	10
6	16	13
8	10	16

Hot Weather

There are many occasions when solvent cementing plastic pipe at 95°F (35°C) temperatures and above cannot be avoided. If special precautions are taken, problems can be avoided.

Solvent cements for plastic pipe contain high-strength solvents which evaporate faster at elevated temperatures. This is especially true when there is a hot wind blowing. If the pipe is stored in direct sunlight, the pipe surface temperatures may be 20°F to 30°F (10°C to 15°C) higher than the ambient temperature. In this situation, the plastic is less resistant to attack and the solvents will attack faster and deeper, especially inside a joint. It is therefore very important to avoid puddling the cement inside the fitting socket and to ensure that any excess cement outside the joint is wiped off.

Tips for solvent cementing in hot weather:

- Store solvent cements and cleaners in a cool or shaded area prior to use.
- If possible, store fittings and pipe (at least the ends to be solvent welded) in a shady area before cementing.
- Try to do the solvent cementing in cooler morning hours.
- Cool surfaces to be joined by wiping with a damp rag.
- Make sure that the surface is dry prior to applying solvent cement.
- Make sure that both surfaces to be joined are still wet with cement when putting them together. With large size pipe, more people on the crew may be necessary.

Note: During hot weather the expansion-contraction factor may increase. Refer to the expansion-contraction design criteria in this manual.

Joint Cure Schedule for IPEX and IPEX Recommended ABS Solvent Cements*

Temperature Range (°F)	Temperature Range (°C)	Pipe Size (in) & System Operating Pressure		
		up to 1-1/4 160 - 230 psi	1-1/2 to 2 160 - 230 psi	2-1/2 to 8 145 - 230 psi
60 to 100	16 to 38	6 hr	12 hr	24 hr
40 to 60	4 to 16	12 hr	24 hr	48 hr
0 to 40	-18 to 4	48 hr	96 hr	8 days

* The figures in the table are estimates based on laboratory tests for water applications (chemical applications may require different set times). In damp or humid weather allow 50% more cure time (relative humidity over 60%).

NOTE 1: Due to the many variables in the field, these figures should be used as a general guideline only.
NOTE 2: Joint cure schedule is the necessary time needed before pressurizing the system.

Branch Connections

Reductions in branch connections can be made as follows:

- Reducer bushings can be solvent welded into tees, from 1/2" through 8".

  Reducer bushings offer a neat and simple method of reducing socket size in confined spaces. They are telescopic and may be solvent welded into fittings or into each other.

  Care must be taken to properly prepare all jointing surfaces per the solvent welding instructions.

- Reducer saddles can be used, from 2" up to 6".

Saddles permit branch connections to be made without cutting the main pipe in two.

Follow the fitting procedure below carefully:

1

Carefully, cut a hole into the pipe wall with a hole saw to suit the connection. The size of the hole and cutter to be used for each size of saddle is indicated in the table below.

Pipe Size (in)	2	3	4	6
Hole and Cutter Size (in.)	1-7/8	2-3/8	2-7/8	2-7/8

2

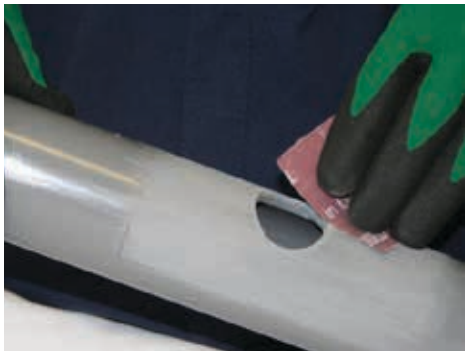
Mark out the area covered by the saddle on the pipe.

Position straps onto the pipe. These are needed to clamp the saddle into position after the solvent welding procedure.

The clamping straps recommended are of the worm-drive type. They should be left on either side of the saddle until the joint has cured.

3

Lightly abrade the mating surfaces of the pipe and the saddle with clean medium sand paper or 60-grit emery cloth.



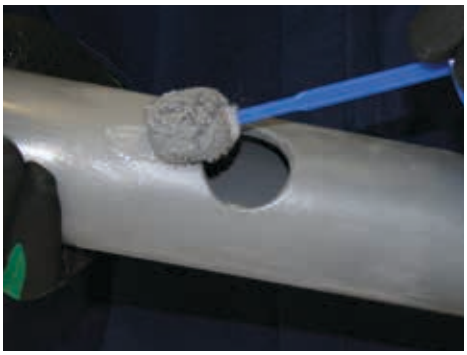
4

Clean and abrade the surfaces of the pipe and saddle using Duraplus MEK cleaner.

Replace the lid on the can once completed.

5

Apply Duraplus cement to the pipe area marked and to the saddle, taking care that cement is applied to the inside of the drilled hole and the outside of the spigot located on the underside of the saddle. Joints require two coats of cement on each surface.



6

Place the saddle into position, ensuring that the spigot is located in the hole against the pipe wall. Clamp the saddle with the straps.

7

Wipe off excess cement.

Replace the lid on the cement can.

Please refer to Joint Cure Schedule on page 27 for complete table of cure times.

THREADED CONNECTIONS

Threaded Connections

Plastic-to-Plastic

A range of threaded fittings is available with molded NPT threads. These threaded adapters can be cemented to pipe or fittings to convert them from plain end to threaded styles. IPEX recommends the use of molded threaded fittings wherever possible.

A special thick-walled 'Class T' pipe is available for threading in sizes up to 2" when molded fittings cannot be used.

When Class T pipe is threaded, the pipe must be de-rated to 180 psi at 73°F.

- Teflon tape should be wound onto male threads for a satisfactory seal.
- Tightening should only be done by hand or, at most, by an extra quarter turn with a strap wrench.
- Extra care must be taken not to over tighten or damage the pipe.
- Never use a pipe wrench.

Any Duraplus Industrial System incorporating a threaded connection is restricted to a maximum of 180 psi pressure at 73°F.

⚠ CAUTION

Anaerobic adhesive thread sealants e.g. Loctite 542, 572, can chemically attack ABS and must not be used. We recommend the use of Teflon® tape only.

ABS to Metal

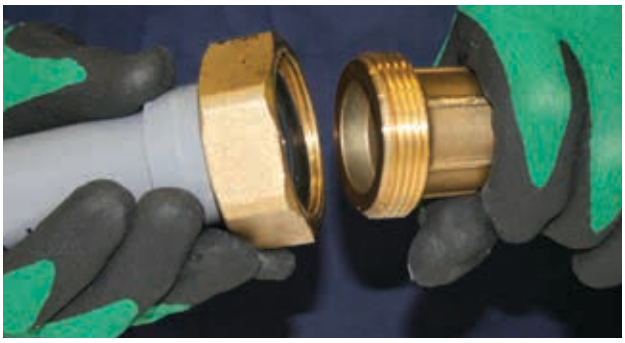
There are several methods of connecting metal and plastic systems.

- Flanges
- Socket/Male Threaded Adapters*
- Composite Unions*
- Reinforced Female Threaded Adapters*

*** CAUTION:** Not all adapters are manufactured to NPT pipe threads. Consult with IPEX prior to using threaded adapters to connect metal and plastic systems.

The incorporation of a metal threaded composite union into the system means that a threaded plastic component need not be used and therefore pressure de-rating is not required.

Composite unions are available with brass female threads up to and including 1".

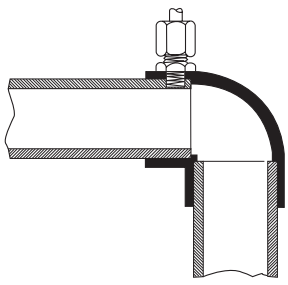


Note 1: Metal pipes and heat exchangers should be flushed thoroughly if they are to be connected to Duraplus ABS. This will ensure that if there are any harmful chemicals or settlement they will not contaminate or attack the ABS pipe.

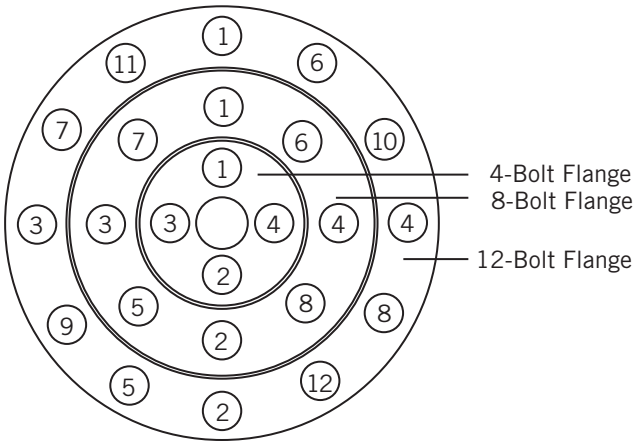
Note 2: Avoid screwing metallic male threads into plastic female threads, except those that have metal reinforcement. Consult the factory or your IPEX sales representative for the availability of these metal reinforced fittings.

Connections for Instrumentation

On 6" diameter pipe and above, small diameter connections up to 1/4" NPT can be made by drilling through pipe and fitting where the material is at its thickest and tapping the hole to receive a threaded fitting. This must never be done while the system is in service or under any internal pressure conditions.



Flanged Joints



The Duraplus Industrial range consists of two types:

- Full-face flanges from 1/2" to 6"
- Stub flanges from 2" to 8"

A galvanized mild steel backing ring and the appropriate neoprene gasket must be used with both types of flanges.

The full-face flange has a serrated face and makes use of a flat drilled gasket.

The stub flange has a serrated face and makes use of a plain, flat, undrilled gasket.

Stub-type flanges make bolt hole adjustment very simple.

Recommended Torque

Size (mm)	Size (in)	Torque (N.m)	Torque (lbf.ft)
20	1/2	15	11
25	3/4	15	11
32	1	15	11
40	1-1/4	20	15
50	1-1/2	30	22
63	2	35	26
75	2-1/2	40	30
90	3	40	30
110	4	40	30
140	5	50	37
160	6	60	44
225	8	70	52

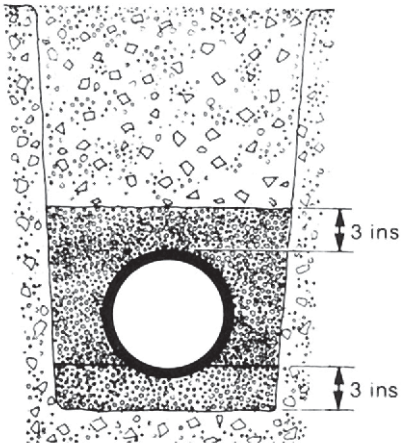
INSTALLATION OF BURIED PIPE

Recommendations covering essential requirements for large installations below-ground can be summarized as follows:

Trenches

- In general, trenches should not be less than 3' deep. However, site conditions may permit pipe being laid nearer to the surface; contact IPEX for detailed advice.
- Trenches should be straight-sided and as narrow as is practical to allow proper consolidation of packaging materials.
- Trench bottoms should be as level as practical.
- Large pieces of rock, debris and sharp objects should be removed.
- Unless the excavation is of friable, small and regular material, a bed of finely graded gravel should be laid approximately 3" deep on the floor of trench. (Sand may be used, but subterranean water is liable to wash sand away and leave the pipe unsupported.)

Below-Ground Installation



A section of a pipe installed below-ground in accordance with the following recommendations.

Installations

- If pipe is joined above-ground, it should remain undisturbed for 2 hours before being 'snaked' into the trench. Alternatively, it may be joined in the trench.
- Particular care should be taken to ensure pipe and joining materials are dry and free of debris when beginning the joining procedure.
- After laying, pipe should be covered with pea gravel or similar material to a depth of 3" above the pipe and extended sideways to both trench walls and then compacted. The joint should be left exposed for pressure testing.
- Care should be taken to ensure that sharp objects, stones, etc., are prevented from falling into the trench before covering the pipe with pea gravel.
- Backfilling should be carried out between joints prior to pressure testing.
- After pressure testing, joints should be covered with pea gravel and backfilling completed.

Thrust Blocks

For solvent welded systems thrust blocks are not required.

For mechanical joint systems, it is necessary to provide concrete anchor blocks at all sudden changes in direction, such as elbows, bonds, trees etc. This is necessary to withstand the forces generated by system pressurization.

Note: Do not lay ABS in contaminated ground or where chemical spilages may occur.

Installed Exposure to Sunlight

Where pipes are to be installed in locations likely to be permanently exposed to prolonged periods of high-intensity sunlight, they can be protected from degradation by painting.

This precaution is not considered necessary for Duraplus Industrial Pipe installed in the Northern States when carrying innocuous liquids.

Where the full ductility of the Duraplus System needs to be maintained, or where Duraplus Industrial systems are used for conveying hazardous liquids or compressed gases in exposed locations, it is recommended that they are painted to retain the full toughness and ductility of the material. This can be achieved as follows:

1. Lightly abrade the pipe and fittings using medium-grade glass paper, to provide a 'key' for the paint to adhere to.
2. Clean the system with soap and water to remove any residual grease or oil. Do not use solvents or detergents.
3. Select a white, water-based latex paint, preferably ones containing titanium dioxide. Do not use cellulose or solvent-based paints.
4. Apply an undercoat followed by a final gloss coat.

TESTING

Site Pressure Testing

The purpose of an onsite pressure test is to establish that the installed section of line – and in particular all joints and fittings – will withstand the design working pressure, plus a safety margin, without loss of pressure or fluid.

Generally a test pressure of 1-1/2 times the safe working pressure for the installed pipe is adequate. Whenever possible, it is recommended that hydrostatic testing be carried out. It is suggested that the following hydrostatic test procedure be followed after the solvent-welded joints have been allowed to cure for a minimum period of 24 hours at 73°F (timed from the last joint). Please refer to Joint Curve Schedule for details (page 29).

Hydrostatic Test Procedure

1. Fully inspect the installed piping for evidence of mechanical abuse and/or dry, suspect joints.
2. Split the system into convenient test sections not exceeding 1,000 ft.
3. Slowly fill the pipe section with cold water, taking care to evacuate all entrapped air in the process. Use air release valves at any high points in the system. Do not pressurize at this stage.
4. Leave the section for at least 1 hour to allow equilibrium temperature to be achieved.
5. Check the system for leaks. If clear, check for and remove any remaining air and increase pressure up to 50 psi. Do not pressurize further at this stage.
6. Leave the section pressurized for 10 minutes. If the pressure decays, inspect for leaks. If the pressure remains constant, slowly increase the hydrostatic pressure to 1-1/2 times the nominal working pressure.
7. Leave the section pressurized for a period not exceeding 1 hour. During this time, the pressure should not change.

If there is a significant drop in static pressure or extended times are required to achieve pressure, either joint leakage has occurred or air remains in the line. Inspect for leakage and if none is apparent, reduce the pressure and check for trapped air. This must be removed before further testing.

Any joint leaks should be repaired and allowed to cure fully before re-pressurizing for a minimum of 24 hours.

STORAGE

Prolonged Storage in Sunlight

Prolonged storage in sunlight may lead to degradation and some loss of impact resistance because of the combined effect of heat and ultraviolet radiation. Tarps should be used wherever possible to prevent this from happening.

On-site Storage

The high-impact strength of the Duraplus Industrial System provides some protection against damage to plastic pipe often incurred during handling and storage on-site.

However, it is recommended the following precautions are taken:

1. The storage site should be flat, level and free from sharp stones, etc.
2. Pipes should not be stacked to heights exceeding the following:
3. Smaller pipes may be 'nested' inside larger pipes.
4. Side bracing should be provided to prevent stack collapse.

Pipe Size	Max Stacking Height
up to 3"	20 x pipe size
4" to 6"	12 x pipe size
8"	7 x pipe size

WARNING

Freezing Conditions

Precautions should be taken to prevent contents from freezing, as this can cause pipe work to split. Glycol can be added to the system to lower the freezing point.

Thermal Insulation

Some insulation products can contain substances capable
of having a detrimental effect on thermoplastic pipe work (eg. certain types of foam rubber insulations can cause pipes to fail where the ABS is conveying liquids at temperatures above 86°F (30°C.) Common insulation materials known to be suitable with ABS pipe work are:

- fiber wool, such as 'Rockwool'
- Armaflex Class 1 HT
- Koolphen K Phenolic foam
- Polystyrene

Note: Please contact our Technical Customer Service if further assistance or recommendations are required.

Some adhesives can be detrimental. Do not bond insulation to ABS. (This comment also applies to any tapes, adhesives, or other substances used to secure the heating tape to the pipe work.)

Trace Heating

The selection of heating tapes with silicone rubber, woven wire, or woven polyester outer sheaths will eliminate the risk of plasticizer migration. These tapes are therefore preferred for use on thermoplastic systems.

Pipe Contents Identification

Do not put self-adhesive labels directly on to pipe surfaces
as this may be detrimental to pipe performance. It is recommended that some sort of barrier, such as aluminum foil, is placed between pipe and identification label.

Sealants

Certain sealants are formulated with phthalates. Phthalates are known to be extremely aggressive toward ABS materials, and therefore confirmation of the suitability of any mastic sealant should be determined before being used in conjunction with ABS pipe work. IPEX recommends using Teflon tape.

Contact with Synthetic Oils

Some synthetic oils used for drawing tubes and tube bending in the production of equipment such as fan coils, refrigeration display cases and other metal coiled devices are unsuitable for use with thermoplastic piping systems. The main types of synthetic oils identified as being incompatible with thermoplastic piping systems include but are not limited to Esters, Polyalkylene Glycols, and Organic Phosphates.

Some metal equipment manufacturers use these oils in their manufacturing process and normally remove these oils after manufacturing the part. However, IPEX recommends flushing the metal equipment thoroughly before installation with the thermoplastic piping system to ensure that residual oil left in the equipment cannot come into contact with the ABS.

IPEX recommends flushing the equipment with methylated spirits, however the equipment manufacturer should always be contacted for compatibility and complete flushing procedures. It is important to ensure proper drying time after flushing before connecting the equipment to the ABS piping system. Please note that only the metal pipe in the equipment should be flushed, ABS piping should not be flushed with methylated spirits.

Contact with Fluxes

Some fluxes can be detrimental to ABS. Care should be taken when soldering copper pipe work directly above, or close to, ABS pipe work.

Pressure Surges

Pressure surges should not be allowed to exceed the maximum continuous working pressure of the system.

Insulation

Some insulation products may be unsuitable for use with Duraplus ABS Industiral piping systems. They may contain harmful plasticizers which can migrate into the ABS material. Certain insulation products are suitable for use with ABS but may need to be installed using adhesives that contain harmful solvents.

It is important to ensure compatibility of the insulation material as well as installation materials, such as adhesives, with your IPEX representative.

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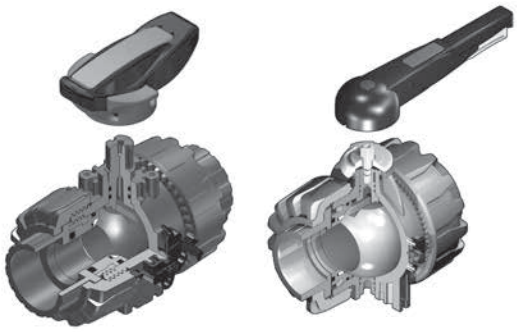
SECTION FIVE: VALVES

The following section contains concise technical information for the Duraplus ABS Industrial system valves. Please refer to Volume XI of the IPEX Industrial Technical Manual Series entitled, "Thermoplastic Valves" for further information. Also available is the Thermoplastic Valve Multimedia CD which contains extensive "Features & Benefits" information for all IPEX valves.

VKD SERIES BALL VALVES

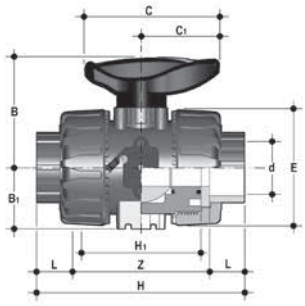
IPEX VKD Series Ball Valves offer a variety of advanced features such as the patented seat stop carrier, a high quality stem and ball support system, and a multifunctional handle with optional lock. The new DUAL BLOCK® system locks the union nuts preventing back-off due to vibration or thermal cycling. Deep grooves, thick o-rings, and cushioned Teflon® seats contribute to strong seals under pressure while integral mounting features and bracketing combine for simple adaptation for actuation and anchoring.

Pressure rated to 232 psi at 73°F. Sizes 1/2" to 4".

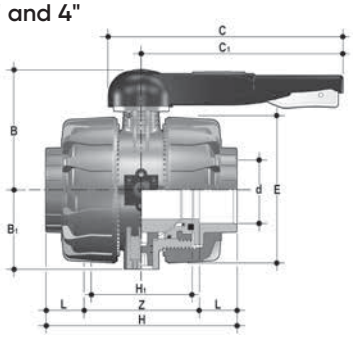


Dimensions

Sizes 1/2" to 2"



Sizes 3" and 4"



Size (in)	d (in)	L (in)	Z (in)	H (in)	H1 (in)	E (in)	B1 (in)	B (in)	C1 (in)	C (in)	W (lbs)
1/2	0.84	0.63	2.80	4.06	2.56	2.13	1.14	2.13	1.57	2.64	0.45
3/4	1.05	0.75	3.03	4.53	2.76	2.56	1.36	2.56	1.93	3.35	0.73
1	1.32	0.87	3.31	5.04	3.07	2.87	1.54	2.74	1.93	3.35	0.97
1-1/4	1.66	1.02	3.70	5.75	3.46	3.39	1.81	3.25	2.52	4.25	1.53
1-1/2	1.90	1.22	4.02	6.46	3.66	3.86	2.05	3.50	2.52	4.25	2.04
2	2.38	1.50	4.84	7.83	4.37	4.80	2.44	4.25	2.99	5.28	3.48
3	3.50	2.01	6.61	10.63	5.87	7.99	4.13	6.97	10.71	12.87	15.90
4	4.50	2.40	7.32	12.13	6.57	9.37	5.08	7.68	12.99	15.16	24.60

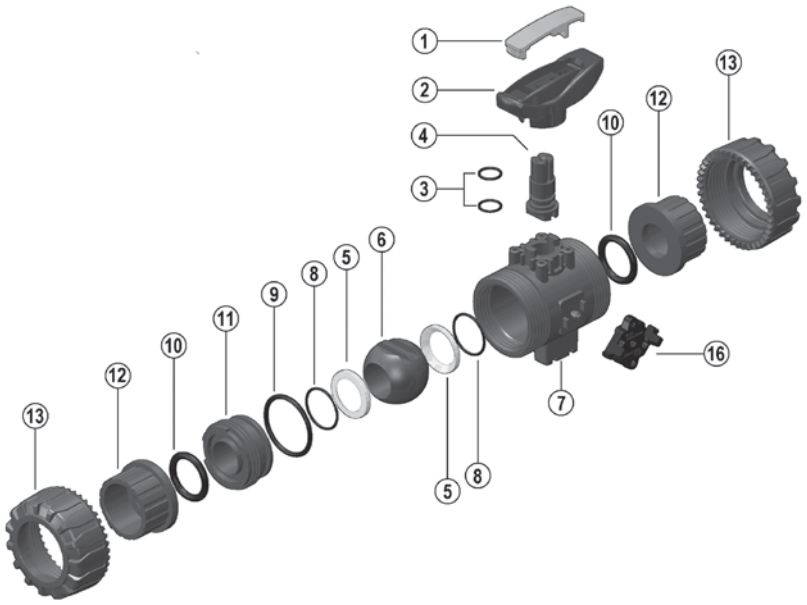
Flow Coefficients

Flow coefficients (C_v) = flow rate in gallons per minute of water at 68°F that will flow through the valve with a 1 psi pressure drop. The C_v values shown in the table are calculated with the valve fully open.

Size (in)	C_v
1/2	14.0
3/4	27.0
1	53.9
1-1/4	77.0
1-1/2	123
2	238
3	497
4	665

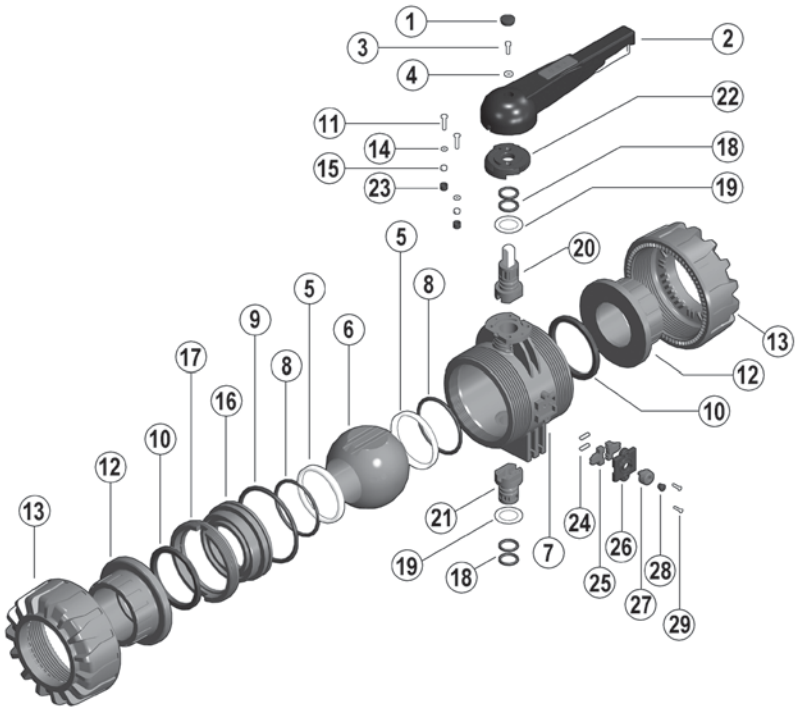
VKD SERIES BALL VALVES

Components



Sizes 1/2" to 2"

#	Component	Material
1	Insert	PVC
2	Handle	PVC
3	Stem O-Ring	EPDM
4	Stem	Duraplus ABS
5	Ball Seat	PTFE
6	Ball	Duraplus ABS
7	Body	Duraplus ABS
8	Ball Seat O-Ring	EPDM
9	Body O-Ring	EPDM
10	Socket O-Ring	EPDM
11	Carrier with Stop Ring	Duraplus ABS
12	End Connector	Duraplus ABS
13	Union Nut	Duraplus ABS
16	Dual Block®	POM



Sizes 3" and 4"

#	Component	Material
1	Protective Cap	PE
2	Handle	PVC
3	Bolt	SS
4	Washer	SS
5	Ball Seat	PTFE
6	Ball	Duraplus ABS
7	Body	Duraplus ABS
8	Ball Seat O-ring	EPDM
9	Body O-Ring	EPDM
10	Socket O-Ring	EPDM
11	Bolt	SS
12	End Connector	Duraplus ABS
13	Union Nut	Duraplus ABS
14	Washer	SS
15	Nut	SS
16	Carrier	Duraplus ABS
17	Stop Ring	Duraplus ABS
18	Stem O-Ring	EPDM
19	Bushing	PTFE
20	Upper Stem	Duraplus ABS & SS
21	Lower Stem	Duraplus ABS
22	Pad	GRPP
23	Protective Cap	PE
24	Spring	SS
25	Nut Block	GRPP
26	Cover	PP
27	Nut Block Button	GRPP
28	Protective Cap	PE
29	Screw	Nylon

VKD SERIES BALL VALVES

Sample Specification

1.0 Ball Valves – VKD

1.1 Material

- The valve body, stem, ball and unions shall be made of Duraplus™ ABS compound which shall meet or exceed the requirements of cell classification 43234 according to ASTM D3965.

1.2 Seats

- The ball seats shall be made of Teflon® (PTFE).

1.3 Seals

- The o-ring seals shall be made of EPDM.

2.0 Connections

2.1 Socket style

- The socket end connections shall conform to Duraplus™ ABS pipe dimensions as manufactured by IPEX.

3.0 Design Features

- The valve shall be double blocking with union ends.
- All valves shall be full port.
- All valves shall allow for bi-directional flow.
- The valve body shall be single end entry with a threaded carrier (ball seat support).
- The threaded carrier shall be adjustable with the valve installed.
- The valve body shall have an expansion and contraction compensating groove on the molded end.
- The valve body, union nuts, and carrier shall have deep square style threads for increased strength.
- The ball shall be machined smooth to minimize wear on valve seats.
- All valve seats shall have o-ring backing cushions to compensate for wear and prevent seizure of the ball.
- The stem design shall feature double o-ring seals as well as a safety shear point above the o-rings.
- All valves shall have integrally molded mounting features for actuation.
- All valves shall have integrally molded support bracketing for anchoring.
- The valve shall include the Dual Block® union nut locking mechanism.

3.1 Pressure Tested

- All valves shall have been pressure tested in both the open and closed positions by the manufacturer.

3.2 Pressure Rating

- All valves shall be rated at 232 psi at 73°F.

3.3 Markings

- All valves shall be marked to indicate size, material designation, and manufacturers name or trade mark.

3.4 Color Coding

- All valves shall be color-coded light gray.

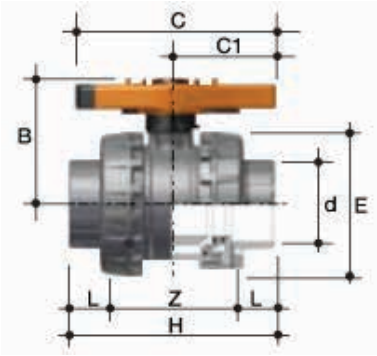
4.0 All valves shall be Duraplus® ABS by IPEX or approved equal.

VXE SERIES BALL VALVES

IPEX VXE Series Ball Valves feature an ultra-compact double block design, and full port bi-directional operation. The true union design allows the valve to be easily removed from the piping system and be fully serviced. A threaded seat stop carrier provides improved seal integrity under tough service conditions while the EasyFit multifunction handle doubles as a tool for ball seat adjustment, and for tightening union nuts precisely.

Pressure rated to 232 psi at 73°F. Sizes 1/2" to 2".

Dimensions



Dimensions (in)

Nom. Pipe Size	d	L	Z	H	E	B	C	C1	Wt. (lbs)
1/2	0.84	0.65	1.93	3.23	2.13	1.93	2.52	0.79	0.37
3/4	1.05	0.75	2.09	3.58	2.48	2.44	3.07	0.91	0.56
1	1.32	0.89	2.28	4.06	2.83	2.80	3.43	1.06	0.78
1-1/4	1.66	1.02	2.68	4.72	3.35	3.23	4.02	1.18	1.21
1-1/2	1.90	1.18	3.11	5.47	3.94	3.62	4.29	1.30	1.70
2	2.38	1.42	4.02	6.85	4.65	4.33	5.24	1.54	2.83

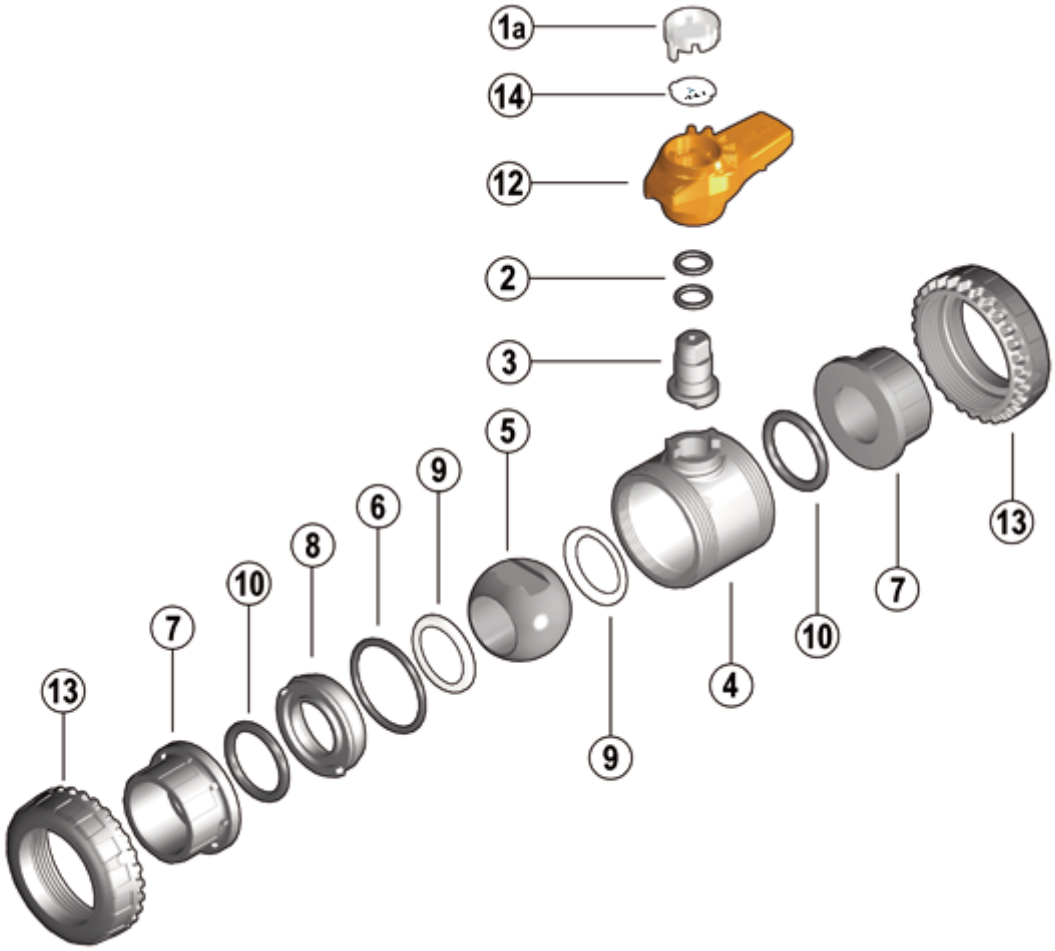
Flow Coefficients

Flow coefficients (C_V) = flow rate in gallons per minute of water at 68°F that will flow through the valve with a 1 psi pressure drop. The C_V values shown in the table are calculated with the valve fully open.

Size	C_V
1/2	14.0
3/4	27.0
1	53.9
1-1/4	77.0
1-1/2	123
2	238

VXE SERIES BALL VALVES

Components



No.	Component	Material	Qty
1a	Transparent Service Plug	PVC	1
2	Stem O-Ring	EPDM	2
3	Stem	Duraplus ABS	1
4	Body	Duraplus ABS	1
5	Ball	Duraplus ABS	1
6	Body Seal O-Ring	EPDM	1
7	End Connector	Duraplus ABS	2
8	Support for Ball Seat	Duraplus ABS	1
9	Ball Seat	PTFE	2
10	Socket Seal O-Ring	EPDM	2
12	Handle	PVC	1
13	Union Nut	Duraplus ABS	2
14	Tag Holder	PVC	1

VXE SERIES BALL VALVES

Sample Specification

1.0 Ball Valves – VXE

1.1 Material

- The valve body, stem, ball and unions shall be made of Duraplus™ ABS compound which shall meet or exceed the requirements of cell classification 43234 according to ASTM D3965.

1.2 Seats

- The ball seats shall be made of Teflon® (PTFE).

1.3 Seals

- The o-ring seals shall be made of EPDM.

2.0 Connections

2.1 Socket Style

- The IPS socket end connectors shall conform to Duraplus™ ABS pipe dimensional as manufactured by IPEX.

3.0 Design Features

- The valve shall be double blocking with union ends.
- All sizes 1/2" through 4" shall be full port.
- All sizes shall allow for bi-directional flow.
- The valve body shall be single end entry with a threaded carrier (ball seat support).
- The valve body shall have an expansion and contraction compensating groove on the molded end.
- The valve body, union nuts, and carrier shall have deep square style threads for increased strength.
- The ball shall be machined smooth to minimize wear on valve seats.
- The stem design shall feature a shear point above the o-ring to maintain system integrity in the unlikely event of a stem breakage.
- The handle shall incorporate a tool for adjustment of the threaded carrier.
- The handle shall incorporate a tool for adjustment of union nuts.
- The handle shall incorporate a transparent PVC plug and tag holder for valve identification.

3.1 Pressure Rating

- All valves shall be rated at 232 psi at 73°F.

3.2 Markings

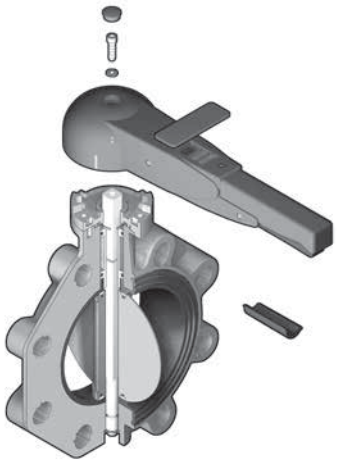
- All valves shall be marked to indicate size, material designation, and manufacturers name or trade mark.

3.3 Color Coding

- All valves shall be color-coded light gray.

4.0 All valves shall be Duraplus™ ABS by IPEX or approved equal.

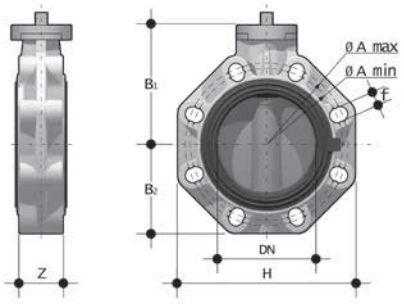
FK SERIES BUTTERFLY VALVES



IPEX FK Series Butterfly Valves offer superior strength and chemical resistance in highly corrosive environments and process flow conditions. The special trapezoid shape of the liner and a serrated body cavity guarantee a bubble tight seal while keeping break-away torque at an absolute minimum. This versatile industrial valve features double self-lubricating seals and direct actuator mount capability.

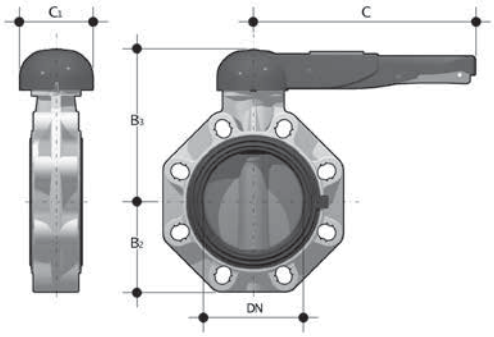
Pressure rated to 150 psi at 73°F. Sizes 2" to 8"

Dimensions



Size (in)	DN (in)	Z (in)	B1 (in)	B2 (in)	H (in)	Amin (in)	Amax (in)	f	# holes
2	1.97	1.69	4.41	2.76	5.79	4.53	4.94	0.75	4
3	3.15	1.93	5.24	3.66	7.28	5.71	6.30	0.75	8
4	3.94	2.20	5.79	4.21	8.31	6.50	7.48	0.75	8
6	5.91	2.76	7.09	5.28	10.55	9.06	9.53	0.91	8
8	7.87	2.80	8.94	6.34	12.72	11.02	11.73	0.91	8

Flow Coefficients



Size (in)	DN (in)	C_1 (in)	C (in)	B_2 (in)	B_3 (in)	# holes
2	1.97	3.94	6.89	2.76	5.63	4
3	3.15	4.33	10.71	3.66	7.01	8
4	3.94	4.33	10.71	4.21	7.56	8
6	5.91	4.33	12.99	5.28	8.86	8
8	7.87	4.80	16.54	6.34	10.71	8

Flow Coefficients

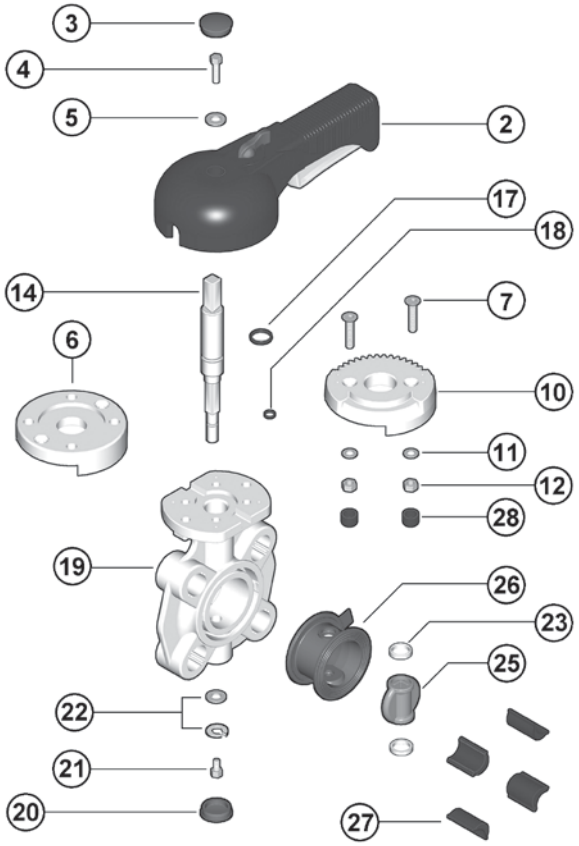
Flow coefficients (C_v) = flow rate in gallons per minute of water at 68°F that will flow through the valve with a 1 psi pressure drop. The C_v values shown in the table are calculated with the valve fully open.

Size (in)	C_v
2	90
3	249
4	413
6	1309
8	2135

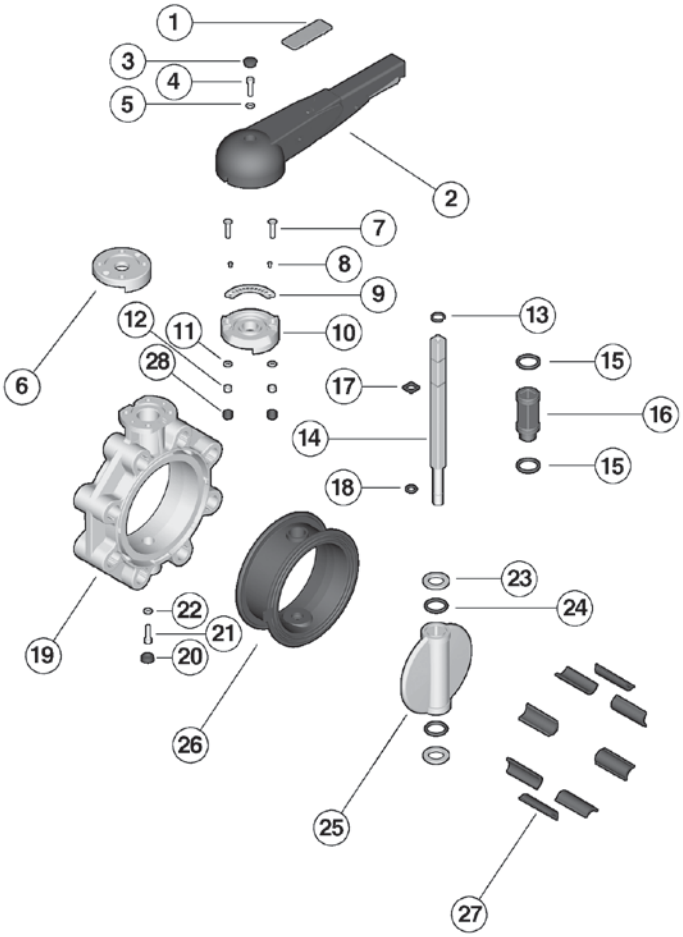
FK SERIES BUTTERFLY VALVES

Components

Sizes 2"



Sizes 3" to 8"



#	Component	Material
1	Handle Insert	ABS
2	Handle	PVC
3	Cap	PE
4	Screw	SS
5	Washer	SS
6	Spacer Pad	GRPP
7	Screw	SS
8	Screw	SS
9	Ratchet	SS
10	Pad	GRPP
11	Washer	SS
12	Nut	SS
13	Retaining Ring	SS
14	Shaft	420 SS

#	Component	Material
15	Bushing O-Ring	EPDM/FKM
16	Bushing	nylon
17	Shaft O-Ring	EPDM/FKM
18	Shaft O-Ring	EPDM/FKM
19	Body	GRPP
20	Cap	PE
21	Wcrew	SS
22	Washer	SS
23	Anti-Friction Ring	PTFE
24	Disc O-Ring	EPDM/FKM
25	Disc	Duraplus ABS
26	Primary Liner	EPDM/FKM
27	Inserts	ABS
28	Cap	PE

FK SERIES BUTTERFLY VALVES

Sample Specification

1.0 Butterfly Valves – FK

1.1 Material

- The valve body shall be made of glass reinforced polypropylene (GRPP) obtained from homopolymer polypropylene (PPH).
- The valve disc shall be made of Duraplus™ ABS compound which shall meet or exceed the requirements of cell classification 43234 according to ASTM D3965.
- The valve shaft shall be made of 420 stainless steel.

1.2 Seats

- The disc liner shall be made of EPDM.

or The disc liner shall be made of FKM.

1.3 Seals

- The o-ring seals shall be made of EPDM.

or The o-ring seals shall be made of FKM.

2.0 Connections

2.1 Flanged style

- The ANSI 150 flanged connections shall conform to the dimensional standard ANSI B16.5.

3.0 Design Features

- The valve shall be of wafer design.
- Manual control of the valve shall be achieved through the use of a lever handle.
- The shaft shall have standard ISO square dimensions for direct mounting of actuators.
- The disc shall be a trapezoidal elastomeric liner and provide a bubble tight seal.
- The liner shall completely isolate the valve body from the process flow.
- The liner shall function as a flange gasket on both sides of the valve.
- The body cavity shall feature special channeling to prevent liner slippage and compression.
- The disc, seats, and seals shall be the only wetted parts.
- Teflon® seated o-ring seals shall prevent the stainless steel shaft from becoming wetted.

3.1 Pressure Rating

- All valves shall be rated at 150 psi at 73°F.

3.2 Markings

- All valves shall be marked to indicate size, material designation, and manufacturers name or trade mark.

3.3 Color Coding

- All valves shall be color-coded light gray.

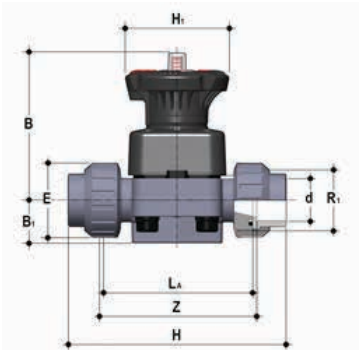
4.0 All valves shall be Duraplus™ ABS by IPEX or approved equal.

DK SERIES DIAPHRAGM VALVES

IPEX DK Series Dialock® Diaphragm Valves are the ideal solution for modulating flow and controlling dirty or abrasive fluids in a variety of applications. The modular nature of these valves results in many material, body style, and diaphragm options. The re-designed weir-style body has significantly improved the DK's flow rate compared to the old design and it facilitates precise linear flow regulation through the valve's full range of operation. The new innovative and patented Dialock locking mechanism allows the manual handwheel to be adjusted and locked in over 300 positions.

Pressure rated to 150 psi at 73°F. Sizes 1/2" to 2".

Dimensions



Dimension (in)

Size	d(in) PVC/ CPVC	B	B_1	E	H	H_1	L_A	R_1	Z	Wt. (lbs)
1/2	0.84	4.02	0.98	1.61	5.63	3.15	3.54	1	3.86	1.72
3/4	1.05	4.13	1.18	1.97	6.57	3.15	4.25	1-1/4	4.53	1.98
1	1.32	4.49	1.30	2.28	7.09	3.15	4.57	1-1/2	4.80	2.49
1-1/4	1.66	4.69	1.18	2.83	8.19	3.15	5.28	2	5.67	3.02
1-1/2	1.90	5.79	1.38	3.11	9.21	4.72	6.06	1-1/4	6.46	5.07
2	2.38	6.77	1.81	3.86	10.71	4.72	7.24	2-3/4	7.68	7.34

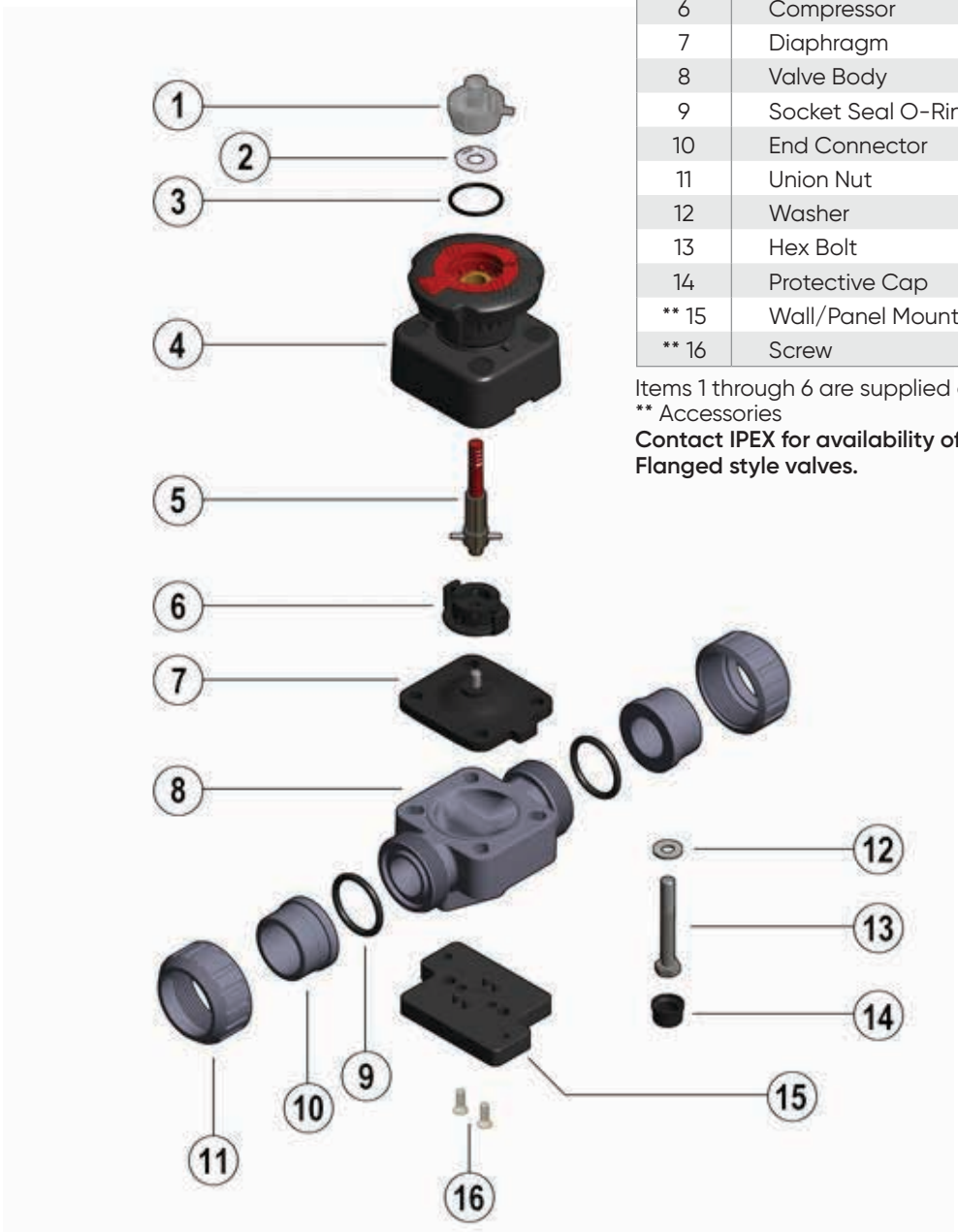
Flow Coefficients

Flow coefficients (C_V) = flow rate in gallons per minute of water at 68°F that will flow through the valve with a 1 psi pressure drop. The C_V values shown in the table are calculated with the valve fully open.

Size (in)	C_V
1/2	7.8
3/4	18.1
1	30.8
1-1/4	38.1
1-1/2	75.3
2	114.2
2-1/2	110.9

DK SERIES DIAPHRAGM VALVES

Components



#	Component	Material	Qty
1	Transparent Cap	PVC	1
2	Labelling Plate	PVC	1
3	O-Ring	EPDM	1
4	Handwheel / Bonnet	GFPP / PVDF	1
5	Threaded Stem – Indicator	SS	1
6	Compressor	IXEF®	1
7	Diaphragm	EPDM	1
8	Valve Body	Duraplus ABS	1
9	Socket Seal O-Ring	EPDM	2
10	End Connector	Duraplus ABS	2
11	Union Nut	Duraplus ABS	2
12	Washer	SS	4
13	Hex Bolt	SS	4
14	Protective Cap	PE	4
** 15	Wall/Panel Mounting Plate	GFPP	1
** 16	Screw	SS	2

Items 1 through 6 are supplied as an assembly.
** Accessories
Contact IPEX for availability of spare components for Spigot and Flanged style valves.

DK SERIES DIAPHRAGM VALVES

Sample Specification

1.0 Diaphragm Valves – DK

1.1 Material

- The valve body, stem, ball and unions shall be made of Duraplus™ ABS compound which shall meet or exceed the requirements of cell classification 43234 according to ASTM D3965.
- The valve bonnet assembly shall be made of high temperature, high strength, glass-filled polypropylene (GFPP)

1.2 Diaphragm

- The diaphragm shall be made of EPDM.

2.0 Connections

2.1 Socket style

- The socket end connectors shall conform to Duraplus™ ABS pipe dimensions as manufactured by IPEX.

3.0 Design Features

- All valves shall be weir-style for throttling applications.
- All valves shall have a manual handwheel that can be adjusted and locked in over 300 positions.
- The manual handwheel shall be made of high strength glass-filled polypropylene (GFPP).
- All valves shall have a graduated optical position indicator to allow for a visual check of the valve position.
- All valves shall have a custom labelling plate housed in a transparent cap.
- All through bolts shall be made of stainless steel.
- The valve shall incorporate a feature that allows an identification tag to be easily affixed to the valve body.
- Bodies shall have brass mounting inserts.

3.1 Pressure Rating

- All valves shall be rated at 150 psi at 73°F.

3.2 Markings

- All valves shall be marked to indicate size, material designation, and manufacturers name or trade mark.

3.3 Color Coding

- All valves shall be color-coded light gray.
- All bonnet assemblies shall be color-coded black and red.

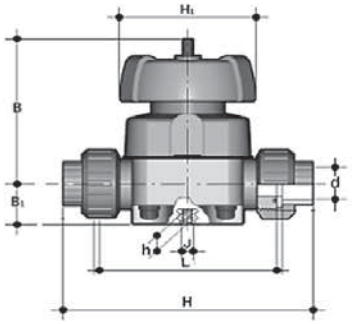
4.0 All valves shall be Duraplus™ ABS by IPEX or approved equal.

VM SERIES DIAPHRAGM VALVES

IPEX VM Series Diaphragm Valves are the ideal solution for modulating flow and precise throttling in a variety of applications. The compact modular design allows for installation in any orientation, simple elastomer replacement, and possible conversion to an automated valve without removing the body from the line.

Pressure rated to 150 psi at 73°F. Sizes 3" to 4".

Dimensions



Nom. Pipe Size	Critical Dimensions (inches)								
	d	H	L	B1	B	H1	h	J	Wt. (lbs)
* 3	3.50	11.81	2.01	2.17	8.86	8.46	0.91	M12	15.43
* 4	4.50	13.78	–	2.72	11.61	9.84	0.91	M12	23.15

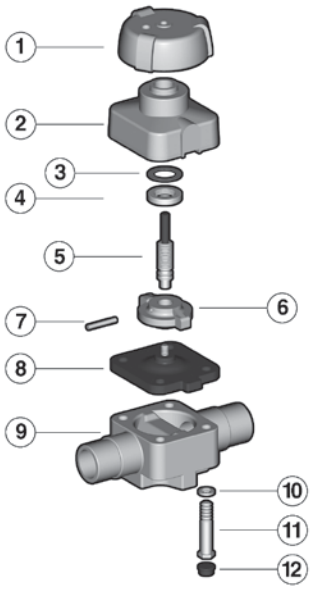
Note: Other diaphragm materials available upon request
* Spigot ends

Flow Coefficients

Flow coefficients (C_V) = flow rate in gallons per minute of water at 68°F that will flow through the valve with a 1 psi pressure drop.The C_V values shown in the table are calculated with the valve fully open.

Size (in)	C_V
3	140
4	189

Components



#	Component	Material
1	Handwheel	GFPP
2	Bonnet	GFPP
3	Compression Bearing	POM
4	Security Ring	Brass
5	Indicator - Stem	SS
6	Compressor	PBT
7	Pin	SS
8	Diaphragm	EPDM
9	Valve Body	Duraplus ABS
10	Washer	Zinc plated steel
11	Hex Bolt	Zinc plated steel
12	Protective Cap	PE

VM SERIES DIAPHRAGM VALVES

Sample Specification

1.0 Diaphragm Valves – VM

1.1 Material

- The valve body, stem, ball and unions shall be made of Duraplus™ ABS compound which shall meet or exceed the requirements of cell classification 43234 according to ASTM D3965.
- The valve bonnet assembly shall be made of high temperature, high strength, glass-filled polypropylene.

1.2 Diaphragm

- The diaphragm shall be made of EPDM.

2.0 Connections

2.1 Spigot style

- The spigot end connections shall conform to Duraplus™ ABS pipe dimensions as manufactured by IPEX.

3.0 Design Features

- All valves shall be weir-style for throttling applications.
- All bodies to be used with EPDM diaphragms shall feature raised molded sealing rings (concentric).
- All through bolts shall be made of 304 stainless steel.
- All manual valves shall have a rising position indicator.

3.1 Pressure Rating

- All valves shall be rated at 150 psi at 73°F.

3.2 Markings

- All valves shall be marked to indicate size, material designation, and manufacturers name or trade mark.

3.3 Color Coding

- All valves shall be color-coded light gray.
- All bonnet assemblies shall be color-coded black.

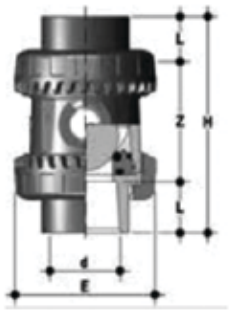
4.0 All valves shall be Duraplus™ ABS by IPEX or approved equal.

SXE SERIES BALL CHECK VALVES

IPEX SXE Series Ball Check Valves feature a true union design allowing for easy removal and maintenance of the valve without disturbing the rest of the pipe assembly. Positive shutoff of the valve in both vertical and horizontal installations is achieved with just 3 psi of back pressure. The innovative SXE EasyFit design features a custom labelling system, and the optional EasyFit multifunctional handle allows for union nut rotational control and safe blocked carrier tightening.

Pressure rated to 232 psi at 73°F. Sizes 1/2" to 2".

Dimensions



Dimension (in)

Nom. Pipe Size	d	L	Z	H	E	Wt. (lbs)
1/2	0.84	0.65	1.97	3.23	2.13	0.29
3/4	1.05	0.75	2.09	3.58	2.48	0.38
1	1.32	0.89	2.32	4.06	2.83	0.60
1-1/4	1.66	1.02	2.68	4.72	3.35	0.91
1-1/2	1.90	1.18	3.03	5.47	3.94	1.34
2	2.38	1.42	3.86	6.85	4.65	2.14

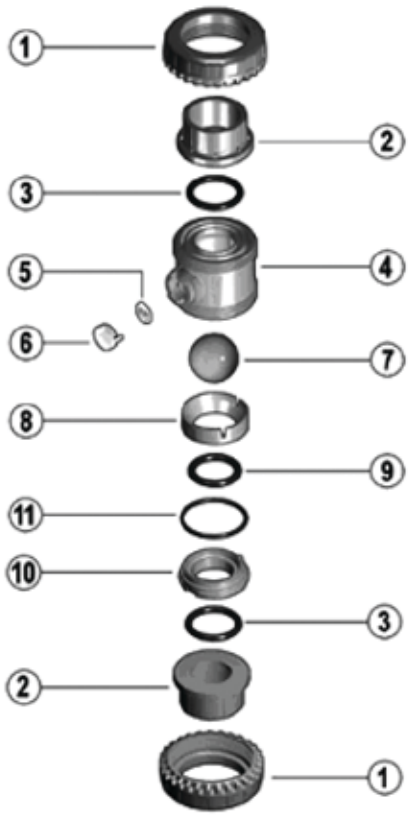
Flow Coefficients

Flow coefficients (C_v) = flow rate in gallons per minute of water at 68°F that will flow through the valve with a 1 psi pressure drop. The C_v values shown in the table are calculated with the valve fully open.

Size	C_v
1/2	10.6
3/4	17.9
1	30.0
1-1/4	44.6
1-1/2	64.4
2	93.2

SXE SERIES BALL CHECK VALVES

Components



#	Component	Material	Qty
1	Union Nut	Duraplus ABS	2
2	End Connector	Duraplus ABS	2
3	Socket Seal (O-ring)	EPDM	2
4	Body	Duraplus ABS	1
5	Tag Holder	PVC	1
6	Transparent Service Plug	PVC	1
7	Ball	Duraplus ABS	1
8	Packing-presser Ring	Duraplus ABS	1
9	Ball Seal (O-ring)	EPDM	1
10	Support for Ball Seat	Duraplus ABS	1
11	Radial Seal (O-ring)	EPDM	1

SXE SERIES BALL CHECK VALVES

Sample Specification

1.0 Ball Check Valves – SXE

1.1 Material

- The valve body, ball, end connectors, and unions shall be made of Duraplus™ ABS compound which shall meet or exceed the requirements of cell classification 43234 according to ASTM D3965.

1.2 Seals

- The o-ring seals shall be made of EPDM

2.0 Connections

2.1 Socket style

- The socket end connectors shall conform to Duraplus™ ABS pipe dimensions as manufactured by IPEX.

3.0 Design Features

- The valve shall have true union ends.
- The valve cavity shall feature an optimized profile design to reduce pressure drop and improve the Cv value
- The valve cavity shall feature full body guide ribs to reduce chatter and improve seal quality.
- The ball shall be fully machined to achieve high surface finish and accurate dimensional tolerance.
- The valve body and union nuts shall have deep square style threads for increased strength.
- The Main-seal carrier shall be a safe blocked design and allow for safe disconnection of the union nuts for maintenance. The main-seal carrier shall be compatible with the EasyFit multifunctional handle and EasyFit Torque Wrench (1/2" – 2" valves) for precise component tightening.
- The union nuts shall be compatible with the EasyFit multifunctional handle and EasyFit Torque Wrench (1/2" – 2" valves) for precise tightening.
- The valve shall have a transparent plug housing for use with EasyFit Labelling System for valve identification.

3.1 Pressure Rating

- All valves shall be rated at 232 psi at 73°F.

3.2 Markings

- All valves shall be marked to indicate size, material designation, and manufacturers name or trade mark.

3.3 Color Coding

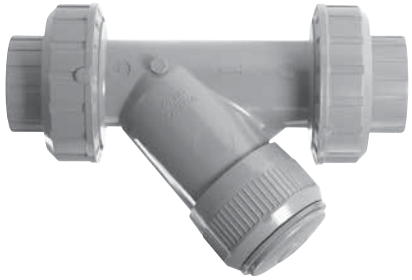
- All valves shall be color-coded light gray.

4.0 All valves shall be Duraplus™ ABS by IPEX or approved equal.

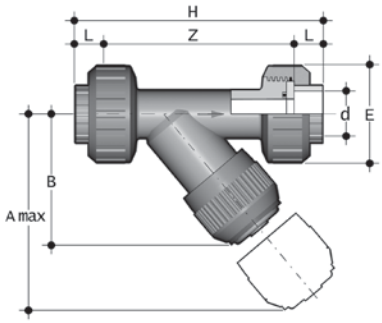
RV SERIES SEDIMENT STRAINERS

IPEX RV Series Sediment Strainers protect critical pipeline components by removing solids and suspended impurities. The bottom-entry design permits in-line maintenance and simple cleaning or replacement of worn screens. True union ends facilitate both installation and removal.

Pressure rated to 220 psi at 73°F depending on size.
Sizes 1/2" to 2".



Dimensions



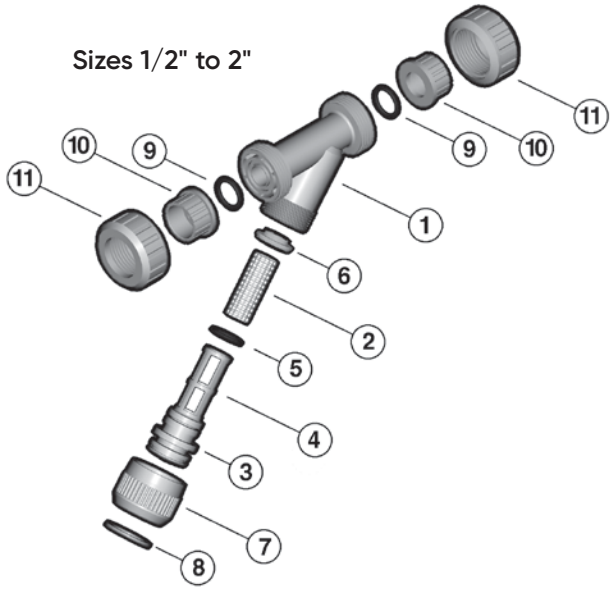
Size (in)	d (in)	L (in)	Z (in)	H (in)	E (in)	B (in)	Amax (in)
1/2	0.84	0.63	4.06	5.31	2.17	2.83	4.92
3/4	1.05	0.75	4.72	6.22	2.60	3.31	5.71
1	1.32	0.87	5.20	6.93	2.95	3.74	6.50
1-1/4	1.66	1.02	6.10	8.15	3.43	4.37	7.48
1-1/2	1.90	1.22	7.13	9.57	3.94	4.72	8.27
2	2.38	1.50	8.72	11.73	4.72	5.47	9.45

Flow Coefficients

Flow coefficients (C_v) = flow rate in gallons per minute of water at 68°F that will flow through the valve with a 1 psi pressure drop. The C_v values shown in the table are calculated with the valve fully open.

Size (in)	C_v
1/2	2.80
3/4	4.90
1	7.21
1-1/4	13.2
1-1/2	17.9
2	28.7

Components



#	Component	Material
1	Body	Duraplus ABS
2	Screen Mesh	PP
3	Bonnet	Duraplus ABS
4	Screen Support	Duraplus ABS
5	O-Ring Seal	EPDM
6	Retaining Ring	Duraplus ABS
7	Lock Nut	Duraplus ABS
8	Split Ring	Duraplus ABS
9	Socket O-Ring	EPDM
10	End Connector	Duraplus ABS
11	Union Nut	Duraplus ABS

RV SERIES SEDIMENT STRAINERS

Sample Specification

1.0 Sediment Strainers – RV

1.1. Material

- The valve body, end connectors, and unions shall be made of Duraplus™ ABS compound which shall meet or exceed the requirements of cell classification 43234 according to ASTM D3965.

1.2. Seals

- The o-ring seals shall be made of EPDM.

1.3. Mesh Screen

- The mesh screen shall be made of PP which shall meet or exceed the requirements of Type 1 Polypropylene according to ASTM D4101.

2.0 Connections

2.1. Socket style

- The socket end connections shall conform to Duraplus™ ABS pipe dimensions as manufactured by IPEX.

3.0 Design Features

- Strainers shall be Y-pattern in style.
- All sizes shall have true union ends.
- It shall be possible to service the valve without removing it from the line.
- The filter screen shall be size ASTM 30 mesh.

3.1. Pressure Rating

- Strainer sizes 1/2" through 1-1/2" shall be rated at 220 psi at 73°F.
- Strainer size 2" shall be rated at 130 psi at 73°F.

3.2. Markings

- All valves shall be marked to indicate size, material designation, and manufacturers name or trade mark.

3.3. Color Coding

- All valves shall be color-coded light gray.

4.0 All valves shall be Duraplus™ ABS by IPEX or approved equal.

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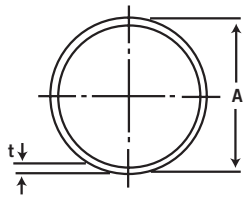
SECTION SIX: DIMENSIONAL DATA

NOTE: Duraplus ABS fabricated fittings are custom made from pipe and FRP wrapped for rigidity and improved pressure capability. Due to manufacturing constraints, some fittings may not be exactly symmetrical or appear as sketched. The dimensions provided are approximate and should not be used to create precise layouts.

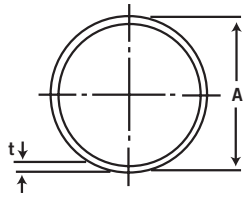
* Fabricated spigot end fittings are rated at 73°F for: 3" to 8" (100psi)

Pipe – 145 psi at 73°F (Class C)



Pipe Diameter (D)	Significant Number	Product Code	Critical Dimensions			
			A	t	Standard Length (ft)	lb./ft.
1	511104	346059	1.315	0.079	19.7	0.14
1-1/2	511106	346060	1.900	0.110	19.7	0.28
2	511107	346061	2.375	0.142	19.7	0.45
3	511109	346062	3.500	0.205	19.7	0.94
4	511110	346063	4.500	0.260	19.7	1.56
6	511112	346064	6.625	0.390	19.7	3.44
8	511513	346065	8.625	0.500	19.7	5.76

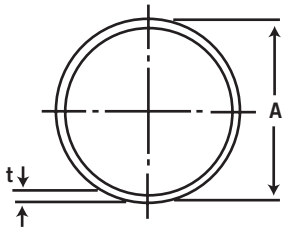
Pipe – 230 psi at 73°F (Class E)



Pipe Diameter (D)	Significant Number	Product Code	Critical Dimensions			
			A	t	Standard Length (ft)	lb./ft.
1/2	513102	346067	0.840	0.079	19.7	0.09
3/4	513103	346068	1.050	0.048	19.7	0.13
1	513104	346069	1.315	0.122	19.7	0.21
1-1/4	513105	346070	1.660	0.154	19.7	0.33
1-1/2	513106	346071	1.900	0.177	19.7	0.43
2	513107	346072	2.375	0.220	19.7	0.67
3	513109	346073	3.500	0.327	19.7	1.45
4	513110	346074	4.500	0.417	19.7	2.41

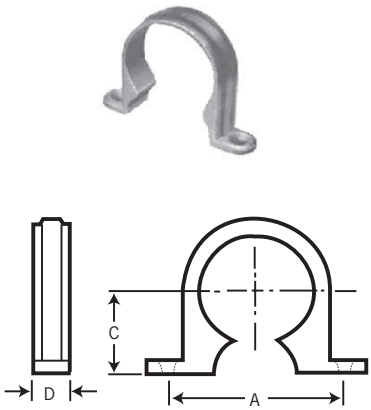
DIMENSIONS

Class "T" – Suitable for Threading (180 psi at 73°F after threading)



Pipe Diameter (D)	Significant Number	Product Code	Critical Dimensions			
			A	t	Standard Length (ft)	lb./ft.
1/2	514102	346054	0.84	0.142	19.7	0.15
3/4	514103	346055	1.05	0.142	19.7	0.19
1	514104	346056	1.315	0.169	19.7	0.29
1-1/2	514106	346057	1.90	0.236	19.7	0.57
2	514107	346058	2.375	0.283	19.7	0.86

Saddle Clip – Polypropylene



Nom. Pipe Size	Significant No.	Product Code	Critical Dimensions				
			A	C	D	Screw/ Bolt Size	Wt. (oz)
1/2	455102	337454	1.61	0.71	0.55	#8 5/32"	0.14
3/4	455103	337455	1.77	0.83	0.63	#10 1/4"	0.21
1	455104	337456	2.20	0.91	0.63	#10 1/4"	0.25
1-1/4	455105	337457	2.56	1.14	0.63	#10 1/4"	0.39
1-1/2	455106	337458	2.64	1.34	0.63	5/16"	0.42
2	455107	337459	3.43	1.50	0.87	5/16"	0.88
3	455109	337460	4.80	1.97	1.34	5/16"	1.59
4	455110	337461	6.14	2.56	1.50	–	–

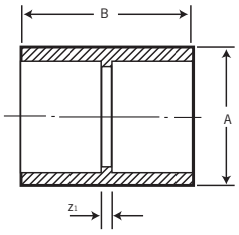
Cobra Clip – Polypropylene

Nom. Pipe Size	Significant No.	Product Code	Critical Dimensions					
			A	B	C	G	Screw/ Bolt Size	Wt. (oz)
3/8	434305	437340	–	1.38	0.98	0.63	#8 5/32"	0.25
1/2	434306	437341	–	1.38	1.18	0.63	#10 1/4"	0.29
3/4	434307	437342	–	1.38	1.38	0.67	#10 1/4"	0.39
1	434308	437343	–	1.57	1.57	0.67	#10 1/4"	0.49
*1-1/4	434309	437344	2.95	1.77	1.77	0.79	#10 1/4"	0.74
*1-1/2	434310	437345	3.35	1.97	1.97	0.83	#10 1/4"	1.05
*2	434311	437346	4.02	2.36	2.36	0.83	#10 1/4"	1.47
*3	434313	437348	5.83	3.15	3.54	1.22	5/16"	4.26
*4	434314	437349	6.73	3.54	3.78	1.38	5/16"	6.53
6	434317	437432	9.57	6.69	5.91	1.57	5/16"	11.64

* Clips of size 1-1/4" and above are fitted with retaining strap. Bolts/screws not supplied.

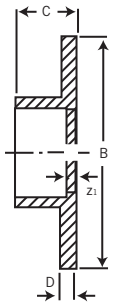
DIMENSIONS

Coupling – Socket



Nom. Pipe Size	Significant No.	Product Code	Critical Dimensions			
			Z_1	A	B	Wt. (oz)
1/2	100102	337022	0.08	1.02	1.50	0.21
3/4	100103	337023	0.12	1.26	1.69	0.42
1	100104	337024	0.12	1.61	1.97	0.85
1-1/4	100105	337025	0.16	2.05	2.36	1.45
1-1/2	100106	337026	0.08	2.36	2.60	2.19
2	100107	337027	0.16	2.91	3.07	4.02
3	100109	337028	0.16	4.25	4.09	12.52
4	100110	337029	0.20	5.35	5.31	20.98
6	100112	337030	0.35	7.91	7.52	80.01
8	100113	337031	0.43	10.12	9.80	129.35

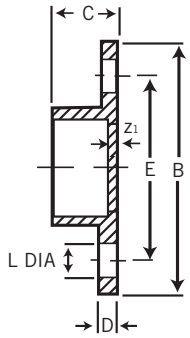
Flange, Full-Face – Undrilled/Socket



Nom. Pipe Size	Significant No.	Product Code	Critical Dimensions				
			Z_1	B	C	D	Wt. (oz)
1/2	129102	337226	0.16	3.78	0.83	0.39	2.65
3/4	129103	337227	0.16	4.13	0.94	0.39	3.00
1	129104	337228	0.16	4.53	1.06	0.39	3.92
1-1/4	129105	337229	0.16	5.51	1.26	0.39	4.59
1-1/2	129106	337330	0.20	5.91	1.42	0.39	5.64
2	129107	337231	0.24	6.50	1.77	0.43	8.22
3	129109	337232	0.31	7.83	2.36	0.43	14.60
4	129110	337233	0.24	8.66	2.87	0.55	23.18
6	129112	337234	0.31	11.18	3.90	0.87	49.98

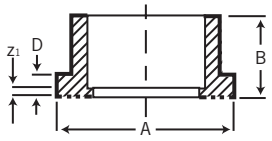
DIMENSIONS

Flange, Full-face – Drilled ANSI 150, Socket



Nom. Pipe Size	Significant No.	Product Code	Critical Dimensions							
			Z_1	B	C	D	E	L	Holes	Wt. (oz)
1/2	322102	337353	0.16	3.78	0.83	0.39	2.36	0.55	4	2.40
3/4	322103	337354	0.16	4.13	0.94	0.39	2.76	0.55	4	2.75
1	322104	337355	0.16	4.53	1.06	0.39	3.15	0.55	4	3.77
1-1/4	322105	337356	0.16	5.51	1.30	0.39	3.50	0.625	4	4.30
1-1/2	322106	337357	0.206	5.91	1.46	0.39	3.86	0.55	4	5.43
2	322107	337358	0.24	6.54	1.77	0.39	4.76	0.71	4	7.87
3	322109	337359	0.31	7.83	2.36	0.43	5.98	0.71	4	14.04
4	322110	337360	0.24	8.66	2.83	0.55	7.48	0.71	8	22.50
6	322112	337361	0.31	11.18	3.86	0.87	9.49	0.875	8	47.27

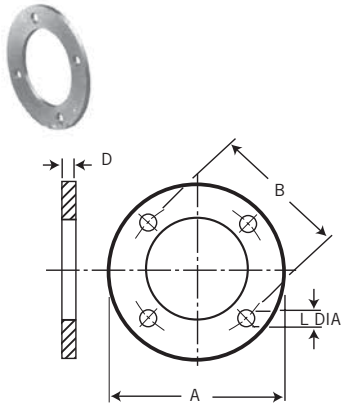
Flange, Stub – Socket



Nom. Pipe Size	Significant No.	Product Code	Critical Dimensions				
			Z_1	B	A	D	Wt. (oz)
2	135107	337235	0.12	1.57	3.78	0.55	3.17
3	135109	337236	0.24	2.24	5.00	0.71	7.05
4	135110	337237	0.24	2.72	6.26	0.79	12.35
6	135112	337238	0.43	4.09	8.39	0.94	28.40
8	135113	337239	0.55	5.20	10.59	1.02	73.20

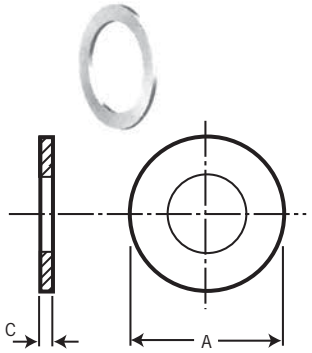
DIMENSIONS

Gasket, Full-face – EPDM, Drilled to ANSI 150



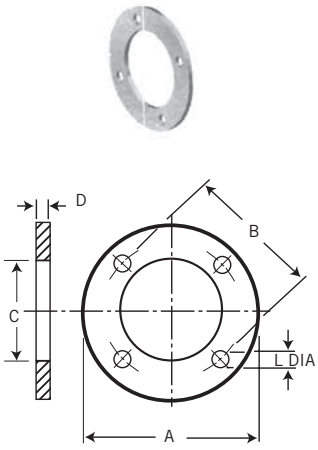
Nom. Pipe Size	Significant No.	Product Code	Critical Dimensions					
			A	B	D	L	Holes	Wt. (oz)
1/2	426102	337439	3.74	2.36	0.12	0.55	4	1.09
3/4	426103	337440	4.41	2.76	0.12	0.55	4	1.31
1	426104	337441	4.53	3.15	0.12	0.55	4	1.31
1-1/4	426105	337442	4.75	3.50	0.12	0.625	4	1.45
1-1/2	426106	337443	5.24	3.86	0.12	0.55	4	1.94
2	426107	337444	6.02	4.76	0.12	0.71	4	1.98
3	426109	337445	7.24	5.98	0.12	0.71	4	3.46
4	426110	337446	8.50	7.48	0.12	0.71	8	3.95
6	426112	337447	11.02	9.49	0.12	0.875	8	5.71

Gasket, Stub Flange – EPDM



Nom. Pipe Size	Significant No.	Product Code	Critical Dimensions		
			A	C	Wt. (oz)
2	431107	337448	3.82	0.12	0.74
3	431109	337449	5.04	0.12	0.81
4	431110	337450	6.30	0.15	1.27
6	431112	337451	8.43	0.15	1.55
8	431113	337452	10.59	0.15	3.25

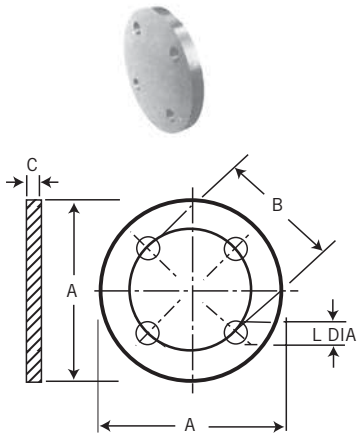
Backing Rings - Galvanized Mild Steel, Drilled to ASA 150



Nom. Pipe Size	Significant No.	Product Code	Critical Dimensions						
			A	B	C	D	L	Holes	Wt. (oz)
1/2	425102	337426	3.50	2.36	1.38	0.24	0.55	4	8.47
3/4	425103	337427	3.86	2.76	1.77	0.24	0.55	4	9.52
1	425104	337428	4.25	3.15	1.93	0.24	0.55	4	11.64
1-1/4	425105	337429	4.63	3.50	2.35	0.25	0.625	4	10.30
1-1/2	425106	337430	5.04	3.86	2.68	0.24	0.55	4	14.81
2	425107	337431	6.02	4.76	3.07	0.31	0.71	4	27.87
3	425109	337433	7.52	5.98	4.33	0.31	0.71	4	42.33
4	425110	337434	9.06	7.48	5.51	0.35	0.71	8	55.73
6	425112	337435	11.02	9.49	7.68	0.43	0.875	8	78.66
8	425113	337436	13.39	11.73	10.04	0.47	0.875	8	107.94

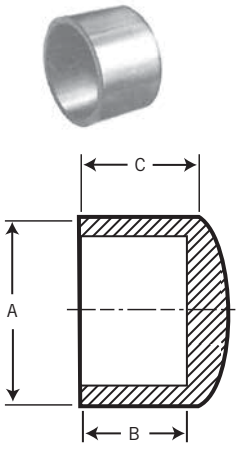
DIMENSIONS

Blind Flanges – Drilled to ANSI 150



Nom. Pipe Size	Significant No.	Product Code	Critical Dimensions					
			A	B	C	L	Holes	Wt. (oz)
3	325109	337364	7.76	5.98	0.750	0.71	4	18.34
4	325110	337365	8.43	7.18	0.750	0.71	8	25.40
6	325112	337366	11.26	9.49	1.02	0.875	8	55.56
8	325113	337367	13.27	11.73	1.02	0.875	8	81.13

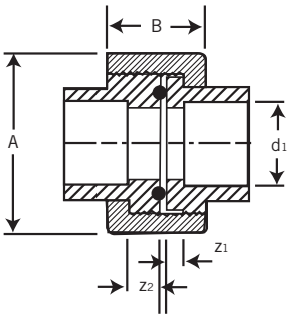
Cap – Socket



Nom. Pipe Size	Significant No.	Product Code	Critical Dimensions			
			A	B	C	Wt. (oz)
1/2	140102	337246	1.06	0.63	0.79	0.21
3/4	140103	337247	1.42	0.67	0.91	0.35
1	140104	337248	1.73	0.83	1.10	0.63
1-1/4	140105	337249	2.17	0.87	1.22	1.16
1-1/2	140106	337250	2.48	0.98	1.38	1.76
2	140107	337251	3.07	1.10	1.57	3.17
3	140109	337252	4.37	2.09	2.56	9.24
4	140110	337253	5.35	2.51	3.26	16.40

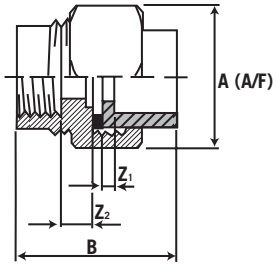
DIMENSIONS

Union – Socket/Plastic to Plastic, EPDM 'o' ring



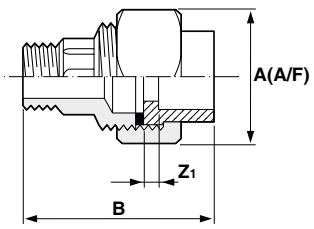
Nom. Pipe Size	Significant No.	Product Code	Critical Dimensions						
			d_1	Z_1	Z_2	A	B	psi Rating	Wt. (oz)
1/2	205102	337271	0.84	0.20	0.39	1.69	1.93	230	1.27
3/4	205103	337272	1.05	0.20	0.39	2.01	2.17	230	1.80
1	205104	337273	1.32	0.28	0.47	2.52	2.56	230	3.03
1-1/4	205105	337274	1.66	0.39	0.55	2.83	3.03	230	4.30
1-1/2	205106	337275	1.90	0.51	0.63	3.11	3.62	230	5.64
2	205107	337276	2.38	0.59	0.75	4.02	4.41	230	10.47
3	205109	337277	3.50	0.24	0.16	6.10	4.45	145	26.45
4	205110	337278	4.50	0.28	0.24	7.09	5.43	145	40.73

Union, Composite – Plastic to Brass, Socket/Female BSPT, EPDM 'o' ring



Nom. Pipe Size	Significant No.	Product Code	Critical Dimensions				
			Z_1	Z_2	A	B	Wt. (oz)
1/2	212102	337300	0.12	0.28	1.57	1.65	5.82
3/4	212103	337301	0.12	0.35	1.89	1.93	10.23
1	212104	337302	0.43	0.47	2.17	2.32	10.93
1-1/4	212105	337303	0.35	0.39	2.56	2.68	15.87
1-1/2	212106	337304	0.47	0.55	3.11	2.95	28.22
2	212107	337305	0.55	0.55	3.46	3.54	33.51

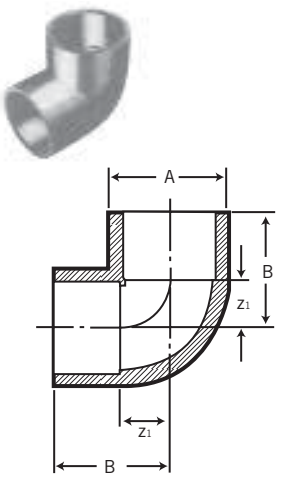
Union, Composite – Plastic to Brass, Socket/Male MPT, EPDM 'o' ring



Nom. Pipe Size	Significant No.	Product Code	Critical Dimensions			
			Z_1	A	B	Wt. (oz)
1/2	217102	337400	0.12	1.57	2.13	6.17
3/4	217103	337401	0.12	1.89	2.91	11.29
1	217104	337109	0.31	2.17	3.39	14.82
1-1/4	217105	337191	0.39	2.56	3.70	21.87
1-1/2	217106	337192	0.51	3.07	4.25	35.27
2	217107	337193	0.59	3.46	5.08	42.33

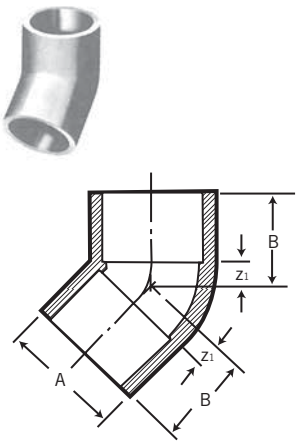
DIMENSIONS

Elbow, 90° – Socket



Nom. Pipe Size	Significant No.	Product Code	Critical Dimensions			
			Z1	A	B	Wt. (oz)
1/2	115102	337133	0.47	1.02	1.14	0.39
3/4	115103	337134	0.55	1.26	1.34	0.67
1	115104	337135	0.67	1.61	1.61	1.23
1-1/4	115105	337136	0.83	2.05	1.93	2.47
1-1/2	115106	337137	1.02	2.36	2.20	3.56
2	115107	337138	1.22	2.91	2.68	6.74
3	115109	337139	2.05	4.37	4.09	25.40
4	115110	337140	2.56	5.55	5.12	53.09
6	115112	337141	3.35	7.99	6.89	136.16
8	115113	337142	4.41	10.08	9.88	243.39

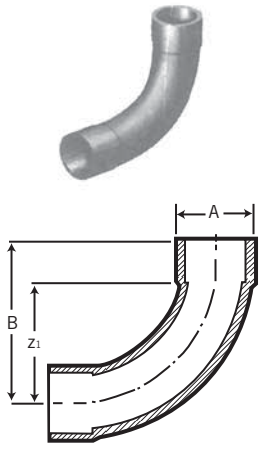
Elbow, 45° – Socket



Nom. Pipe Size	Significant No.	Product Code	Critical Dimensions			
			Z1	A	B	Wt. (oz)
1/2	119102	337157	0.31	1.06	1.02	0.32
3/4	119103	337158	0.47	1.30	1.06	0.53
1	119104	337159	0.51	1.61	1.46	0.99
1-1/4	119105	337160	0.59	2.05	1.73	2.08
1-1/2	119106	337161	0.71	2.36	1.97	3.03
2	119107	337162	1.06	3.23	2.60	5.64
3	119109	337163	1.57	4.41	3.70	26.46
4	119110	337164	1.97	5.47	4.53	45.86
6	119112	337165	1.61	7.80	5.28	84.30
8	119113	337166	2.56	10.20	7.17	198.24

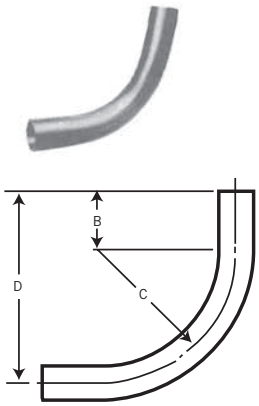
DIMENSIONS

Bend, 90° – Short Radius



Nom. Pipe Size	Significant No.	Product Code	Critical Dimensions			
			Z_1	A	B	Wt. (oz)
1/2	118102	337148	1.69	1.02	2.20	0.71
3/4	118103	337149	1.77	1.30	2.56	1.59
1	118104	337150	2.48	1.57	3.35	2.29
1-1/4	118105	337151	3.19	2.01	4.25	4.59
1-1/2	118106	337152	4.02	2.44	5.28	10.23
2	118107	337153	4.96	2.87	6.50	19.75
3	118109	337154	6.77	4.37	8.90	50.97
4	118110	337155	8.50	5.51	11.02	84.66

Bend, 90° Long Radius – 4 x D, spigot

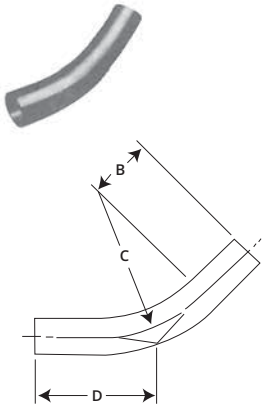


Nom. Pipe Size	Significant No.	Product Code	Critical Dimensions			
			B	C	D	Wt. (oz)
3	309109	337320	3.86	12.01	15.87	54.15
4	309110	337321	5.43	16.02	21.46	121.34
6	309112	337322	8.15	24.02	32.17	332.63
8	309113	337323	14.25	31.97	46.22	672.68

Note: Long radius bends are fabricated from the highest pressure rated pipe available in each case. Tolerance on angle +/- 3°.

DIMENSIONS

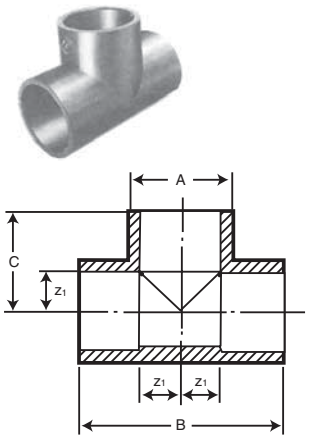
Bend, 45° Long Radius – 4 x D, spigot



Nom. Pipe Size	Significant No.	Product Code	Critical Dimensions			
			B	C	D	Wt. (oz)
3	310109	337330	4.76	12.01	9.37	38.80
4	310110	337331	5.71	16.02	11.81	80.78
6	310112	337332	8.58	24.02	17.32	221.87
8	310113	337333	11.02	31.97	23.31	403.53

Note: Long radius bends are fabricated from the highest pressure rated pipe available in each case. Tolerance on angle +/- 3°.

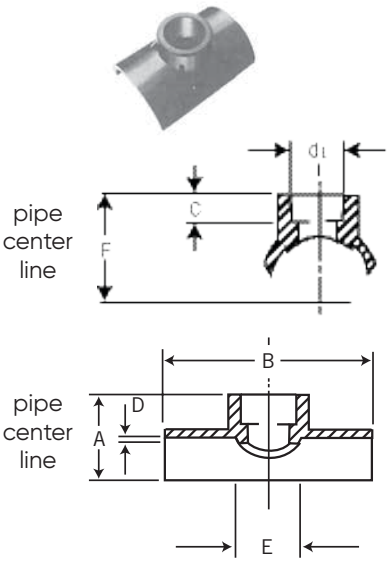
Tee, Socket



Nom. Pipe Size	Significant No.	Product Code	Critical Dimensions				
			Z_1	A	B	C	Wt. (oz)
1/2	122102	337171	0.43	1.02	2.28	1.14	0.46
3/4	122103	337172	0.59	1.26	2.72	1.34	0.81
1	122104	337173	0.75	1.61	3.27	1.65	1.52
1-1/4	122105	337174	0.91	2.05	3.98	1.97	3.25
1-1/2	122106	337175	0.98	2.32	4.45	2.09	4.69
2	122107	337176	1.22	2.91	5.39	2.76	8.78
3	122109	337177	1.73	4.45	8.03	4.13	32.66
4	122110	337178	2.13	5.63	9.61	4.76	69.14
6	122112	337179	3.46	8.07	13.98	6.89	169.67
8	122113	337180	3.94	10.12	18.43	9.45	338.63

DIMENSIONS

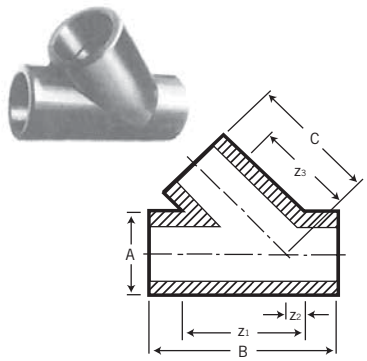
Saddle, Socket



Nom. Pipe Size	Significant No.	Product Code	Critical Dimensions							
			d_1	A	B	C	D	E	F	Wt. (oz)
2 x 1-1/4	126129	337205	1.66	2.36	5.35	1.12	0.10	1.89	1.30	3.17
*3 x 1	126132	337207	1.32	2.99	5.51	0.93	0.13	2.36	1.81	6.24
3 x 1-1/2	126134	337208	1.90	2.99	5.51	1.16	0.13	2.36	1.81	5.57
*4 x 1	126137	337209	1.32	3.74	5.51	0.93	0.18	2.87	2.36	9.70
4 x 2	126140	337210	2.38	3.74	5.51	1.37	0.18	2.87	2.36	8.11
*6 x 1	126143	337211	1.32	2.80	5.98	0.93	0.26	2.87	3.46	9.53
6 x 1-1/2	126145	337212	1.90	2.80	5.98	1.16	0.26	2.87	3.46	9.42
6 x 2	126146	337213	2.38	2.80	5.98	1.37	0.26	2.87	3.46	7.94

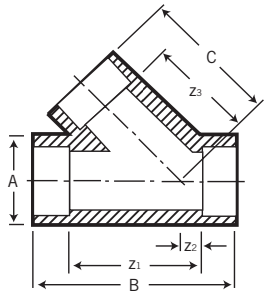
Note: Two saddles can be mounted diametrically opposite.
* fabricated

Wye, 45°, Socket End



Nom. Pipe Size	Significant No.	Product Code	Critical Dimensions						
			Z_1	Z_2	Z_3	A	B	C	Wt. (oz)
1/2	128102	337214	1.34	0.28	1.06	1.10	2.68	1.73	1.06
3/4	128103	337215	1.61	0.31	1.26	1.30	3.19	2.05	1.59
1	128104	337216	1.93	0.35	1.54	1.61	3.82	2.48	2.82
1-1/4	128105	337217	2.40	0.39	2.05	1.97	4.61	3.15	6.84
1-1/2	128106	337218	3.15	0.47	2.64	2.36	5.51	3.82	10.51
2	128107	337219	3.54	0.59	2.87	2.91	6.69	4.45	19.26

Spigot End – Fabricated

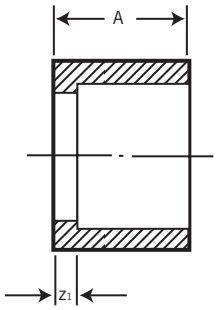


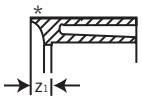
Nom. Pipe Size	Significant No.	Product Code	Critical Dimensions						
			Z_1	Z_2	Z_3	A	B	C	Wt. (oz)
3	128109	337220	11.00	3.50	7.00	3.50	17.00	10.00	152.31
4	128110	337221	13.50	4.00	8.50	4.50	19.50	12.00	203.18
6	128112	337222	16.50	4.50	10.50	6.625	26.50	15.50	279.16
8	128113	337223	18.00	4.50	13.00	8.625	30.00	19.00	459.02

Note: Spigot wyes are fabricated from pipe and FRP wrapped for rigidity. Fabricated wyes are not pressure rated.

DIMENSIONS

Reducer Bushing – Spigot x Socket

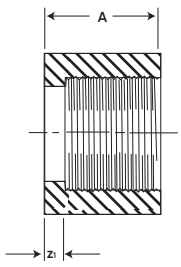




Nom. Pipe Size	Significant No.	Product Code	Critical Dimensions		
			Z1	A	Wt. (oz)
1/2 x 3/8	109121	337050	0.08	0.67	0.25
3/4 x 1/2	109122	337051	0.12	0.79	0.28
1 x 1/2	109123	337052	0.24	0.91	0.81
1 x 3/4	109124	337053	0.16	0.94	0.53
*1-1/4 x 1/2	109116	337045	0.47	1.10	0.74
*1-1/4 x 3/4	109117	337046	0.31	1.10	0.67
1-1/4 x 1	109125	337054	0.20	1.10	0.71
*1-1/2 x 1/2	109118	337047	0.51	1.18	0.92
*1-1/2 x 3/4	109119	337048	0.39	1.18	0.95
1-1/2 x 1	109126	337055	0.28	1.18	0.67
1-1/2 x 1 1/4	109127	337056	0.16	1.22	1.41
*2 x 3/4	109120	337049	0.59	1.50	1.59
*2 x 1	109128	337057	0.59	1.50	1.59
*2 x 1-1/4	109129	337058	0.43	1.50	1.38
2 x 1-1/2	109130	337059	0.28	1.46	1.48
*3 x 1-1/2	109134	337061	0.83	2.01	4.58
*3 x 2	109135	337062	0.59	2.01	6.28
4 x 3	109141	337064	0.47	2.56	9.77
*6 x 4	109147	337065	1.06	3.66	23.49
*8 x 6	109152	337066	0.91	4.33	41.80

* fabricated

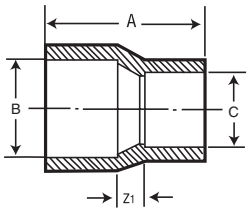
Reducer Bushing – Spigot x Female BSBT



Nom. Pipe Size	Significant No.	Product Code	Critical Dimensions		
			Z1	A	Wt. (oz)
1/2 x 3/8	111121	337072	0.24	0.67	0.14
3/4 x 1/2	111122	337073	0.20	0.79	0.25
1 x 3/4	111124	337074	0.24	0.91	0.42

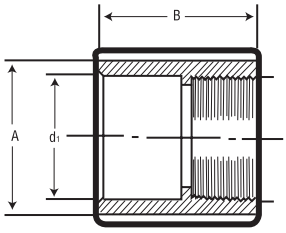
DIMENSIONS

Reducer Coupling – Socket



Nom. Pipe Size	Significant No.	Product Code	Critical Dimensions				
			B	C	Z1	A	Wt. (oz)
3/4 x 1/2	114122	337121	1.26	1.02	0.28	1.73	0.39
1 x 3/4	114124	337122	1.61	1.30	0.35	2.09	0.74
1-1/4 x 1	114125	337123	2.05	1.61	0.39	2.48	1.38
1-1/2 x 1-1/4	114127	337124	2.32	2.01	0.31	2.68	2.05
2 x 1-1/2	114130	337125	2.91	2.32	0.47	3.23	3.53
3 x 2	114135	337126	4.25	2.95	1.02	4.49	11.29
4 x 3	114141	337127	5.35	4.25	0.79	5.35	19.68
6 x 4	114147	337128	8.07	5.51	2.17	8.39	69.67
8 x 6	114152	337129	10.08	7.80	1.97	10.35	120.28

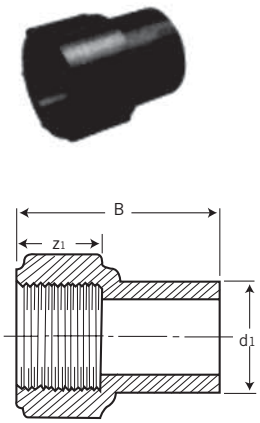
Female Adapter – Socket x FPT



Nom. Pipe Size	Significant No.	Product Code	Critical Dimensions				
			d1	Z1	A	B	Wt. (oz)
1/2	101102	337094	0.84	0.12	1.10	1.46	0.28
3/4	101103	337095	1.05	0.12	1.42	1.61	0.49
1	101104	337096	1.32	0.12	1.73	1.89	1.06
1-1/2	101106	337097	1.90	0.12	2.48	2.60	2.29
2	101107	337098	2.38	0.12	3.11	2.76	4.02

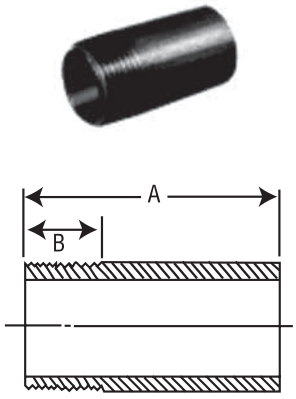
DIMENSIONS

Female Adapter – Spigot x BSPT



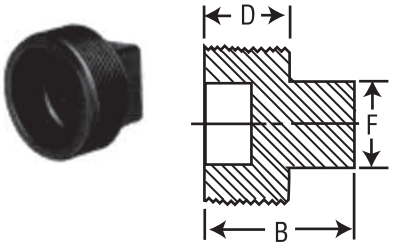
Nom. Pipe Size	Significant No.	Product Code	Critical Dimensions			
			Z_1	A	B	Wt. (oz)
1/2	153102	337257	0.63	1.06	1.50	0.28
3/4	153103	337258	0.71	1.42	1.73	0.49
1	153104	337259	0.83	1.69	1.97	0.85
1-1/4	153105	337260	0.87	2.17	2.36	1.73
1-1/2	153106	337261	0.98	2.48	2.60	2.10
2	153107	337262	1.14	3.07	3.07	4.55

Nipple – Spigot x MPT



Nom. Pipe Size	Significant No.	Product Code	Critical Dimensions		
			A	B	Wt. (oz)
1/2	314102	337341	3.00	0.90	0.35
3/4	314103	337342	3.00	1.00	0.46
1	314104	337343	3.00	1.10	0.69
1-1/2	314106	337345	3.00	1.35	1.39
2	314107	337346	3.00	1.35	2.08
3	314109	337347	6.00	1.50	11.00
4	314110	337348	6.00	2.10	20.00

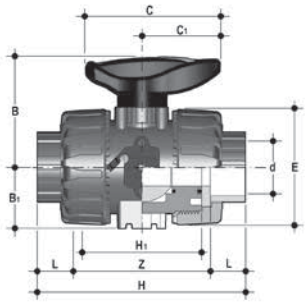
Plug – Male BSPT



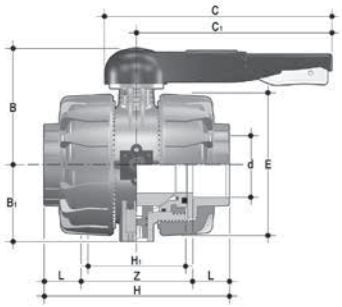
Nom. Pipe Size	Significant No.	Product Code	Critical Dimensions			
			B	D	F	Wt. (oz)
1/2	155102	337264	0.91	0.55	0.51	0.20
3/4	155103	337265	1.10	0.59	0.55	0.30
1	155104	337266	1.18	0.67	0.67	0.40
1-1/4	155105	337267	1.38	0.87	0.87	1.10
1-1/2	155106	337268	1.50	0.87	1.06	1.30
2	155107	337269	1.77	1.02	1.46	1.80

DIMENSIONS

VKD Series Ball Valve – T/U Socket, EPDM Seals



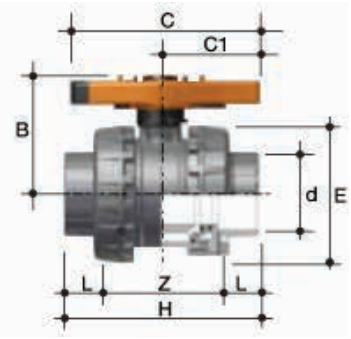
Sizes 1/2" to 2"



Sizes 3" to 4"

Nom. Pipe Size	Significant No.	Product Code	Critical Dimensions (inches)									
			d	H	L	Z	H1	E	B1	B	C_1	C
1/2	902102	337802	0.84	4.61	0.89	2.83	2.56	2.13	1.14	2.13	1.57	2.64
3/4	902103	337803	1.05	5.08	1.00	3.07	2.76	2.56	1.36	2.56	1.93	3.35
1	902104	337804	1.32	5.59	1.13	3.33	3.07	2.87	1.54	2.74	1.93	3.35
1-1/4	902105	337805	1.66	6.38	1.26	3.86	3.46	3.39	1.81	3.25	2.52	4.25
1-1/2	902106	337806	1.90	6.77	1.38	4.02	3.66	3.86	2.05	3.50	2.52	4.25
2	902107	337807	2.38	7.83	1.50	4.83	4.37	4.80	2.44	4.25	2.99	5.28
3	902109	337808	3.50	10.63	1.89	6.85	5.87	7.99	4.13	6.97	10.71	12.87
4	902110	337809	4.50	12.13	2.26	7.60	6.57	9.37	5.08	7.68	12.99	15.16

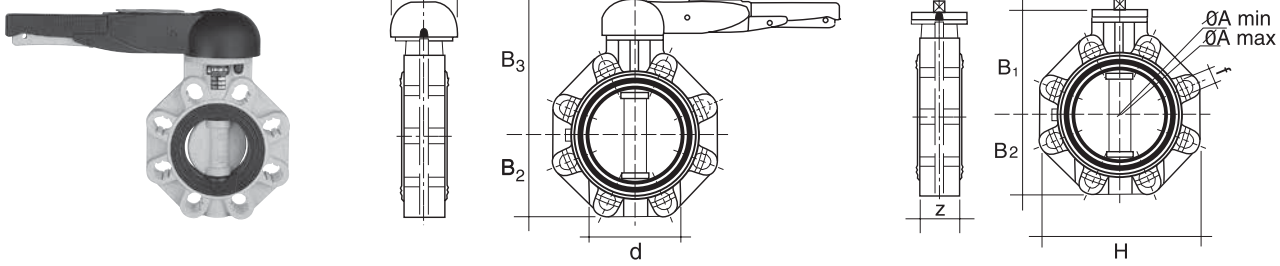
VXE Series Ball Valve – T/U Socket, EPDM Seals



Nom. Pipe Size	Significant No.	Product Code	Critical Dimensions (inches)								
			d	L	Z	H	E	B	C	C_1	Wt. (lbs)
1/2	902111	337810	0.84	0.65	1.93	3.23	2.13	1.93	2.52	0.79	0.37
3/4	902112	337811	1.05	0.75	2.09	3.58	2.48	2.44	3.07	0.91	0.56
1	902113	337812	1.32	0.89	2.28	4.06	2.83	2.80	3.43	1.06	0.78
1-1/4	902114	337813	1.66	1.02	2.68	4.72	3.35	3.23	4.02	1.18	1.21
1-1/2	902115	337814	1.90	1.18	3.11	5.47	3.94	3.62	4.29	1.30	1.70
2	902116	337815	2.38	1.42	4.02	6.85	4.65	4.33	5.24	1.54	2.83

DIMENSIONS

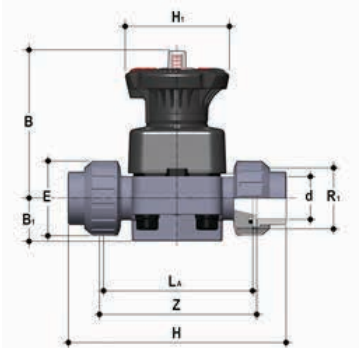
FK Series Butterfly Valve – EPDM / FKM Seals



Nom. Pipe Size	Significant No.	Product Code	Critical Dimensions (inches)											
			d	A MIN	A MAX	B_1	B_2	B_3	C	C_1	f	H	Z	Wt. (lbs)
2	681107	337656	1.97	5.04	5.70	4.69	3.15	6.46	10.70	4.33	0.75	6.50	1.81	3.23
3	681109	337657	3.15	5.71	6.30	5.24	3.66	7.00	10.70	4.33	0.75	7.28	1.93	4.11
4	681110	337658	3.94	6.50	7.50	5.79	4.21	7.56	10.70	4.33	0.75	8.31	2.20	4.88
6	681112	337659	5.91	9.10	9.53	7.10	5.30	8.86	12.99	4.33	0.91	10.60	2.80	8.47
8	681113	337660	7.87	11.02	11.73	8.94	6.34	10.71	16.54	4.80	0.91	12.72	2.80	14.35

Disc: Shall be ABS. Other materials and larger sizes are available upon request.

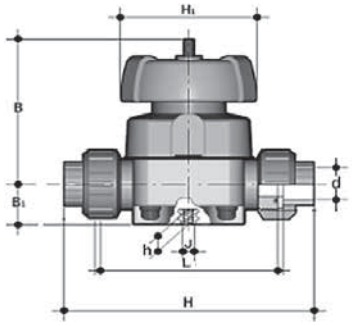
DK Diaphragm Valve – Spigot, EPDM Diaphragm



Nom. Pipe Size	Significant No.	Product Code	Critical Dimensions (inches)									
			d	B	B_1	E	H	H_1	L_A	R_1	Z	Wt. (lbs)
1/2	H0DVA102	337119	0.84	4.02	0.98	1.61	5.63	3.15	3.54	1	3.86	1.72
3/4	H0DVA103	337194	1.05	4.13	1.18	1.97	6.57	3.15	4.25	1-1/4	4.53	1.98
1	H0DVA104	337195	1.32	4.49	1.30	2.28	7.09	3.15	4.57	1-1/2	4.80	2.49
1-1/4	H0DVA105	337196	1.66	4.69	1.18	2.83	8.19	3.15	5.28	2	5.67	3.02
1-1/2	H0DVA106	337197	1.90	5.79	1.38	3.11	9.21	4.72	6.06	1-1/4	6.46	5.07
2	H0DVA107	337198	2.38	6.77	1.81	3.86	10.71	4.72	7.24	2-3/4	7.68	7.34

DIMENSIONS

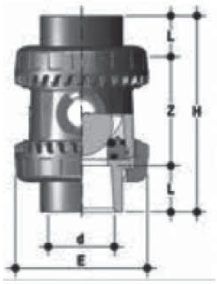
VM Series Diaphragm Valve – Spigot, EPDM Diaphragm



Nom. Pipe Size	Significant No.	Product Code	Critical Dimensions (inches)								
			d	H	L	B_1	B	H_1	h	J	Wt. (lbs)
3	H0VMA209	337649	3.50	11.81	2.01	2.17	8.86	8.46	0.91	M12	15.43
4	H0VMA210	337116	4.50	13.78	–	2.72	11.61	9.84	0.91	M12	23.15

Note: Other diaphragm materials available upon request

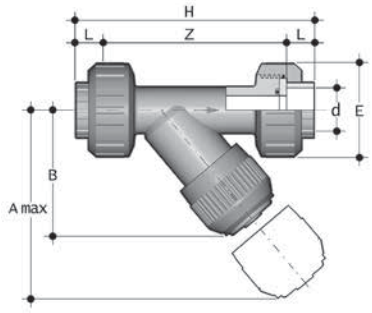
SXE Ball Check Valve – Socket, EPDM Seals



Nom. Pipe Size	Significant No.	Product Code	Critical Dimensions (inches)					
			d	L	Z	H	E	Wt. (lbs)
1/2	H0SXA102	337501	0.84	0.65	1.97	3.23	2.13	0.29
3/4	H0SXA103	337502	1.05	0.75	2.09	3.58	2.48	0.38
1	H0SXA104	337503	1.32	0.89	2.32	4.06	2.83	0.60
1-1/4	H0SXA105	337504	1.66	1.02	2.68	4.72	3.35	0.91
1-1/2	H0SXA106	337505	1.90	1.18	3.03	5.47	3.94	1.34
2	H0SXA107	337506	2.38	1.42	3.86	6.85	4.65	2.14

DIMENSIONS

RV Series Sediment Strainers – T/U Socket, EPDM Seals



Nom. Pipe Size	Significant No.	Product Code	Critical Dimensions (inches)						
			d	L	Z	H	E	B	Amax
1/2	846102	337739	0.84	0.63	4.06	5.31	2.17	2.83	4.92
3/4	846103	337740	1.05	0.75	4.72	6.22	2.60	3.31	5.71
1	846104	337741	1.32	0.87	5.20	6.93	2.95	3.74	6.50
1-1/4	846105	337742	1.66	1.02	6.10	8.15	3.43	4.37	7.48
1-1/2	846106	337743	1.90	1.22	7.13	9.57	3.94	4.72	8.27
2	846107	337744	2.38	1.50	8.72	11.73	4.72	5.47	9.45

Mesh: 1.5mm, ASTM mesh size 30, Polypropylene.

SECTION SEVEN: SPECIFICATIONS

Sample Specification

General

Duraplus ABS is designed for industrial pressure pipe applications where the extremely high-impact resistance and ductility of the material offers some insurance against internal and external shock loadings and site abuse conditions. It's unique combination of ABS properties – non-toxicity, purity, corrosion- and chemical-resistance, toughness, low-hydraulic resistance, and the ability to perform over a wide temperature range (-40°F to +140°F) ensures excellent in-service performance and system life.

Material Specification

Pipe and fittings shall be manufactured from a copolymeric material – Acrylonitrile Butadiene Styrene (ABS) – conforming to a 43232 cell classification in accordance with ASTM D3965.

Material for both pipe and fittings shall have a design stress of not less than 2,000 psi, and shall be designed with a 2 to 1 safety factor for a 50 year lifespan when operated under continuous pressure.

The material shall have an izod impact resistance value of not less than 6 ft./lb. at 73°F and 3 ft./lb. at -22°F, when tested in accordance with ASTM D256, method 'A'.

Pipe

Pipes shall be manufactured by IPEX and designed on a Standard Dimension Ratio (SDR) basis to give various pressure ratings as described below:

Pipe Class	SDR	Continuous Pressure Rating at 73°F (23°C)	Size Range
Class C	SDR 15.5	145 psi	1" to 8"
Class E	SDR 10.0	230 psi	1/2" to 4"
Class T	–	180 psi	1/2" to 4"

Fittings

Fittings shall be of the socket type, designed for solvent welding as supplied by IPEX.

Fittings shall be designed and manufactured so that they withstand the continuous pressures applicable to the maximum pressure native of the pipe.

Solvent Cement

All joints shall be made with Gray Duraplus ABS solvent cement as supplied by IPEX.

The solvent cement shall be designed to withstand continuous applied pressures up to 230 psi at 73°F.

Design and Installation

The design and installation of ABS pressure systems shall be performed in accordance with the recommendations detailed in the Handling and Installation section of this manual, local and national regulations where applicable.

To ensure the full integrity of the completed system, all components shall be supplied by IPEX.

APPENDIX A: CONVERSION CHARTS

Contents of Pipe

Capacities in Cubic Feet and United States Gallons (231 Cubic Inches) per foot of Length

Dia. in.	Dia. ft.	For 1 Foot Length		Dia. in.	Dia. ft.	For 1 Foot Length		Dia. in.	Dia. ft.	For 1 Foot Length	
		$ft.^3$ Also Area in. $ft.^2$	U.S. Gal. (231 $in.^3$)			$ft.^3$ Also Area in. $ft.^2$	U.S. Gal. (231 $in.^3$)			$ft.^3$ Also Area in. $ft.^2$	U.S. Gal. (231 $in.^3$)
1/4	0.0208	0.0003	0.0026	4-1/4	0.3542	0.0985	0.7370	10-1/2	0.8750	0.6013	4.4980
5/16	0.0260	0.0005	0.0040	4-1/2	0.3750	0.1105	0.8263	10-3/4	0.8958	0.6303	4.7140
3/8	0.0313	0.0008	0.0057	4-3/4	0.3958	0.1231	0.9205	11	0.9167	0.6600	4.9370
7/16	0.0365	0.0010	0.0078	5	0.4167	0.1364	1.0200	11-1/4	0.9375	0.6903	5.1630
1/2	0.0417	0.0014	0.0102	5-1/4	0.4375	0.1503	1.1240	11-1/2	0.9583	0.7213	5.3950
9/16	0.0469	0.0017	0.0129	5-1/2	0.4583	0.1650	1.2340	11-3/4	0.9792	0.7530	5.6330
5/8	0.0521	0.0021	0.0159	5-3/4	0.4792	0.1803	1.3490	12	1.0000	0.7854	5.8760
11/16	0.0573	0.0026	0.0193	6	0.500	0.1963	1.4690	12-1/2	1.0420	0.8523	6.3750
3/4	0.0625	0.0031	0.0230	6-1/4	0.5208	0.2130	1.5940	13	1.0830	0.9218	6.8950
13/16	0.0677	0.0036	0.0270	6-1/2	0.5417	0.2305	1.7240	13-1/2	1.1250	0.9940	7.4350
7/8	0.0729	0.0042	0.0312	6-3/4	0.5625	0.2485	1.8590	14	1.1670	1.0690	7.9970
15/16	0.0781	0.0048	0.0359	7	0.5833	0.2673	1.9990	14-1/2	1.2080	1.1470	8.5780
1	0.0833	0.0055	0.0408	7-1/4	0.6042	0.2868	2.1440	15	1.2500	1.2270	9.1800
1-1/4	0.1042	0.0085	0.0638	7-1/2	0.6250	0.3068	2.2950	15-1/2	1.2920	1.3100	9.8010
1-1/2	0.1250	0.0123	0.0918	7-3/4	0.6458	0.3275	2.4500	16	1.3330	1.3960	10.4400
1-3/4	0.1458	0.0168	0.1250	8	0.6667	0.3490	2.6110	16-1/2	1.3750	1.4850	11.1100
2	0.1667	0.0218	0.1632	8-1/4	0.6875	0.3713	2.7770				
2-1/4	0.1875	0.0276	0.2066	8-1/2	0.7083	0.3940	2.9480				
2-1/2	0.2083	0.0341	0.2550	8-3/4	0.7292	0.4175	3.1250				
2-3/4	0.2292	0.0413	0.3085	9	0.7500	0.4418	3.3050				
3	0.2500	0.0491	0.3673	9-1/4	0.7708	0.4668	3.4920				
3-1/4	0.2708	0.0576	0.4310	9-1/2	0.7917	0.4923	3.6820				
3-1/2	0.2917	0.0668	0.4998	9-3/4	0.8125	0.5185	3.8790				
3-3/4	0.3125	0.0767	0.5738	10	0.8333	0.5455	4.0810				
4	0.3333	0.0873	0.6528	10-1/4	0.8542	0.5730	4.2860				

Volume

Volume of a pipe is computed by: $V = 1/4\,ID^2 \times \pi \times L \times 12$

Where: V = volume (in cubic inches)
ID = inside diameter (in inches)
π = 3.14159
L = length of pipe (in feet)

Weight

1 U.S. gallon @ 50°F..... 8.33 lbs. x sg
1 cubic foot..... 62.35 lbs. x sg
..... 7.48 U.S. gal.
1 cu. ft. of water @ 50°F ... 62.41 lbs.
1 cu. ft. of water @ 39.2°F 62.43 lbs.
(39.2°F is water temp. at its greatest density)
1 kilogram..... 2.2 lbs.
1 imperial gallon of water 10.0 lbs.
1 pound..... 12 U.S. gal ÷ sg
..... .016 cu. ft. ÷ sg

Capacity or Flow

1 U.S. gallon per minute (gpm) 0.134 cfm
.....500 lb. per hr. x sp. gr.
.....500 lb. per hr. 1 gpm ÷ sp. gr.
1 cu. ft. per minute (cfm) .....449 gph
1 cu. ft. per second (cfs) .....449 gpm
1 acre foot per day .....227 gpm
1 acre inch per hour .....454 gpm
1 cubic meter per minute .....264.2 gpm
1,000,000 gal. per day .....595 gpm

Brake H.P. = $\frac{\text{(gpm) (total head in ft.) (specific gravity)}}{\text{(3960) (pump eff.)}}$

Pressure Conversion BY FACTOR TO OBTAIN

Multiply Given Number of ↓

Given	lb./in.^{2}	in.H_2O (at +39.2°F)	cmH_2O (at +4°C)								lb./ft.^{2}	ft.H_2O (at +39.2°F)
lb./in.2	1.000	$2.7680x10^{1}$	$7.0308x10^{1}$	2.0360	$5.1715x10^{1}$	$6.8948x10^{4}$	$6.8948x10^{3}$	$7.0306x10^{-2}$	$6.8947x10^{-2}$	$6.8045x10^{-2}$	$1.4400x10^{2}$	2.3067
in.H20 (at +39.2°F)	$3.6127x10^{-2}$	1.0000	2.5400	$7.3554x10^{-2}$	1.8683	$2.49808x10^{3}$	$2.4908x10^{2}$	$2.5399x10^{-3}$	$2.4908x10^{-3}$	$2.4582x10^{-3}$	5.2022	$8.3333x10^{-2}$
cm H_2O (at +4°C)	$1.4223x10^{-2}$	0.3937	1.0000	$2.8958x10^{-2}$	0.7355	$9.8064x10^{2}$	$9.8064x10^{1}$	$9.9997x10^{-4}$	$9.8064x10^{-4}$	$9.6781x10^{-4}$	2.0481	$3.2808x10^{-2}$
in. Hg (at +32°F)	$4.9116x10^{-1}$	$1.3596x10^{1}$	$3.4532x10^{1}$	1.0000	$2.5400x10^{1}$	$3.3864x10^{4}$	$3.3864x10^{3}$	$3.4532x10^{-2}$	$3.3864x10^{-2}$	$3.3421x10^{-2}$	$7.0727x10^{1}$	1.1330
mm Hg (Torr) (at 0°C)	$1.9337x10^{-2}$	$5.3525x10^{-1}$	1.3595	$3.9370x10^{-2}$	1.0000	$1.3332x10^{3}$	$1.3332x10^{2}$	$1.3595x10^{-3}$	$1.3332x10^{-3}$	$1.3158x10^{-3}$	2.7845	$4.4605x10^{-2}$
dyne/cm^2 (1m bar)	$1.4504x10^{5}$	$4.0147x10^{-4}$	$1.0197x10^{-3}$	$2.9530x10^{-5}$	$7.5006x10^{-4}$	1.0000	$1.0000x10^{-1}$	$1.0197x10^{-6}$	$1.0000x10^{-6}$	$9.8692x10^{-7}$	$2.0886x10^{-3}$	$3.3456x10^{-5}$
newton/m^2 (PASCAL)	$1.4504x10^{-4}$	$4.0147x10^{-3}$	$1.0197x10^{-2}$	$2.9530x10^{-4}$	$7.5006x10^{-3}$	$1.0000x10^{1}$	1.0000	$1.0197x10^{-5}$	$1.0000x10^{-5}$	$9.8692x10^{-6}$	$2.0885x10^{-2}$	$3.3456x10^{-4}$
kgm/cm^2	$1.4224x10^{1}$	$3.9371x10^{2}$	$1.00003x10^{3}$	$2.8959x10^{1}$	$7.3556x10^{2}$	$9.8060x10^{5}$	$9.8060x10^{4}$	1.0000	$9.8060x10^{-1}$	$9.678x10^{-1}$	$2.0482x10^{3}$	$3.2809x10^{1}$
bar	$1.4504x10^{1}$	$4.0147x10^{2}$	$1.0197x10^{3}$	$2.9530x10^{1}$	$7.5006x10^{2}$	$1.0000x10^{6}$	$1.0000x10^{5}$	1.0197	1.0000	$9.8692x10^{-1}$	$2.0885x10^{3}$	$3.3456x10^{1}$
atm. (An)	$1.4696x10^{1}$	$4.0679x10^{2}$	$1.0333x10^{3}$	$2.9921x10^{1}$	$7.6000x10^{2}$	$1.0133x10^{6}$	$1.0133x10^{5}$	1.0332	1.0113	1.0000	$2.1162x10^{3}$	$3.3900x10^{1}$
lb./ft.^{2}	$6.9445x10^{-3}$	$1.9223x10^{-1}$	$4.882x10^{-1}$	$1.4139x10^{-2}$	$3.591x10^{-1}$	$4.7880x10^{2}$	$4.7880x10^{1}$	$4.8824x10^{-4}$	$4.7880x10^{-4}$	$4.7254x10^{-4}$	1.0000	$1.6019x10^{-2}$
ft. H_2O (at +39.2°F)	$4.3352x10^{-1}$	$1.2000x10^{1}$	$3.0480x10^{1}$	$8.826x10^{-1}$	$2.2419x10^{1}$	$2.9890x10^{4}$	$2.9890x10^{3}$	$3.0479x10^{-2}$	$2.9890x10^{-2}$	$2.9499x10^{-2}$	$6.2427x10^{1}$	1.0000

Decimal and Millimeter Equivalents of Fractions

Inches Fractions	Inches Decimals	mm	Inches Fractions	Inches Decimals	mm	Inches Fractions	Inches Decimals	mm	Inches Fractions	Inches Decimals	mm
1/64	.015625	.397	17/64	65625	6.747	33/64	.515625	13.097	49/64	.765625	19.447
1/32	03125	.794	9/32	.28125	7.144	17/32	.53125	13.494	25/32	.78125	19.844
3/64	.046875	1.191	19/64	.296875	7.541	35/64	.546875	13.891	51/64	.796875	20.241
1/16	.0625	1.588	5/16	.3125	7.938	9/16	.5625	14.288	13/16	.8125	20.638
5/64	.078125	1.984	21/64	.328125	8.334	37/64	.578125	14.684	53/64	.828125	21.034
3/32	.09375	2.381	11/32	.34375	8.731	19/32	.59375	15.081	27/32	.83475	21.431
7/64	.109375	2.778	23/64	.359375	9.128	39/64	.609375	15.478	55/64	.859375	21.828
1/8	.125	3.175	3/8	.375	9.525	5/8	.625	15.875	7/8	.875	22.225
9/64	.140625	3.572	25/64	.390625	9.922	41/64	.640625	16.272	57/64	.890625	22.622
5/32	.15625	3.969	13/32	.40625	10.319	21/32	.65625	16.669	29/32	.90625	23.019
11/64	.171875	4.366	27/64	.421875	10.716	43/64	.671875	17.066	59/64	.921875	23.416
3/16	.1875	4.763	7/16	.4375	11.113	11/16	.6875	17.463	15/16	.9375	23.813
13/64	.203125	5.159	29/64	.453125	11.509	45/64	.703125	17.859	61/64	.953125	24.209
7/32	21875	5.556	15/32	.46875	11.906	23/32	.71875	18.256	31/32	.96875	24.606
15/64	.23475	5.953	31/64	.484375	12.303	47/64	.734375	18.653	63/64	.984375	25.003
1/4	.250	6.350	1/2	.500	12.700	3/4	.750	19.050	1	1.000	25.400

CONVERSION CHARTS

Units of Length	Multiply units in left column by proper factor below							
	in.	ft.	yd.	mile	mm	cm	m	km
1 inch	1	0.0833	0.0278	-	25.4	2.540	0.0254	-
1 foot	12	1	0.3333	-	304.8	30.48	0.3048	-
1 yard	36	3	1	-	914.4	91.44	0.9144	-
1 mile	-	5280	1760	1	-	-	1609.3	1.609
1 millimeter	0.0394	0.0033	-	-	1	0.100	0.001	-
1 centimeter	0.3937	0.0328	0.0109	-	10	1	0.01	-
1 meter	39.37	3.281	1.094	-	1000	100	1	0.001
1 kilometer	-	3281	1094	0.6214	-	-	1000	1

(1 micron = 0.001 millimeter)

Units of Weight	Multiply units in left column by proper factor below						
	grain	oz.	lb.	ton	gram	kg	metric ton
1 grain	1	-	-	-	0.0648	-	-
1 ounce	437.5	1	0.0625	-	28.35	0.0283	-
1 pound	7000	16	1	0.0005	453.6	0.4536	-
1 ton	-	32,000	2000	1	-	907.2	0.9072
1 gram	15.43	0.0353	-	-	1	0.001	-
1 kilogram	-	35.27	2.205	-	1000	1	0.001
1 metric ton	-	35,274	2205	1.1023	-	1000	1

Units of Density	Multiply units in left column by proper factor below				
	lb./in.^{3}	lb./ft.^{3}	lb./gal.	g/cm^3	g/liter
1 pound/in.^{3}	1	1728	231.0	27.68	27,680
1 pound/ft.^{3}	-	1	0.1337	0.0160	16.019
1 pound/gal.	0.00433	7.481	1	0.1198	119.83
1 gram/cm^3	0.0361	62.43	8.345	1	1000.0
1 gram/liter	-	0.0624	0.00835	0.001	1

Units of Area	Multiply units in left column by proper factor below						
	in.^{2}	in.^{2}	acre	mile^2	cm^2	m^2	hectare
1 inch^2	1	1	-	-	6.452	-	-
1 foot^2	144	144	-	-	929.0	0.0929	-
1 acre	-	-	1	0.0016	-	4047	0.4047
1 mile^2	-	-	640	1	-	-	259.0
1 centimeter^2	0.1550	0.1550	-	-	1	0.0001	-
1 meter^2	1550	1550	-	-	10,000	1	-
1 hectare	-	-	2.471	-	-	10,000	1

Units of Volume	Multiply units in left column by proper factor below							
	in.^{3}	ft.^{3}	yd.^{3}	cm.^{3}	meter^3	liter	U.S. gal.	Imp. gal.
1 inch^3	1	-	-	16.387	-	0.0164	-	-
1 foot^3	1728	1	0.0370	28,317	0.0283	28.32	7.481	6.229
1 yard^3	46,656	27	1	-	0.7646	764.5	202.0	168.2
1 centimeter^3	0.0610	-	-	1	-	0.0010	-	-
1 meter^3	61,023	35.31	1.308	1,000,000	1	999.97	264.2	220.0
1 liter	61.025	0.0353	-	1000.028	0.0010	1	0.2642	0.2200
1 U.S. gallon	231	0.1337	-	3785.4	-	3.785	1	0.8327
1 Imp. gallon	277.4	0.1605	-	4546.1	-	4.546	1.201	1

CONVERSION CHARTS

Units of Pressure	Multiply units in left column by proper factor below							
	lbs./in.²	lb./ft.²	Int. etc.	kg/cm²	mm Hg at 32°F	in. Hg at 32°F	ft. water at 39.2°F	kPa
lb./in.²	1	144	-	0.0703	51.713	2.0359	2.307	6.894
lb./ft.²	0.00694	1	-	-	0.3591	0.01414	0.01602	0.04788
Int. etc.	14.696	2116.2	1	1.0333	760	29.921	33.90	-
kg/cm²	14.223	2048.1	0.9678	1	735.56	28.958	32.81	98.066
mm Hg	0.0193	2.785	-	-	1	0.0394	0.0446	0.1333
in Hg	0.4912	70.73	0.0334	0.0345	25.400	1	1.133	3.386
ft H20	0.4335	62.42	-	0.0305	22.418	0.8826	1	2.988
kPa	0.00145	20.89	-	0.010169	7.5006	0.2953	0.3346	1

Units of Energy	Multiply units in left column by proper factor below					
	ft.-lb.	BTU	g. cal.	Joule	kw-hr.	hp-hr.
1 foot-pound	1	0.001285	0.3240	1.3556	-	-
1 BTU	778.2	1	252.16	1054.9	-	-
1 gram calorie	3.0860	0.003966	1	4.1833	-	-
1 Int. Joule	0.7377	0.000948	0.2390	1	-	-
1 Int. kilowatt-hour	2,655,656	3412.8	860,563	-	1	1.3412
1 horsepower-hour	1,980,000	2544.5	641,617	-	0.7456	1

Units of Specific Pressure	Multiply units in left column by proper factor below				
	Absolute Joule/g	Int. Joule/g	cal/g	Int. cal/g	BTU/lb.
1 absolute Joule/gram	1	0.99984	0.23901	0.23885	0.42993
1 Int. Joule/gram	1.000165	1	0.23904	0.23892	0.43000
1 calorie/gram	4.1840	4.1833	1	0.99935	1.7988
1 int. calorie/gram	4.1867	4.1860	1.00065	1	1.8000
1 BTU/lb.	2.3260	2.3256	0.55592	0.55556	1

Units of Power (rates of energy use)	Multiply units in left column by proper factor below							
	hp	watt	kw	BTU/min.	ft.-lb./sec.	ft.-lb./min.	g. cal/sec.	metric hp
1 horsepower	1	75.7	0.7475	42.41	550	33.000	178.2	1.014
1 watt	-	1	0.001	0.0569	0.7376	44.25	0.2390	0.00136
1 kilowatt	1.3410	1000	1	56.88	737.6	44,254	239.0	1.360
1 BTU per minute	-	-	-	1	12.97	778.2	4.203	0.0239
1 metric hp	0.9863	735.5	0.7355	41.83	542.5	32.550	175.7	1

Units of Refrigeration	Multiply units in left column by proper factor below				
	BTU (IT) /min.	BTU (IT) /hr.	kg cal/hr.	ton (U.S.) comm	ton (Brit.) comm
1 ton (U.S.) comm	200	12,000	3025.9	1	0.8965
1 ton (Brit.) comm	223.08	13,385	3375.2	1.1154	1

NOTE: BTU is International Steam Table BTU (IT).

CONVERSION CHARTS

Temperature Conversion

°F	°C	°F	°C	°F	°C	°F	°C	°F	°C
-459.4	-273	1	-17.2	61	16.1	300	149	900	482
-450	-268	2	-16.7	62	16.7	310	154	910	488
-440	-262	3	-16.1	63	17.2	320	160	920	493
-430	-257	4	-15.6	64	17.8	330	166	930	499
-420	-251	5	-15.0	65	18.3	340	171	940	504
-410	-246	6	-14.4	66	18.9	350	177	950	510
-400	-240	7	-13.9	67	19.4	360	182	960	516
-390	-234	8	-13.3	68	20.0	370	188	970	521
-380	-229	9	-12.8	69	20.6	380	193	980	527
-370	-223	10	-12.2	70	21.1	390	199	990	532
-360	-218	11	-11.7	71	21.7	400	204	1000	538
-350	-212	12	-11.1	72	22.2	410	210	1020	549
-340	-207	13	-10.6	73	22.8	420	215	1040	560
-330	-201	14	-10.0	74	23.3	430	221	1060	571
-320	-196	15	-9.4	75	23.9	440	227	1080	582
-310	-190	16	-8.9	76	24.4	450	232	1100	593
-300	-184	17	-8.3	77	25.0	460	238	1120	604
-290	-179	18	-7.8	78	25.6	470	243	1140	616
-280	-173	19	-7.2	79	26.1	480	249	1160	627
-273	-169	20	-6.7	80	26.7	490	254	1180	638
-270	-168	21	-6.1	81	27.2	500	260	1200	649
-260	-162	22	-5.6	82	27.8	510	266	1220	660
-250	-157	23	-5.0	83	28.3	520	271	1240	671
-240	-151	24	-4.4	84	28.9	530	277	1260	682
-230	-146	25	-3.9	85	29.4	540	282	1280	693
-220	-140	26	-3.3	86	30.0	550	288	1300	704
-210	-134	27	-2.8	87	30.6	560	293	1350	732
-200	-129	28	-2.2	88	31.1	570	299	1400	760
-190	-123	29	-1.7	89	31.7	580	304	1450	788
-180	-118	30	-1.1	90	32.2	590	310	1500	816
-170	-112	31	-0.6	91	32.8	600	316	1550	843
-160	-107	32	0.0	92	33.3	610	321	1600	871
-150	-101	33	0.6	93	33.9	620	327	1650	899
-140	-96	34	1.1	94	34.4	630	332	1700	927
-130	-90	35	1.7	95	35.0	640	338	1750	954
-120	-84	36	2.2	96	35.6	650	343	1800	982
-110	-79	37	2.8	97	36.1	660	349	1850	1010
-100	-73	38	3.3	98	36.7	670	354	1900	1038
-90	-68	39	3.9	99	37.2	680	360	1950	1066
-80	-62	40	4.4	100	37.8	690	366	2000	1093
-70	-57	41	5.0	110	43	700	371	2050	1121
-60	-51	42	5.6	120	49	710	377	2100	1149
-50	-46	43	6.1	130	54	720	382	2150	1177
-40	-40	44	6.7	140	60	730	388	2200	1204
-30	-34	45	7.2	150	66	740	393	2250	1232
-20	-29	46	7.8	160	71	750	399	2300	1260
-10	-23	47	8.3	170	77	760	404	2350	1288
0	-17.8	48	8.9	180	82	770	410	2400	1316
		49	9.4	190	88	780	416	2450	1343
		50	10.0	200	92	790	421	2500	1371
		51	10.6	210	99	800	427	2550	1399
		52	11.1	212	100	810	432	2600	1427
		53	11.7	220	104	820	438	2650	1454
		54	12.2	230	110	830	443	2700	1482
		55	12.8	240	116	840	449	2750	1510
		56	13.3	250	121	850	454	2800	1538
		57	13.9	260	127	860	460	2850	1566
		58	14.4	270	132	870	466	2900	1593
		59	15.0	280	138	880	471	2950	1621
		60	15.6	290	143	890	477	3000	1649

The following formulas may also be used for converting Celsius or Fahrenheit degrees into the other scales.

Degrees Celsius $°C = \frac{5}{9}(°F - 32)$ Degrees Fahr. $°F = \frac{9}{5}°C + 32$

Degrees Kelvin $°T = °C + 273.2$ Degrees Rankine $°R = °F + 459.7$

NOTES

NOTES

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