Volume X: Socket Fusion Polypropylene System

Industrial Technical Manual Series

SECOND EDITION

IPEX

Committed to Excellence

IPEX SOCKET FUSION POLYPROPYLENE SYSTEM

(Pigmented socket fusion polypropylene)

IPEX Socket Fusion Polypropylene System

Industrial Technical Manual Series Vol. X. 2nd Edition.

This manual provides the most up-to-date and comprehensive information about IPEX Socket Fusion Polypropylene System (SF Polypro). All aspects of SF Polypro are covered from basic raw material properties to installation procedures of the finished product. Written with the engineer, contractor and distributor in mind, it is based on laboratory test results combined with IPEX's years of field experience.

At IPEX, we have been manufacturing nonmetallic pipe and fittings since 1951. We formulate most of our own compounds and maintain strict quality controls during production. Our products are then made available to distribution 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, our commitment to customers extends beyond the sale. 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 takes pride in their work, making available to our customers their extensive industry knowledge and field experience with thermoplastic materials. For further information on more specific details about any IPEX product, contact our customer service department.

Contents

IPEX's Socket Fusion Polypropylene System is a complete PVF system utilized in some of the most demanding chemical processes, where broad chemical resistance, high temperature performances and absolutely fool-proof joints are required.

Made from one of the most versatile thermoplastic materials, IPEX Socket Fusion Polypropylene System (SF Polypro) offers metric pipe, valves and fittings that can be jointed in minutes to create superior connections. It is chemically and electrochemically inert, non-conductive and resists galvanic corrosion making it an ideal system for the most demanding chemical process. The Socket Fusion system works in a broad range of applications and industries including the plating industry, steel cable manufacturing, circuit board manufacturing, battery manufacturing and the food industry, to name a few.

The IPEX Socket Fusion Polypropylene System offers a complete range of 150 psi rated pipe, valves and fittings ranging from 20 mm to 110 mm. The system's Interference-fit design provides far superior joints than solvent cement, non-interference fit socket, butt or IR jointing systems. A portable tool makes repeatable reliable joints that can be tested at full pressure in a matter of minutes, helping to lower your installation and maintenance costs.

IPEX SF Polypropylene System is a complete system that offers:

- A superior joint compared to solvent cement, non-interference fit, butt or IR system welding.
- Copolymer pipe and homopolymer fittings and valves.
- Specialized hand-held and bench fusion equipment.
- Pipe, valves and fittings all designed and backed by one company—IPEX

IPEX provides efficient and qualified pre-and-post sales assistance, aimed at checking and encouraging the correct and optimum use of materials.

Exceptional Chemical Resistance

IPEX SF Polypro offers pipe, valves and fittings with outstanding resistance to a wide range of chemicals.

✔	**AMINES**
✔	**ORGANIC AND INORGANIC ACIDS (Aqueous Solutions)**
✔	**ALCOHOLS**
✔	**ALIPHATIC ALDEHYDES**
✔	**INORGANIC BASES**
✔	**ESTERS/ALIPHATIC KETONES**
✔	**INORGANIC SALTS (Aqueous Solutions)**
✔	**FOODSTUFFS (Vinegar, milk, wine, beer, oils)**
✘	**CHLORINATED COMPOUNDS**
✘	**PETROLEUM/PETROLS/AROMATIC COMPOUNDS**

The information contained in this table is generic and intended as a guideline.

However, chemical resistance is a function of concentration, pressure and temperature. For specific applications, see the IPEX Chemical Resistance Guide.

Lower Installation Costs

In addition to a lower material cost, polypropylene pipe can significantly reduce labor and transportation costs on a typical installation. The reason? Plastics are easily handled, stored, cut and joined. And, heavy equipment used to install metallic and other piping systems are not required, thereby reducing project costs.

Extended Life

IPEX's SF Polypro System is fundamentally ageless and impervious to normal weather conditions. Polypropylene piping systems in uninterrupted service and in a variety of demanding industrial applications have operated successfully for over 40 years. During maintenance or revisions, examinations of the original plastic materials showed excellent physical and hydraulic characteristics.

Once properly selected for the application and correctly installed, IPEX SF Polypro provides years of maintenance-free service. Our materials will not rust, pit, scale or corrode on either interior or exterior surfaces. Unlike other types of piping, polypropylene systems are not adversely affected by aggressive soil or atmospheric conditions.

Corrosion Resistance

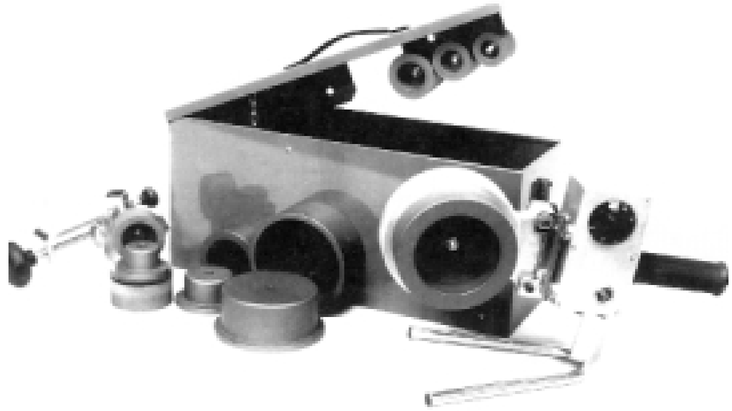
Our polypropylene materials are immune to damage from naturally corrosive soil conditions as well as electrochemical and galvanic corrosion. This is particularly advantageous in underground installations where galvanic reaction often causes damage to metal piping products. Our polypropylene's noncorroding properties ensure improved flow, lower maintenance costs and longer performance life.

Improved Flow

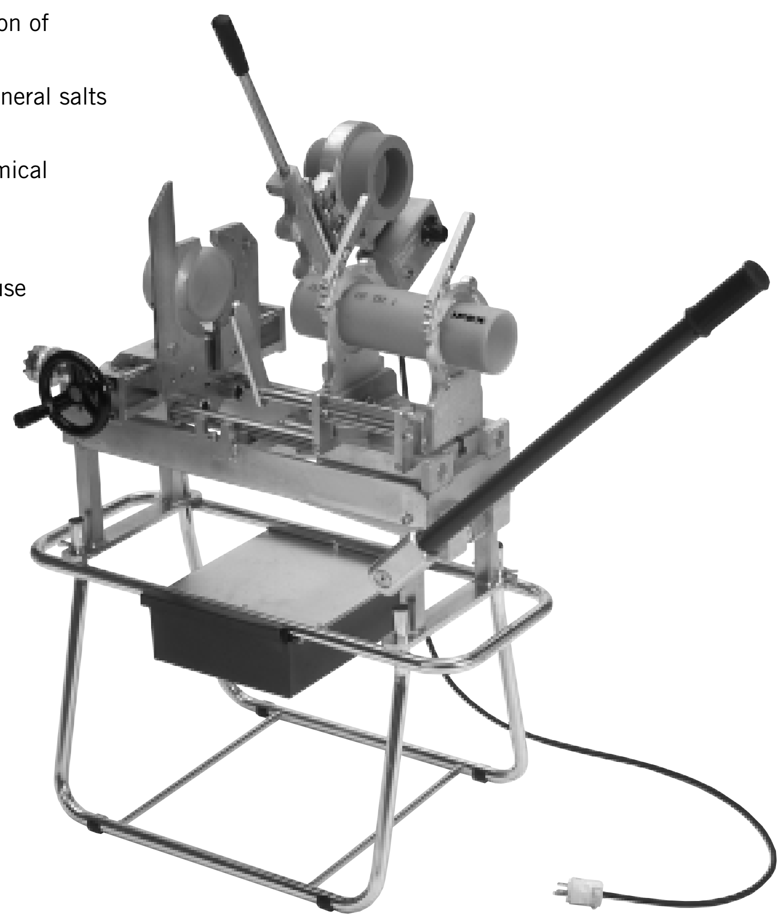
IPEX SF PP piping has a substantially lower Roughness Factor than metal and other materials, and since thermoplastics do not rust, pit, scale or corrode, the interior walls remain smooth in virtually any service. This high carrying capacity may result in the use of smaller diameter piping and or pumps.

Applications

Some of the most common applications and industries that benefit from the IPEX SF Polypro system are:



- RO systems
- Chemical laboratories (transport of Caustic Soda to neutralize acid waste)
- Plating lines
- Circuit board manufacturing
- Pickling lines
- Steel cables manufacturing
- Battery manufacturing
- Film developing
- Paper industry: transport of hot corrosive fluids
- Textile industry: transport of cleaned and used acids
- Chemical industry: transport of non-oxidizing alkaline and acid components
- Pharmaceutical industry: chemicals and pure regents
- Treatment of surfaces: baths for solvent and corrosive fluids
- Food industry: Transport, preservation, filtration of sauces, water and milk
- Thermal plants: transport of waters rich in mineral salts (cold, hot or boiling)
- Tanning industry: transport of aggressive chemical substances, dyes
- Industrial laundries
- Treatment of hot and cold water for sanitary use



Weather Resistance

Nearly all thermoplastics used for piping require stabilizers to reduce the effects of sunlight and oxygen. Thermoplastic materials are generally compounded with UV stabilizers and anti-oxidants to retard the rate of degradation. However, to maximize the service life of a system, it can be covered, coated, wrapped or painted. We recommend latex primer be used with SF Polypro.

Moisture Absorption

IPEX SF Polypro is water repellent. There is no swelling or dimensional change. A slight weight gain found in tests is due merely to traces of moisture on the surface.

Resistance to Rodents and Micro-Organisms

Rodents endeavor to sharpen their teeth by gnawing hard objects. This applies to timber, soft metals and plastics, which neither in terms of taste nor in terms of odor encourage consumption of the material. However, because the smooth surface of polypropylene does not provide enough grip for teeth there are virtually no attempts by rodents to gnaw at pipe or the surface of flat panels.

The raw material utilized by IPEX is not a nutrient for micro-organisms such as bacteria, fungi or spores and therefore is not attacked by them. This also applies in respect to bacteria which have a sulphate reducing effect.

Electrical Conductivity

IPEX polypropylene (PP), like all other plastics, forms part of the group of electrically insulating materials. this includes all materials which have an impedance in excess of 106 Ohm x cm. IPEX PP materials have an impedance of the order of magnitude of approximately 1015 Ohm x cm. In addition, the surface resistance should be noted. If the value of 109 Ohms is exceeded, then the material should be categorized as electrostatically chargeable.

In connection with the construction of plastic pipe systems, electrostatic charges have to be taken into consideration, if media are transported which are not electrically conductive or if the pipes are to be installed in areas which are subject to explosion hazard. The transport of gases or liquids which can ignite is only free from risk, if a closed system is used. In addition, it is possible to reduce the risk of charging by reduced conveying speed.

Explosive atmospheres in areas in which plastic pipe is to be installed can be avoided by careful ventilation, or by ionizing the air, so that the plastic does not become electrostatically charged. Since electrostatic charges are rarely produced when the relative humidity is in excess of 65%, an increase in the humidity is frequently another further solution to the problem.

Pressure Rating and Service Life

Pressure rating for plastic piping is normally expressed based on a 20ºC (68ºF) continuous operating temperature, ie. 150 psi at 68ºF. Higher continuous temperature results in a lower pressure rating in accordance with procedures outlined by ASTM D-2837 and the Plastic Pipe Institute (Division of SPI). The expressed pressure rating of plastic piping represents 50% of the pipes burst pressure after 100,000 hours or 11.4 years of continuous service. Thus, the pressure rating provides a 2:1 safety factor at 100,000 hours service. It is then extrapolated that the theoretical time to failure is in excess of 50 years.

IPEX SF Polypro piping is offered as an SDR 11, indicating 150 psi pressure rating.

PP Type 1 (PP-H) and Type 2 (PP-C, PP-R)

Homopolymer PP (Type 1) and Co-polymer PP (Type 2) can be easily and successfully welded together. These materials are weldable within the melting index group 006 (HFI 190/5 0.4 0.8 g/10 minutes). DVS 2207 part 11 contains this information.

QC Test Conditions for Pressure Systems

(1) This is a precondition for the main test. The objective of the preliminary test is to ensure that any volume changes caused by expansion are more or less eliminated, so that the main test, which immediately follows, provides precise information about the systems' pressure integrity.

(2) Duration time of the abbreviated test starts 30 minutes after application of the test pressure.

(3) Definitions in accordance with DIN 2401

NP - Nominal Pressure (150 psi)

Material	PP Type 1 & Type 2
Preliminary Test (1)	
Test Pressure	1.5 NP (3)
Duration of Test	12 Hours
Main Test	
Test Pressure	1.3 NP
Duration of Test	PN150 6 Hours
Maximum Pressure Drop	1.45 psi/Hour
Abbreviated Test (2)	
Test Pressure	1.5 NP
Duration of Test	1 Hour (2)
Maximum Pressure Drop	1.45 psi/5 Minutes

Radiation Resistance

Polypropylene possesses resistance to high energy radiation.

With regard to the order of magnitude, the lethal dose for human beings is approximately 0.0006 Mrad. From this it can be concluded, that PP can be used in rooms in which humans are allowed to remain constantly.

Radiation Resistance

Material	Maximum Permissible Dose Mrad*	Dose During Long-Term Exposure Mrad*
PP	3	0.1

*10^4 j/kg = 1 Mrad

MATERIAL PROPERTIES

Material Characteristics, Polypropylene

Properties	Test Standard	Test Method Test Specimen	Units of Measure	PP Type 1	PP Type 2
Mechanical Properties					
Density	DIN 53479	Method C	g/cm^3	0.91	0.91
Melting Index Group	DIN 16776	MFI 190/5	Group	006	006
Tensile Test	DIN 53455	Test Bar 3	-	-	-
Yield Stress	-	Test Speed 50 mm/min	N/mm^2	33	26
Elongation at Yield Stress	-	-	%	15	17
Elongation at Rupture	-	-	%	70	120
Bending Test	DIN 53457	Test Bar	-	-	-
Bending Modulus E	1 minute	120 x 10 x 4 mm	N/mm^2	1200	900
Impact Bending Test	DIN 53453	Charpy	-	-	-
Impact Strength	-	Standard Miniature Bar	kj/m^2	w/o Break	w/o Break
Notched Bar Impact Strength	-	Standard Miniature Bar with U-Notch	kj/m^2	7	25
Surface Hardness					
Ball Impression Hardness	DIN 53456	H358/30	N/mm^2	70	64
Shore Hardness	DIN 53505	D	-	72	67
Thermal Properties					
Crystallite Melting Range	-	Polarization Microscope	K(ºC)	160 - 165	160 - 164
Mean Thermal Coefficient of Linear Expansion	DIN 53752	-	K^1(ºC^1)	1.6×10^{-4}	1.6×10^{-4}
Thermal Conductivity	DIN 52612	Two-Plate Method	W/m x K	0.22	0.22
Electrical Properties					
Dielectric Strength	DIN 53481	K20/P 50	kV/mm	52	52
Impedance	DIN 53482	Annular Electrode	Ohm x cm	$>10^{16}$	$>10^{16}$
Surface Resistance	DIN 53482	Electrode A	Ohm	10^{14}	10^{14}
Leakage Path Resistance	DIN 53480	Method KC	Step	>600	>600
Other Properties					
Flammability	DIN 4102	-	Class	B2	B2
Water Absorption	DIN 53495	Method C	%/24h	<0.01	<0.01
Physiologically Harmless	recommendation	BGA/KTW	-	yes	yes
Chemical Resistance	DIN 8078 addendum	-	-	complies	complies

Combustion Behavior

DIN 4102 distinguishes between noncombustible material (Class A) and combustible material (Class B). Plastics, without exception, belong in the latter class.

Further information about the combustion behavior is contained in the oxygen index. This number indicates the minimum oxygen concentration in the combustion atmosphere which is necessary for sustained combustion. If the values are less than 20.8% (oxygen content in the atmosphere), ignition and continuous combustion after removal of the source of ignition is possible.

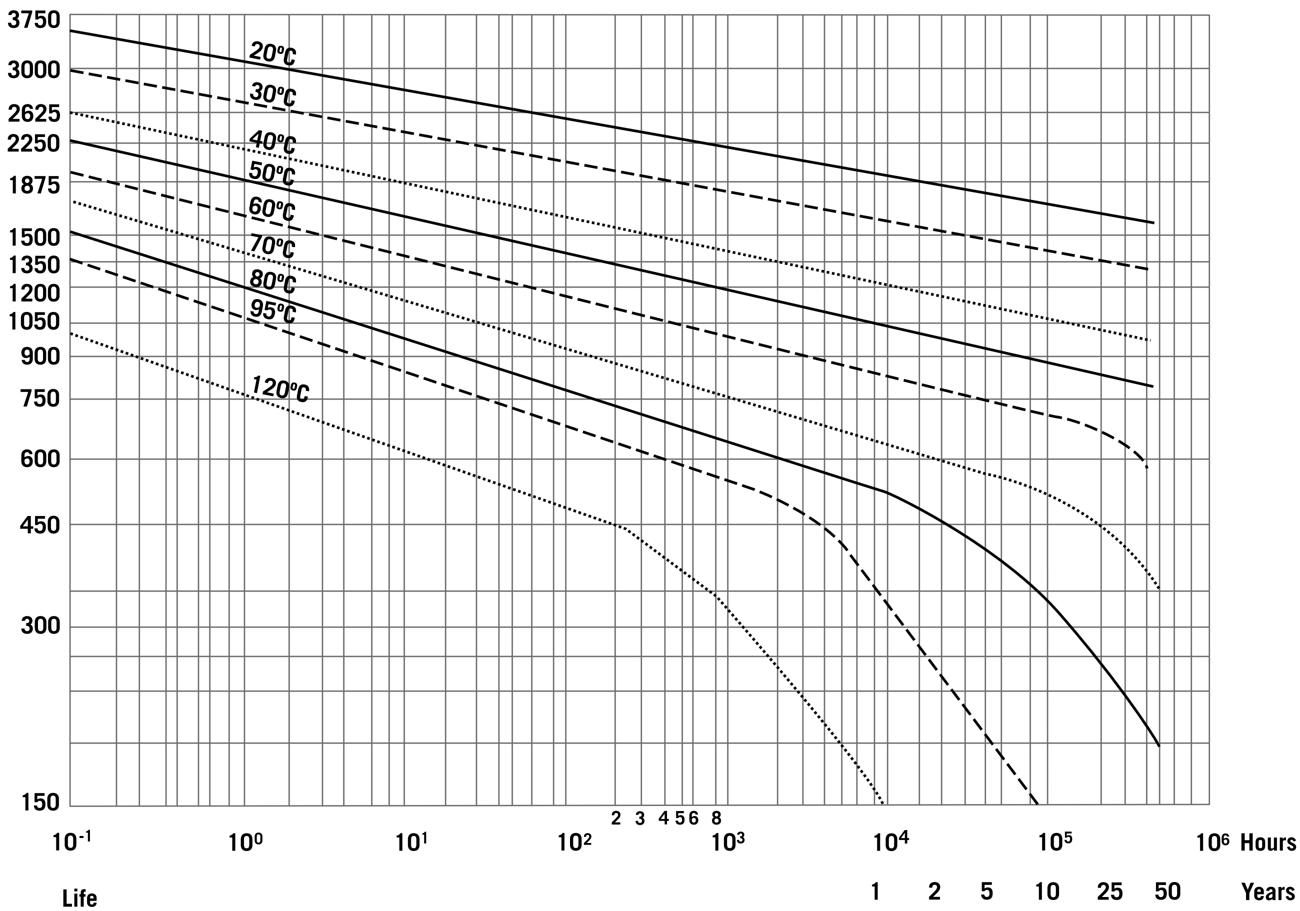
Assessment of Combustion Behavior

Material	Combustion Behavior according to DIN 4102 Class	Ignition Temperature according to ASTM 1929 ºC	Oxygen Index according to ASTM 2863 %	ULV94
PP Type 1 (Homopolymer)	B2	345	18	94 HB
PP Type 2 (Copolymer)	B2	345	18	94 HB

Durability

Durability (see chart below) illustrates the regression curves established for our material through creep rupture/stress-time to failure testing with water as a medium. These curves are the foundation for establishing the long term hydrostatic design basis and thus the long term hydrostatic design stress (hoop stress) rating for our material. Actual pressure ratings achieved by maintaining a constant OD/wall thickness ratio.

Lifeline of Polypropylene



Flow Rate versus Friction Loss - Polypropylene Pipe

Flow Rate (GPM)	16mm			20mm			25mm			32mm			40mm			Flow Rate (GPM)
	V	ΔH	ΔP	V	ΔH	ΔP	V	ΔH	ΔP	V	ΔH	ΔP	V	ΔH	ΔP	
1	1.72	3.23	1.40	1.00	0.88	0.38	0.63	0.29	0.12	0.35	0.09	0.04				1
2	3.43	11.64	5.04	2.01	3.16	1.37	1.27	1.03	0.45	0.70	0.32	0.14				2
5	8.58	63.54	27.51	5.02	17.25	7.47	3.17	5.63	2.44	1.93	1.72	0.75	1.22	0.57	0.25	5
7	12.01	118.49	51.30	7.03	32.16	13.92	4.44	10.50	4.55	2.63	3.21	1.39	1.67	1.07	0.46	7
10	17.16	229.38	99.30	10.04	62.26	26.95	6.34	20.33	8.80	3.86	6.22	2.69	2.44	2.07	0.90	10
15				15.06	131.93	57.11	9.50	43.08	18.65	5.79	13.18	5.71	3.67	4.38	1.90	15
20							12.67	73.40	31.77	7.72	22.46	9.72	4.89	7.47	3.23	20
25										9.82	33.96	14.70	6.22	11.29	4.89	25
30										11.75	47.59	20.60	7.44	15.83	6.85	30
35													8.67	21.06	9.12	35
40													9.89	26.97	11.68	40
45													11.11	33.54	14.52	45

Flow Rate (GPM)	50mm			63mm			75mm			90mm			110mm			Flow Rate (GPM)
	V	ΔH	ΔP	V	ΔH	ΔP	V	ΔH	ΔP	V	ΔH	ΔP	V	ΔH	ΔP	
1																1
2																2
5	0.78	0.19	0.08	0.49	0.06	0.03	0.35	0.03	0.01							5
7	1.06	0.36	0.16	0.67	0.12	0.05	0.47	0.05	0.02							7
10	1.56	0.69	0.30	0.99	0.23	0.10	0.69	0.10	0.04	0.48	0.04	0.02	0.32	0.02	0.01	10
15	2.34	1.47	0.64	1.48	0.49	0.21	1.04	0.20	0.09	0.72	0.08	0.03	0.48	0.03	0.01	15
20	3.12	2.51	1.09	1.97	0.82	0.35	1.39	0.35	0.15	0.96	0.14	0.06	0.64	0.05	0.02	20
25	3.97	3.79	1.64	2.51	1.23	0.53	1.77	0.53	0.23	1.22	0.21	0.09	0.82	0.08	0.03	25
30	4.75	5.31	2.30	3.00	1.73	0.75	2.11	0.74	0.32	1.46	0.30	0.13	0.98	0.11	0.05	30
35	5.53	7.07	3.06	3.50	2.30	1.00	2.46	0.98	0.42	1.70	0.40	0.17	1.14	0.15	0.06	35
40	6.31	9.05	3.92	3.99	2.94	1.27	2.81	1.26	0.55	1.94	0.51	0.22	1.30	0.19	0.08	40
45	7.09	11.26	4.87	4.48	3.66	1.58	3.15	1.57	0.68	2.18	0.64	0.28	1.46	0.24	0.10	45
50	7.87	13.69	5.93	4.98	4.45	1.93	3.50	1.90	0.82	2.42	0.78	0.34	1.62	0.29	0.13	50
60	9.50	19.18	8.30	6.01	6.24	2.70	4.23	2.67	1.16	2.93	1.09	0.47	1.96	0.41	0.18	60
70	11.06	25.52	11.05	6.99	8.30	3.59	4.92	3.55	1.54	3.41	1.45	0.63	2.28	0.54	0.23	70
80				7.98	10.62	4.60	5.61	4.64	2.01	3.89	1.85	0.80	2.60	0.70	0.30	80
90				8.97	13.21	5.72	6.31	5.65	2.45	4.37	2.30	1.00	2.92	0.87	0.38	90
100				10.00	16.06	6.95	7.03	6.87	2.97	4.87	2.80	1.21	3.26	1.05	0.45	100
125							8.77	10.39	4.50	6.07	4.23	1.83	4.06	1.59	0.69	125
150							10.54	14.56	6.30	7.29	5.93	2.57	4.88	2.23	0.97	150
175										8.51	7.89	3.42	5.69	2.97	1.29	175
200										9.74	10.11	4.38	6.51	3.80	1.65	200
250										12.16	15.28	6.61	8.13	5.74	2.48	250
300													9.75	8.05	3.48	300
350													11.39	10.71	4.64	350

Hazen - Williams Equation

$$\Delta H = 0.2083 \left(\frac{100}{C}\right)^{1.852} \times \left(\frac{GPM^{1.852}}{ID^{4.8655}}\right)$$

$$\Delta P = \Delta H / 2.31$$

V = Fluid velocity, ft/sec
ΔH = Head loss, ft H_2O per 100 ft pipe
ΔP = Head loss, psi per 100 ft pipe
C = 150
ID = inner diameter of pipe in inches

DESIGN DATA

Friction Loss through Polypropylene Fittings

In equivalent length of pipe, feet

Pipe outside diameter	⅜" 16mm	½" 20mm	¾" 25mm	1" 32mm	1 ¼" 40mm	1 ½" 50mm	2" 63mm	2 ½" 75mm	3" 90mm	4" 110mm
90° elbow	0.9	1.5	2	2.7	3.5	4.2	5.5	7	8	11
45° elbow	0.5	0.8	1	1.3	1.7	2.1	2.7	3.5	4	5.5
Tee with flow through run	0.6	1.0	1.4	1.7	2.3	2.7	4.3	5.1	6.3	8.3
Tee with flow through branch	1.8	4.0	5.1	6.0	6.9	8.1	12.0	14.3	16.3	22.1
Reducer bushing (one reduction)	-	1.0	1.1	1.2	1.4	1.7	2.6	3.6	4.4	5.2
Male/Female Adapter	0.5	1.0	1.3	1.6	2.2	2.6	3.5	-	-	-

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.

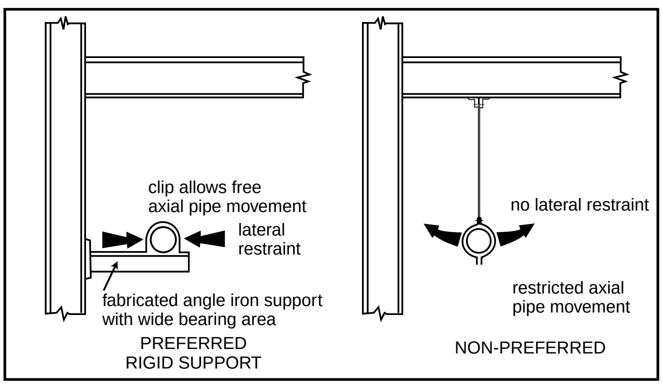
Supporting Pipes

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 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 PN10 pipe.

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.

Support Centers

(max permissible deflection of 0.01")

Size Diameter (mm)	Support Distance ft.			
	73°F	122°F	176°F	212°F
20	3.0	2.7	2.3	1.7
25	3.3	3.0	2.7	1.9
32	3.9	3.5	2.9	2.1
40	4.3	3.9	3.3	2.3
50	4.9	4.3	3.5	2.7
63	5.5	4.9	4.1	3.1
75	6.1	5.3	4.5	3.3
90	6.5	5.9	4.9	3.7
110	7.3	6.5	5.5	4.1

*Always check with the local code or authority having jurisdiction for specific support requirements.

Pipe Clips

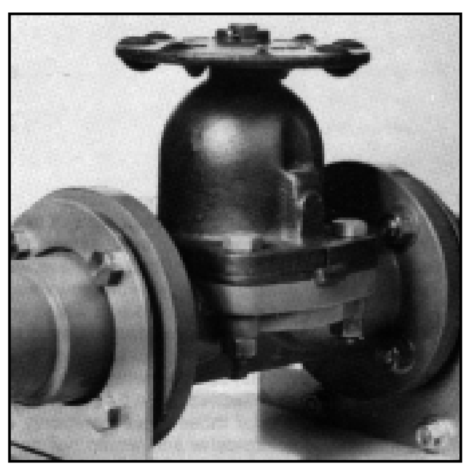
All pipe clips should permit free axial pipe movement at all temperatures and should provide adequate bearing support to the pipe.

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

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.



DESIGN DATA

Expansion and Contraction

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.

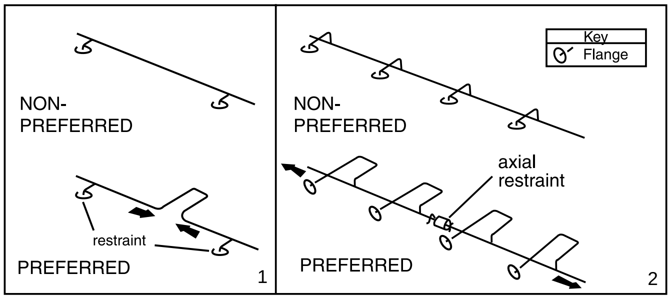
Expansion Loops

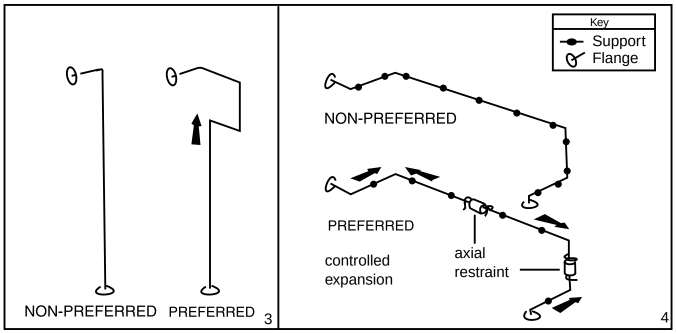
Above-ground systems should be designed to include the maximum practical number of changes in direction with anchors at intermediate points. The support method described previously will ensure that any movement is directed into those areas of flexibility, as shown in the illustrations.

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 IPEX SF PP is shown below.

PP Material	"e" Coefficient in/in/°F	"y" Constant in/100ft/10°F
SF PP	8.33×10^{-5}	1.00

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
$\Delta^T L$	Maximum temperature change in pipe contents, °F
$\Delta^T A$	Maximum temperature change of external air, °F

To calculate pipe wall temperature change, use the equation

$\Delta T = 0.65\, \Delta^T L + 0.10\, \Delta^T A$

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 (full data is available)

How much expansion can be expected in a straight 90 mm PP 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 (ΔT)

Use the equation:

$\Delta T = 0.65\Delta^T L + 0.10\Delta^T A$

therefore

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

i.e. $\Delta T = 0.65 x 36 + 0.10 x 37 = 27°F$

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

$$\Delta L = 1.00 \times \frac{27}{10} \times \frac{60}{100} = 1.00 \times 2.7 \times 0.6$$

ΔL = 1.62 inches

Example B (only ambient data is available)

1. To calculate ΔT

Max ambient temp = 104°F

Min ambient temp = 68°F

therefore

ΔT = 104 - 68 = 36

2. Use the equation:

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

therefore

$$\Delta L = 1.00 \times \frac{36}{10} \times \frac{60}{100}$$

ΔL = 1.00 x 3.6 x 0.6 = 2.16 inch

EXPANSION LOOPS

Normally, piping systems are designed with sufficient directional changes providing inherent flexibility to compensate for expansion and contraction. However, when this is not the case or when there is reasonable doubt as to adequate flexibility of the system, expansion loops or expansion joints should be designed into the system. 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.

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

R = Expansion loop leg length (ft.)

D = Nominal outside diameter of pipe (in.)

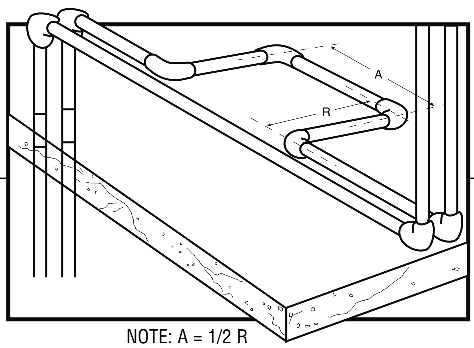
ΔL = Dimensional change due to thermal expansion or contraction (in.)

Example 2:

For 90mm PN 10 PP, $\Delta T = 70°F$, run = 100', $\Delta L = 5.12$ How long should the expansion loop legs be in order to compensate for the expansion?

$R = 1.44 \sqrt{3.54 \times 5.12} = 1.44 \sqrt{18.12} = 6.13$ ft.

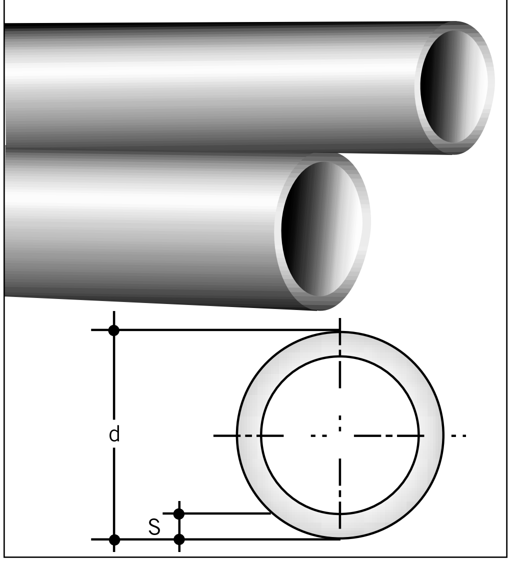
In situations where straight runs of pipe are long or the ends of a straight run are restricted from movement or where the system is restrained, flexibility must be inserted into a pipe system through the introduction of flexural offsets. An example of a method for inserting flexibility in these situations 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

DESIGN DATA

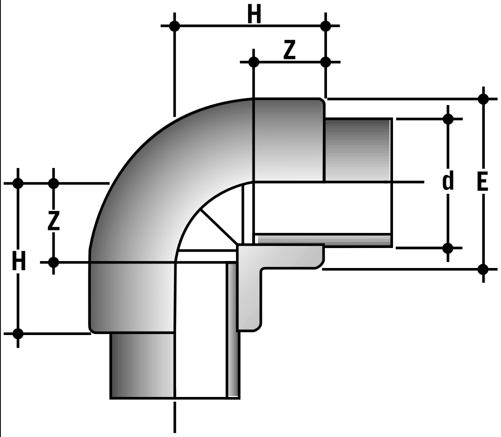
Color: RAL 7032



PP Pipe - PN10 - 150 psi

DIN 8077/8078, UNI 8318 & ISO DIS 15494

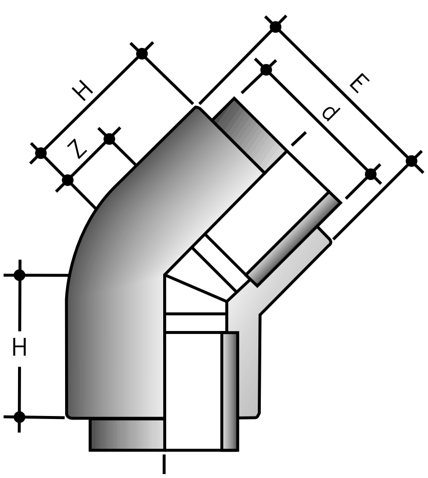
size (d)	S	lbs/ft
20	0.07	0.09
25	0.09	0.13
32	0.11	0.18
40	0.15	0.28
50	0.18	0.43
63	0.23	0.69
75	0.27	0.97
90	0.32	1.39
110	0.39	2.05



GIM - 90° Elbow

for socket fusion

size (d)	E	H	Z	lbs
20	1.08	1.08	0.51	0.03
25	1.32	1.26	0.63	0.05
32	1.63	1.46	0.79	0.08
40	2.03	1.67	0.87	0.14
50	2.50	2.01	1.08	0.23
63	3.09	2.40	1.32	0.40
75	3.64	2.87	1.65	0.66
90	4.35	3.33	1.93	1.00
110	5.31	3.96	2.32	1.79



HIM - 45° Elbow

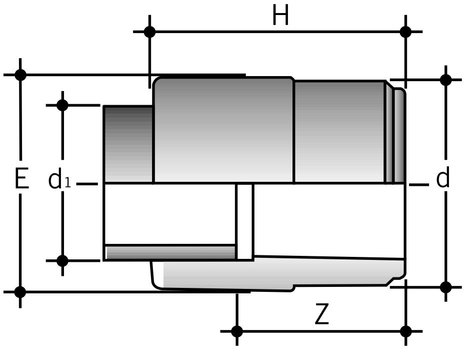
for socket fusion

size (d)	E	H	Z	lbs
20	1.08	0.83	0.26	0.03
25	1.32	0.96	0.33	0.04
32	1.65	1.14	0.47	0.07
40	2.03	1.40	0.59	0.13
50	2.48	1.67	0.75	0.23
63	3.11	2.01	0.93	0.40

Except for item size (d), all other unspecified dimensions are in inches.

RIM - Reducer

for socket fusion d male, d_1 reduced female

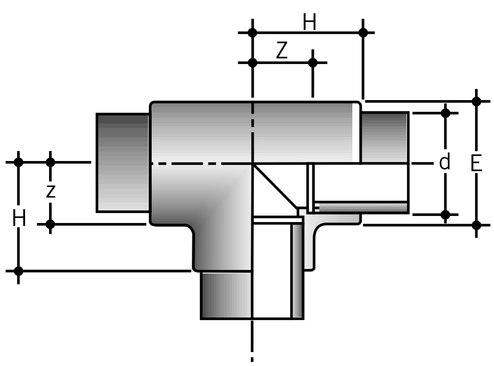


size d x d_1	E	H	Z	lbs
25 x 20	1.10	1.54	0.96	0.02
32 x 20	1.40	1.69	1.18	0.03
32 x 25	1.32	1.81	1.18	0.04
40 x 25	1.65	1.89	1.30	0.05
40 x 32	1.65	2.01	1.30	0.06
50 x 32	2.03	2.13	1.42	0.09
50 x 40	2.03	2.22	1.42	0.10
63 x 32	2.56	2.40	1.73	0.15
63 x 50	2.56	2.66	1.73	0.17
75 x 50	3.05	2.72	1.85	0.23
75 x 63	3.05	2.93	1.85	0.25
90 x 63	3.60	3.23	2.20	0.34
90 x 75	3.60	3.44	2.20	0.39
110 x 63	4.39	3.66	2.60	0.64
110 x 90	4.39	4.00	2.60	0.67

DESIGN DATA

TIM - 90º Tee

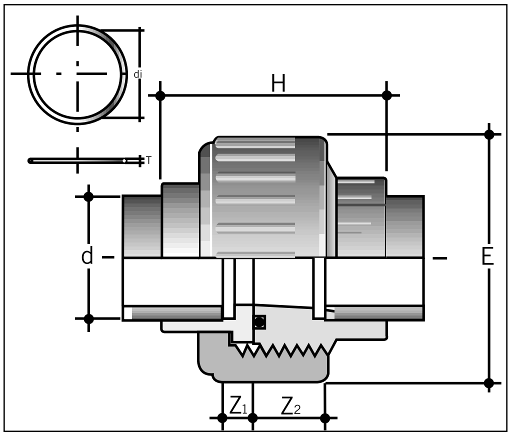
for socket fusion



size (d)	E	H	Z	lbs
20	1.08	1.08	0.51	0.04
25	1.32	1.24	0.61	0.07
32	1.63	1.46	0.75	0.10
40	2.05	1.69	0.89	0.18
50	2.52	2.05	1.12	0.32
63	3.13	2.46	1.38	0.55
75	3.64	2.80	1.57	0.81
90	4.35	3.21	1.81	1.23
110	5.30	3.92	2.28	2.18

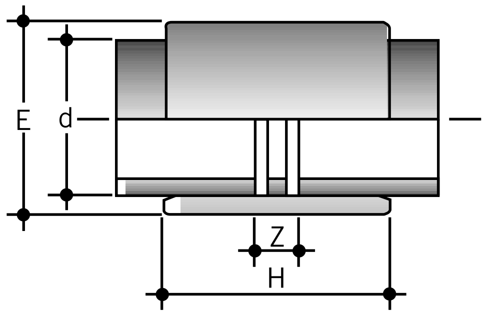
BIM - Socket Union

for socket fusion with FPM or EPDM gaskets



size (d)	E	H	Z_1	Z_2	lbs	O-ring c	O-ring di	O-ring T
20	2.05	2.07	0.27	0.65	0.12	4081	0.83	0.14
25	2.44	2.22	0.28	0.68	0.17	4112	1.15	0.14
32	2.76	2.40	0.30	0.69	0.24	4131	1.34	0.14
40	3.23	2.76	0.30	0.81	0.35	6162	1.66	0.21
50	3.56	3.01	0.30	0.84	0.45	6187	1.92	0.21
63	4.17	3.37	0.31	0.88	0.67	6237	2.43	0.21

Except for item size (d), all other unspecified dimensions are in inches.

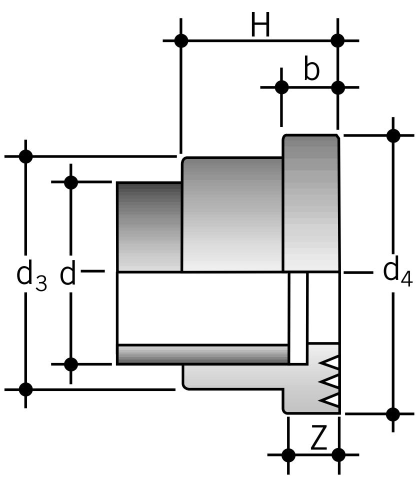


MIM - Socket (coupling)

for socket fusion

size (d)	E	H	Z	lbs
20	1.08	1.44	0.30	0.02
25	1.32	1.57	0.31	0.04
32	1.65	1.75	0.33	0.06
40	2.05	1.91	0.30	0.09
50	2.48	2.19	0.32	0.14
63	3.05	2.52	0.35	0.21
75	3.58	2.83	0.39	0.32
90	4.29	3.19	0.39	0.51
110	5.20	3.66	0.39	0.81

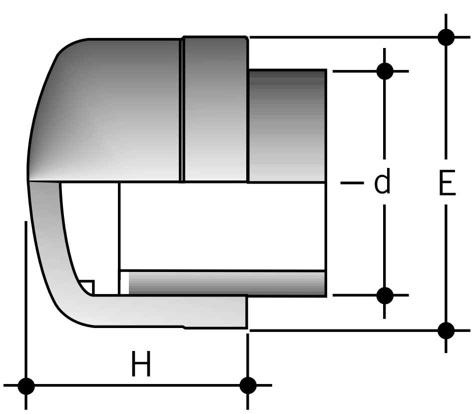
To be used with ODB (d < 75) and ODC



QRM - Stubflange

(according to DIN norms) for socket fusion, with serrated face

size (d)	b	d_3	d_4	H	Z	lbs
20	0.24	1.10	1.39	0.79	0.22	0.02
25	0.28	1.35	1.67	0.87	0.24	0.02
32	0.28	1.69	2.06	0.96	0.26	0.04
40	0.33	2.04	2.47	1.02	0.22	0.06
50	0.33	2.49	2.98	1.14	0.22	0.08
63	0.35	3.12	3.67	1.30	0.22	0.14
75	0.39	3.71	4.33	1.48	0.26	0.22
90	0.45	4.45	5.06	1.69	0.30	0.33
110	0.49	5.37	6.12	1.93	0.30	0.53

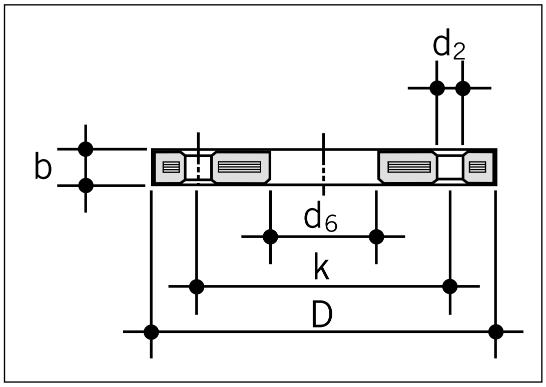


CIM - Cap

end plain for socket fusion

size (d)	E	H	lbs
20	1.08	0.96	0.02
25	1.32	1.06	0.02
32	1.65	1.24	0.04
40	2.01	1.40	0.07
50	2.48	1.61	0.11
63	3.05	1.73	0.19
75	3.58	1.89	0.26
90	4.29	2.56	0.47
110	5.20	2.80	0.77

Except for item size (d), all other unspecified dimensions are in inches.



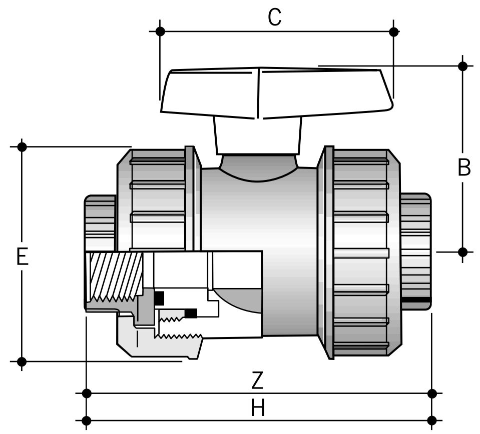
OAB - BACKING RING

PN 10 PP with steel core, flange size: ANSI 150 for QRM stub flanges

d	R (in)	b	K	d_2	d_6	D	bolt holes	bolt size	lbs
20	1/2	0.5	2 3/8	0.62	1.09	3.75	4	M 12	0.48
25	3/4	0.5	2 3/4	0.62	1.39	4.04	4	M 12	0.62
32	1	0.62	3 1/8	0.62	1.64	4.5	4	M 12	0.99
40	1 1/4	0.62	3 1/2	0.62	2.08	5.12	4	M 16	1.19
50	1 1/2	0.72	3 7/8	0.62	2.45	5.23	4	M 16	1.32
63	2	0.72	4 3/4	0.78	3.08	6.34	4	M 16	1.94
75	2 1/2	0.72	5 1/2	0.78	3.76	7.2	4	M 16	2.42
90	3	0.72	6	0.78	4.41	7.59	4	M 16	2.68
110	4	0.72	7 1/2	0.78	5.22	9.02	8	M 16	4.07

Except for item size (d), all other unspecified dimensions are in inches.

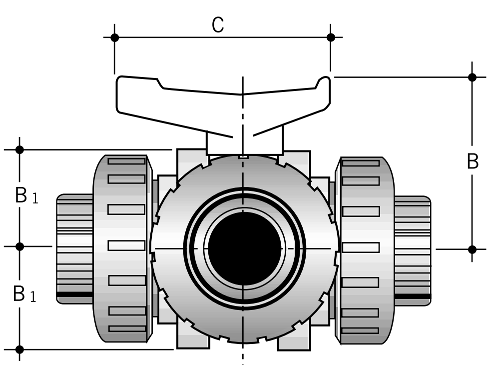
DESIGN DATA

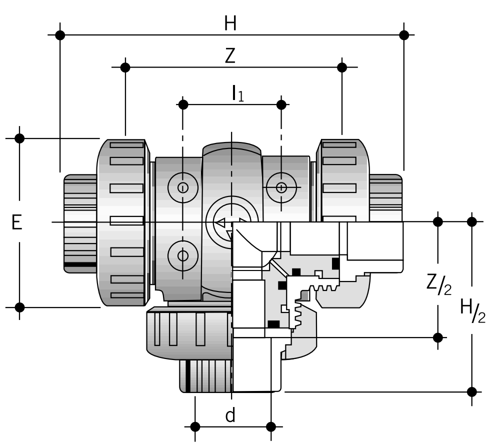


VK Double Blocking Ball Valve True Union

PP Dimensions

size (d)	H	E	B	C	lbs	psi
20	4.02	2.17	1.93	2.60	0.30	150
25	4.49	2.56	2.32	2.95	0.46	150
32	4.96	2.91	2.60	3.35	0.66	150
40	5.55	3.39	2.95	3.82	0.95	150
50	6.46	3.90	3.43	4.33	1.39	150
63	7.83	4.72	3.98	5.28	2.32	150
75	8.39	5.94	4.88	9.25	4.42	150
90	10.51	7.32	5.59	11.22	7.62	150
110	10.83	8.66	6.54	13.19	11.22	150



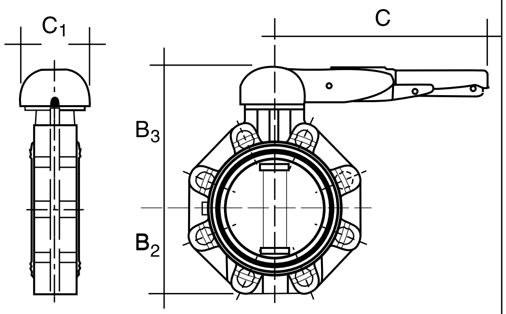


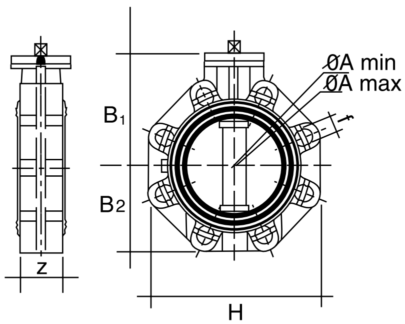
VT (L-port, T-port) Three-way Ball Valve

size (d)	B	C	E	lbs
20	2.01	2.56	2.09	0.39
25	2.32	2.99	2.48	0.59
32	2.56	3.35	2.80	0.88
40	2.99	3.94	3.31	1.35
50	3.46	4.41	3.82	1.89
63	4.09	5.39	4.57	3.08

size (d)	Z	H	B1	I1	psi
20	3.23	4.37	1.06	0.93	150
25	3.74	5.00	1.26	1.20	150
32	4.29	5.71	1.44	1.55	150
40	5.12	6.73	1.69	1.58	150
50	6.10	7.95	2.03	2.05	150
63	7.20	9.37	2.34	2.22	150

Except for item size (d), all other unspecified dimensions are in inches.

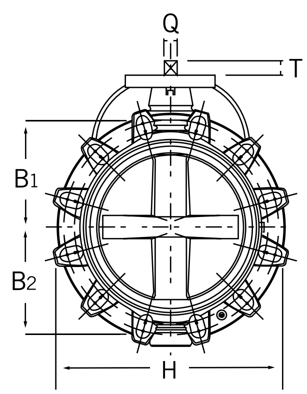


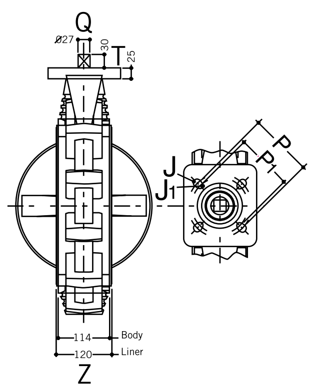


FK Butterfly Valve

d (in)	B_3	C	C_1	f	ISO mount pattern	lbs
2½	6.46	10.70	4.33	0.75	F05/F07	3.23
3	7.00	10.70	4.33	0.75	F07	4.11
4	7.56	10.70	4.33	0.75	F07	4.88
5	8.35	12.99	4.33	0.91	F07	6.82
6	8.86	12.99	4.33	0.91	F07	8.47
8	10.71	16.54	4.80	0.91	F07	14.35

d (in)	A min	A max	B_1	B_2	H	Z	ISO mount pattern	psi
2½	5.04	5.70	4.69	3.15	6.50	1.81	F05/F07	150
3	5.71	6.30	5.24	3.66	7.28	1.93	F07	150
4	6.50	7.50	5.79	4.21	8.31	2.20	F07	150
5	8.03	8.50	6.57	4.72	9.45	2.52	F07	150
6	9.10	9.53	7.10	5.30	10.60	2.80	F07	150
8	11.02	11.73	8.94	6.34	12.72	2.80	F07	150



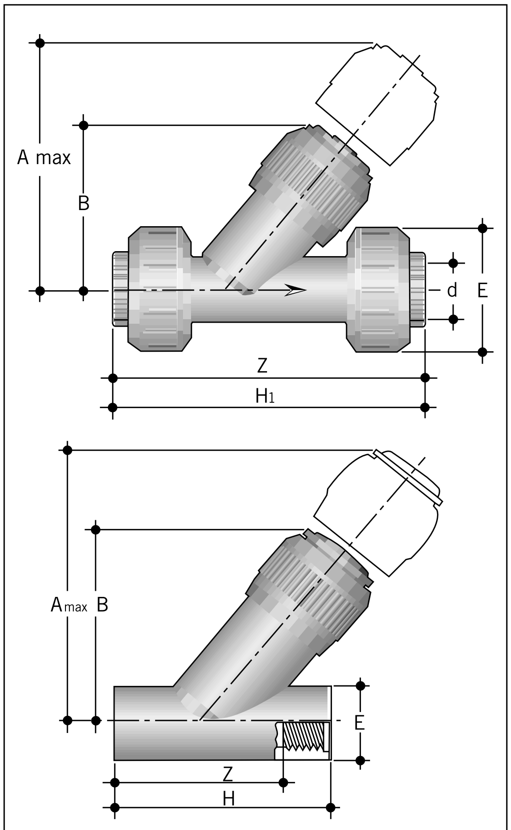


FK 10" & 12" Butterfly Valve

I (in)	B_1	B_2	H	A	lbs
10	9.76	8.27	15.95	4.49	26.45
12	12.01	9.65	18.70	4.49	41.89

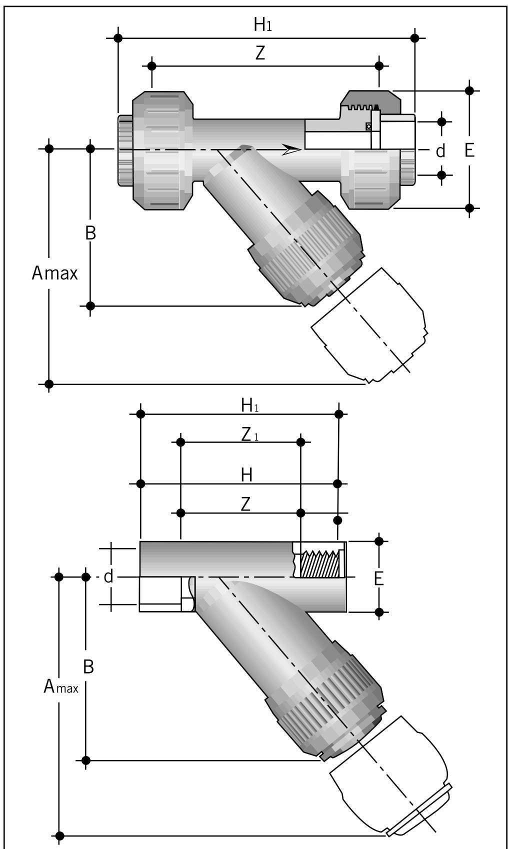
I (in)	J	P	ISO mount pattern	T	Q	psi
10	.51	4.92	F12	1.14	1.06	150
	.67	5.51	F14			
12	.51	4.92	F12	1.14	1.06	150
	.17	5.51	F14			

Except for item size (d), all other unspecified dimensions are in inches.



VR Y-Pattern Piston Check Valve

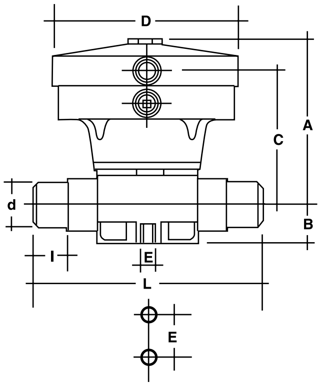
size d	A max	B	E	Z	H1	H	psi	lbs
20	4.92	2.80	2.17	4.27	5.41	-	150	0.36
25	5.71	3.27	2.56	4.92	6.18	-	150	0.50
32	6.50	3.70	2.91	5.61	7.03	-	150	0.84
40	7.48	4.29	3.39	6.46	8.07	-	90	1.42
50	8.27	4.69	3.90	7.74	9.59	-	90	2.01
63	9.45	5.61	4.72	9.41	11.57	-	90	3.42
75	11.81	6.93	4.06	9.49	-	9.49	90	5.39
90	12.80	7.60	4.53	10.24	-	10.24	60	6.89

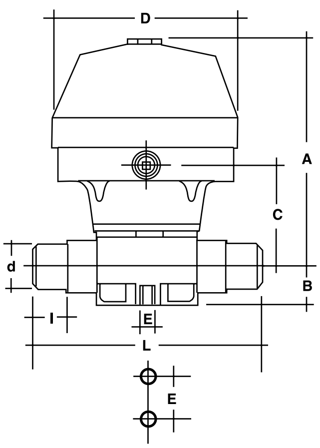


RV Y-Pattern Sediment Strainer

size d	A max	B	E	Z	H1	H	psi	lbs
20	4.92	2.80	2.17	4.27	5.41	-	150	0.33
25	5.71	3.27	2.56	4.92	6.18	-	150	0.43
32	6.50	3.70	2.91	5.61	7.03	-	150	0.65
40	7.48	4.29	3.39	6.46	8.07	-	90	1.05
50	8.27	4.69	3.90	7.74	9.59	-	90	1.49
63	9.45	5.61	4.72	9.41	11.57	-	90	2.42
75	11.81	6.93	4.06	9.49	-	9.49	90	3.48
90	12.80	7.60	4.53	10.24	-	10.24	60	4.22
110	15.16	9.00	5.43	9.45	-	12.70	60	6.60

Except for item size (d), all other unspecified dimensions are in inches.





VM Pneumatic Diaphragm Valve

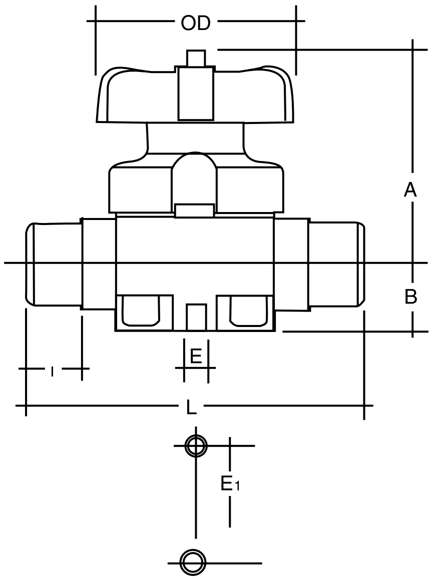
Normally Open/Double-Acting

size d	L	DO	A NO/DA	B	C NO/DA	PSI	lbs NO/DA
20	4.88	4.96	5.67	1.02	4.72	150	2.86
25	5.67	4.96	5.67	1.02	4.72	150	2.86
32	6.06	4.96	5.67	1.02	4.72	150	2.86
40	6.85	6.10	7.91	1.57	5.24	150	6.16
50	7.64	6.10	7.91	1.57	5.24	150	6.16
63	8.82	8.27	9.33	1.57	6.14	150	10.12
75	11.22	10.16	12.01	2.17	9.92	90	27.50
90	11.81	10.16	12.01	2.17	9.92	90	28.60
110	13.78	10.16	12.99	2.72	10.55	90	48.50

Normally Closed

size d	A NC	I	C NC	E	E_1	PSI	lbs NC
20	6.89	0.63	2.60	M6	0.98	150	4.07
25	6.89	0.75	2.60	M6	0.98	150	4.07
32	6.89	0.91	2.60	M6	0.98	150	4.07
40	9.61	1.06	4.06	M8	1.75	150	8.80
50	9.61	1.26	4.06	M8	1.75	150	8.80
63	11.50	1.54	4.92	M8	1.75	150	15.29
75	12.80	1.73	7.36	M12	3.94	90	33.30
90	12.80	2.01	7.36	M12	3.94	90	34.10
110	13.98	-	10.55	M12	4.72	90	56.10

Except for item size (d), all other unspecified dimensions are in inches.



VM Manually Operated Diaphragm Valve

size d	A	B	L	D	PSI	lbs
20	3.74	1.02	4.88	3.54	150	1.54
25	3.74	1.02	5.67	3.54	150	1.54
32	3.74	1.02	6.06	3.54	150	1.54
40	4.96	1.57	6.85	4.53	150	3.30
50	4.96	1.57	7.64	4.53	150	3.30
63	5.83	1.57	8.82	5.51	150	5.28
75	8.86	2.17	11.22	8.46	150	16.50
90	8.86	2.17	11.81	8.46	150	16.50
110	11.61	2.72	13.78	9.84	150	23.00

size d	E_1	E	I
20	0.98	M6	0.63
25	0.98	M6	0.75
32	0.98	M6	0.91
40	1.75	M8	1.06
50	1.75	M8	1.26
63	1.75	M8	1.54
75	3.94	M12	1.73
90	3.94	M12	2.01
110	4.72	M12	-

Except for item size (d), all other unspecified dimensions are in inches.

Scope

This specification sheet covers the manufacturer's (IPEX) requirements for PN10 pigmented, socket fusion Polypropylene pipe, valves, fittings and fusion equipment. The system is designed for use in demanding applications including, but not limited to, the pressurized handling of aggressive chemicals, potable and pure water, chilled water and foodstuffs.

Polypropylene Materials

Pipe material shall meet the requirements for a copolymer (Type II) polypropylene in accordance with ASTM D-2146. Fittings and valve material (wetted parts only) shall meet the requirements for PP-H (Homopolymer Type I) in accordance with ASTM D-4101. All polypropylene materials used in the manufacturing of IPEX SF Polypro system shall be in compliance with CFR requirements for basic polypropylene. Pigment for all components shall be RAL 7032 in compliance with CFR requirements for pigments suitable for contact with foodstuffs, potable water and pharmaceutical use.

Pipe

IPEX pipe shall have outside diameters, wall thickness and allowable tolerances that conform to an SDR (Standard Dimensional Ratio) of 11. Hydrostatic design basis of the pipe shall conform to ASTM D2837, DIN 8077/8078 and ISO DIS 15494. Pipe shall be pressure rated for 150 psi (PN10) @ 68°F.

Fittings

All IPEX polypropylene fittings 20 mm (½") through 110 mm (4") shall be socket fusion style and shall be rated for 150 psi (PN10) @ 68°F.

The ID of all fitting shall provide an Interference Fit with pipe or spigot components (prior to the fusion heating cycle) and shall conform to DIN 16962. The amount of minimum and maximum interference between pipe and fittings shall be regulated by ISO DIS 3609/15494 and DIN8077.

Valves

All polypropylene valves shall have either socket ends according to DIN 16962 or spigot ends according to DIN 8077/8078 or threaded ends according to ASA B 2.1.1945 or flanged ends according to ANSI B 16.1.

Glass reinforcement (GRF) of wetted parts shall not be allowed in any valve. (Consult individual cut sheet for detailed valve specifications.)

Fusion Equipment

All socket fusion of IPEX polypropylene pipe, valves and fittings shall conform to the specification of ASTM D-2657. Fitting clamps with sharp edges can damage the fitting; equipment featuring such devices shall not be allowed. Welding of IPEX SF Polypro system components shall be performed with the use of IPEX socket fusion tools.

For joints from 20 mm (½") to 50 mm (1½") IPEX PF063, PF110, Poly110M or Poly110P shall be used.

For joints 63 mm (2") to 110 mm (4") only IPEX Poly110m or Poly110P shall be used.

Socket Fusion Training

IPEX SF Polypro systems shall only be installed by IPEX trained installers.

VK SERIES: TRUE UNION END BALL VALVE

1.0 Ball Valves - VK

1.1 Material

- Valve body, stem, ball and unions shall be made of homopolymer polypropylene resin that is compatible with IPEX SF Polypro piping systems.

1.2 Seats

- Ball seats shall be Teflon® backed by EPDM or VITON o-rings.

1.3 Seals

- Seal material shall be EPDM or VITON (specifier must select one). The same material must be selected for seat back up o-rings (1.2).

2.0 Design Features

- Valves shall be blocking in both directions and shall have union ends.
- Valves shall have a limited travel blocking carrier.
- Body shall be single end entry.
- The blocking device shall be adjustable with the valve installed.
- 20 mm - 110 mm shall be full port.
- All sizes shall have a spanner wrench incorporated in the handle.
- 75 mm - 110 mm shall have integrally molded mounting pads.
- 110 mm shall be trunnion style.
- All valves shall have an expansion compensating groove on solid end.

2.1 Pressure Tested

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

2.2 Pressure Rating

- Valves shall be rated as follows:
  20 mm - 110 mm - 150 psi at 73°F

3.0 Ball valves shall be PP by IPEX or approved equal.

VT / VL SERIES: THREE-WAY TRUE UNION END BALL VALVE

1.0 Ball Valve - VT / VL

1.1 Material

- Valve body, stem, ball and unions shall be made of homopolymer polypropylene or resin that is compatible with IPEX SF Polypro piping system.

1.2 Seats

- Ball seats shall be Teflon®.

1.3 Seals

- Seal material shall be EPDM or VITON (specifier must select one).

2.0 Design Features

- All valves shall be molded to be true union (all three ports).
- All ports shall have a Teflon® seat.
- Valve design shall permit positive shut off of any of the three ports.
- Balls shall be T-port or L-port (specifier must select one).
- Thickness of valve body shall be the same at all three ports.
- All valves shall have integrally molded mounting pads.

2.1 Pressure Rating

- Valves shall be rated at 150 psi at 73ºF.

3.0 Ball valves shall be PP by IPEX or approved equal.

FK SERIES: BUTTERFLY VALVE

1.0 Butterfly Valves - FK

1.1 Material

- Valve body shall be made of glass reinforced PP(PPG) obtained from homopolymer polypropylene (PPH).
- Valve disc shall be made of homopolymer polypropylene or compatible with IPEX SF Polypro piping system.
- Valve shaft shall be made of 420 stainless steel.

1.2 Seats

- Liner boot shall be EPDM or VITON (specifier to select one).

1.3 Seals

- O-rings shall be EPDM or VITON (specifier to select one).

2.0 Design Features

- Shaft shall have standard ISO square dimensions for direct mounting of actuators.
- Disc seating shall be provided by a pyramidal elastomeric liner boot.
- Liner shall:
    - a) completely isolate valve body from flow, and
    - b) function as flange gasket on both sides of the valve
- Body cavity shall feature a special serrated surface to prevent liner slippage and compression.
- Disc, seats and seals to be the only wetted parts.
- A Teflon® seated double elastomeric seal packaging shall prevent the stainless steel shaft from becoming wetted.
- Valve shall be bubble tight and of wafer or lug design.
- Lug style valves shall feature lugs permanently integrated during molding.

2.1 Pressure Rating

- Valves shall be rated at 150 psi at 73ºF.

3.0 Butterfly valves shall be by IPEX or approved equal.

VR SERIES: PISTON CHECK VALVE

1.0 Check Valves - VR

1.1 Material

- Valve body and piston shall be made of pigmented polypropylene that is compatible with IPEX SF Polypro piping system.

1.2 Seats

- Seat material shall be EPDM or VITON (specifier must select one).

1.3 Seals

- Seal material shall be EPDM or VITON (specifier must select one).

2.0 Design Features

- Valve body shall have true union ends (20 mm to 63 mm) and solid threaded or socket ends (75 mm - 90 mm).
- All valves shall be y - pattern globe style.
- All valves shall be gravity operated.
- The weight shall be totally encapsulated inside the piston.
- Valve shall work both in horizontal and vertical lines, without minimum column requirements.
- Servicing of the valves shall be possible without removal from the line.

2.1 Pressure Rating

- Valves shall be rated as follows:

  20 mm - 63 mm - 150 psi at 73ºF
  75 mm - 90 psi at 73ºF
  90 mm - 60 psi at 73ºF

3.0 Piston Check valves shall be by IPEX or approved equal.

RV SERIES: SEDIMENT STRAINER

1.0 Strainers - RV

1.1 Material

- Strainer body shall be made of pigmented polypropylene that is compatible with IPEX SF Polypro piping system.

1.2 Seals

- Seal material shall be EPDM or VITON (specifier must select one).

1.3 Screens

- Screens shall be:

  PP
  Stainless Steel

2.0 Design Features

- Strainer shall be Y - pattern style and shall have true union ends 20 mm - 63 mm) and socket (75 mm - 110 mm).
- It shall be possible to service the valve without removing it from the line.
- Following mesh sizes shall be available:

  13, 15, 19, 30 (PVC)
  19 (stainless steel)

2.1 Pressure Rating

- Strainers shall be rated as follows:

  20 mm - 63 mm - 150 psi at 73ºF
  75 mm - 90 psi at 73ºF
  90 mm - 110 mm - 60 psi at 73ºF

3.0 Sediment Strainers shall be by IPEX or approved equal.

VM SERIES: PNEUMATIC DIAPHRAGM VALVE

1.0 Pneumatic Diaphragm Valves - VM

1.1 Material

- Valve body shall be made of polypropylene resin that is compatible with IPEX SF Polypro piping system.
- Valve bonnets shall be made of high temperature, high strength glass-filled polypropylene.

1.2 Diaphragm

- Diaphragm material shall be EPDM, VITON or PTFE faced with elastomeric backing (specifier must select one).

2.0 Design Features

- All valves shall be true union (20 mm - 63 mm) or spigot (20 mm - 110 mm).
- All valves shall be weir style for throttling applications.
- All bodies to be used with EPDM or VITON diaphragms shall feature raised molded sealing rings (concentric).
- All bodies to be used with PTFE diaphragms shall be machined flat.
- All PTFE diaphragms shall feature a raised molded ring to combine sealing performance and longer life.
- All through bolts shall be 304SS.
- Bolts will thread directly into integrally molded brass inserts in the bonnet.
- All manual valves shall have a rising valve indicator.
- Bodies of all sizes and material shall have mounting brass inserts.

2.1 Design Features - Actuators

- All springs shall be cut from spring grade steel for maximum memory life and epoxy coated for maximum chemical resistance.
- Fail safe to open and double-acting actuators shall feature weak springs located in the center of the actuator.
- Fail safe to close actuators shall feature three concentric springs located in the middle of the actuator.
- All actuators (20 mm - 90 mm) shall be glass-filled polypropylene.

  The following accessories shall be available for all actuators:
  position indicator, stroke limiter, stroke limiter with position indicator,
  limit switch, 4-20 MA positioner, limit switch box, solenoids

- All actuators (½" thru 3") shall feature a smooth top (no nut holes) for cleanliness.
- Edge of actuator membrane shall be inside of actuator protective housing.

2.2 Pressure Rating

- Valves shall be rated as follows: 20 mm - 110 mm - 150 psi at 73°

3.0 VM Series Diaphragm valves shall be by IPEX or approved equal.

VM SERIES: MANUAL DIAPHRAGM VALVE

1.0 Manual Diaphragm Valves - VM

1.1 Material

- Valve body shall be made of polypropylene resin that is compatible with IPEX SF Polypro piping system.
- Valve bonnets shall be made of high temperature, high strength glass-filled polypropylene.

1.2 Diaphragm

- Diaphragm material shall be EPDM, VITON or PTFE faced with elastomeric backing (specifier must select one).

2.0 Design Features

- All valves shall be true union (20 mm - 63 mm) or spigot (20 mm - 110 mm).
- All valves shall be weir style for throttling applications.
- All bodies to be used with EPDM or VITON diaphragms shall feature raised molded sealing rings (concentric).
- All bodies to be used with PTFE diaphragms shall be machined flat.
- All PTFE diaphragms shall feature a raised molded ring to combine sealing performance and longer life.
- All through bolts shall be 304SS.
- Bolts will thread directly into integrally molded brass inserts in the bonnet.
- All manual valves shall have a rising valve indicator.
- Bodies of all sizes and material shall have mounting brass inserts.

2.1 Pressure Rating

- Valves shall be rated as follows:

  20 mm - 110 mm - 150 psi at 73ºF

3.0 VM Series Diaphragm valves shall be by IPEX or approved equal.

Optional: All PP valves (20 mm - 63 mm) can be true union end design.

Socket Weld Installation

Socket welding involves fusing of the pipe in the socket of the fitting. The joint is made by simultaneously fusing the male and female surfaces by means of special manual or automatic heating device. The welding appliance, in its simplest form, is composed of a heating surface on which a series of heating bushes are mounted. The appliance is completed by an appropriate heating system complete with an automatic temperature controller. No additional materials are required for this type of welding. It should be noted that socket welding does not affect the chemical resistance of the polypropylene, nor does it influence the chemical resistance or pressure resistance of the assembled pipes and fittings.

Manual-Type Welding Equipment

Instructions

These instructions are for the use of IPEX manual type welding equipment. The use of automatic and semi-automatic appliances, which are particularly suitable for diameters greater than 63 mm, calls for a specific working knowledge of the welding tool. In this case, adhere strictly to the specific tool instructions.

Appliance for manual joining of pipes and fittings by socket welding.

1

Select the heating bush and the heating spigot of the required diameters, insert them and secure them to the heating tool.

2

Carefully clean the contact surfaces. When choosing the type of liquid detergent, use recommended products such as: trichloroethane, chloroethene, ethyl alcohol and isopropyl alcohol.

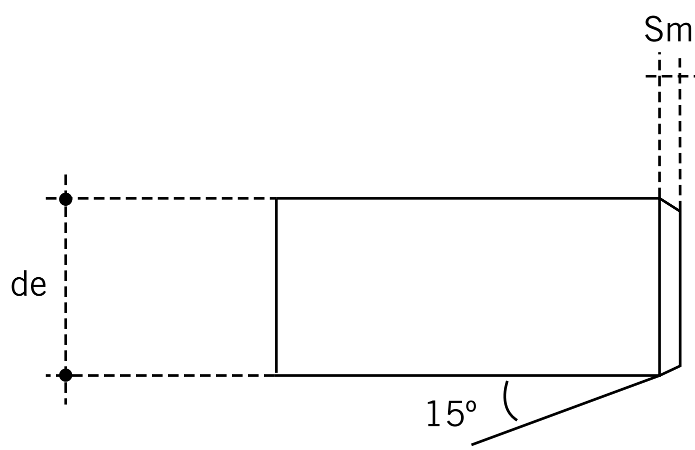
3 Set the temperature of the heating tool. To form the joint correctly, the temperature should be set between 250 and 270ºC.

4 When the appliance has reached the preset temperature, check the temperature of the heating surface using a fast acting thermoprobe.

5 Cut the pipe at right angles and chamfer the newly cut edge.

Table 1 **Polypropylene Fittings for Socket Welding. Chamfer dimensions.**

Outside Diameter de (mm)	**Chamfer depth Sm**
20	4 mm 5/32 inches
25	
32	
40	
50	
63	5 mm 1/5 inches
75	
90	
110	



Insertion Length L1: indicates the maximum length of insertion of the heated pipe into the socket of the fitting. (Table 2)

The insertion depth of the pipe into the fitting varies by diameter.

Table 2 **Insertion Depth Table**

D	20	25	32	40	50	63	75	90	110
L1 *mm*	14	15	17	18	20	26	29	32	35
L1 *inch*	0.55	0.58	0.67	0.70	0.78	1.00	1.14	1.25	1.37

6

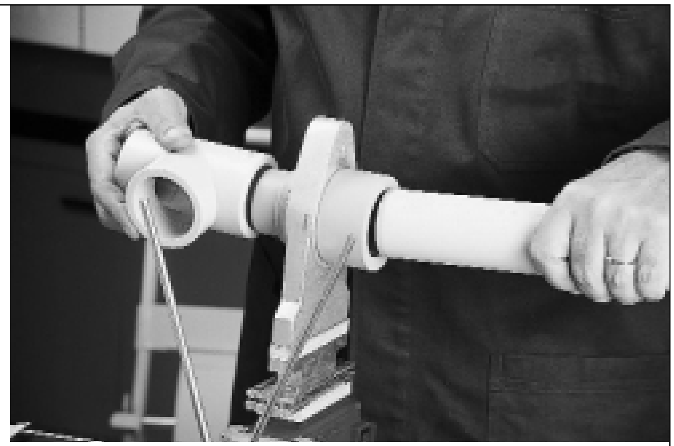
Mark the pipe at the insertion length L1.

7

Mark a longitudinal reference line on the outside of the pipe and the fitting to prevent the two parts from rotating while the joint is being made.

8 Clean the fitting and pipe from any traces of oil or grease on the weld surfaces with an approved cleaning agent such as isopropyl alcohol.

9



Check that the thermostat green light is on steady or, if external conditions requires the use of a Temperstick*, use the correct Temperstick to check the bushings temperature (DO NOT USE THE STICK ON THE PARTS OF THE BUSHINGS THAT WILL COME IN CONTACT WITH PIPE OR FITTINGS). Briefly and simultaneously engage both pipe and fitting with their respective bushing to determine interference. If substantial more resistance is offered by either the pipe or the fitting, begin your insertion with just that one item. Start the insertion of the second item once the first has reached the bushing half point. If same resistance is observed, start both pipe and fitting insertion simultaneously. Once the mark on the pipe reaches the edge of the female bushing and the top of the fitting reaches the stop on the male bushing apply just enough pressure to prevent "kick-back" and begin the heating time count as shown in Table 3.

* Should welding be performed outdoors in adverse (cold and/or windy) weather conditions, it is advisable to double check the thermostat reading with Temperstick. Should the Temperstick ascertain an insufficient tool temperature, simply increase by small increments the thermostat setting until the Temperstick deposit on the tool evaporates. After any changes to the temperature dial, the red light will come on. You must wait for the green indicator to light before using the Temperstick.

Table 3 **Heating, Welding and Cooling Times**

Polypropylene pipes to: DVS 2207 Part 11				
Diameter (mm)	**Minimum Thickness (mm)(T)**	**Heating Time (s)**	**Welding Time (s)**	**Cooling Time (min)**
20	2.5	5	4	2
25	2.7	7		
32	3	8	6	4
40	3.7	12		
50	4.6	16		
63	3.6	24	8	6
75	4.3	30		
90	6.1	40		
110	6.3	50	10	8

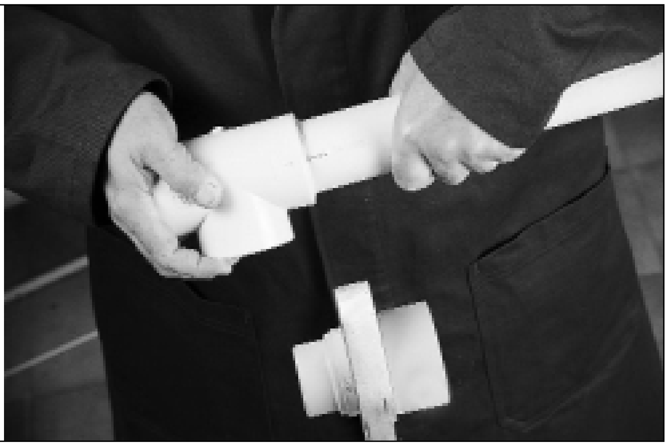
(T) For a correctly executed weld we recommend using pipe wall thicknesses greater than 2 mm (0.08").

10

When the minimum heating time has elapsed, quickly remove the elements from the heating bushings and fit the pipe into the socket for the entire insertion L1 marked previously. Do not turn the pipe in the sockets; Ensure the longitudinal reference marks are perfectly aligned.

11

Hold the joint together for the welding time shown in Table 3 and then leave it to cool slowly at ambient temperature (never dip the joint into water or expose it to a forced airstream).



12

When the internal and external surfaces have cooled sufficiently (minimum cooling time Table 3).

Conduct pressure test according to local codes and regulations.

Socket Fusion Polypropylene Bench Socket Fusion Joining Kit

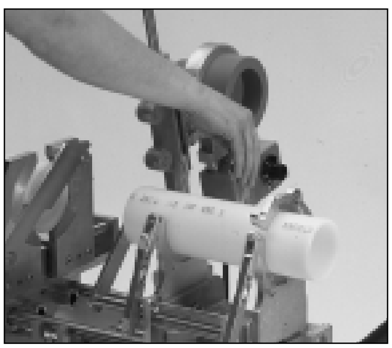
Socket Fusion Polypropylene (SF Polypro) can be easily and efficiently joined using the IPEX Bench Socket Fusion Tool. The tool, available in both manual and hydraulic versions, comes complete with all the parts and accessories needed to socket weld the entire range of 20 mm to 110 mm SF Polypro products. The kit includes a self-aligning frame; removable stand with tool box; thermostat-controlled heating mirror; master pipe, fitting clamps and all their reducers; heater bushing; patented insertion-depth selector; and manual or hydraulic controls.

The IPEX Bench Fusion Tool is the natural choice when performing larger size socket welds or when completing a large number of welds requiring maximum accuracy from the first to the last.

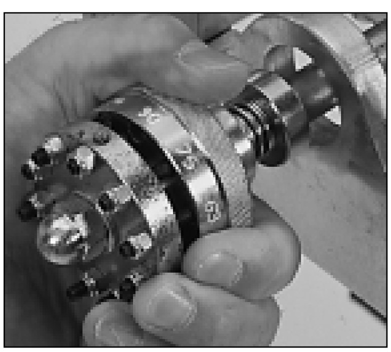
Socket Fusion Procedure

It is strongly recommended that your local IPEX representative demonstrate the socket fusion procedure before you attempt to assemble SF Polypro systems. Use only IPEX socket fusion tools. They are designed specifically for our systems, with components that are dimensionally matched. Do not attempt to install a system of mixed brands.

Preparing the Machine



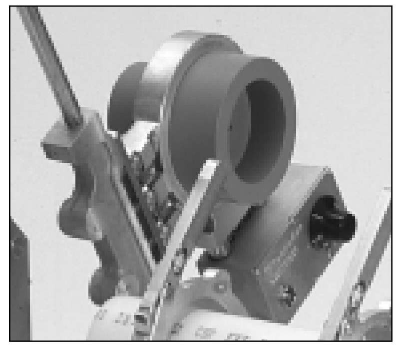
- Assemble the machine and stand at the work area. Select the correct size of V-blocks for the fittings. Select the inserts for the pipe clamps and fasten them in place using the allen wrench provided. Inserts are not required for 4" or 110 mm pipe.



- Set the insertion depth selector stop on the end of the machine to the correct size. These settings are in millimeters and are pre-set at the factory. The inch equivalents are as follows:

in	½	¾	1¼	1½	2	3	4
mm	20	25	40	50	63	90	110

Preparing the Heating Tool



- Be sure the mirror is clean. Dirty or greasy mirror surfaces will reduce heat transfer and joint strength.

CAUTION:
Handle the heater bushings carefully. Damage to the Teflon coating on the heater bushings can cause poor welds.

- Bolt the heater bushings securely to the mirror with the hardware provided. Plug the heater into a grounded 110-volt outlet. Be sure the outlet is protected by circuit breakers or fuses. Using other electrical devices on the same power source causes amperage loss and can also cause bad welds.

- Set the temperature selector to 260ºC (500ºF) and wait for the temperature light indicator to go off. The temperature of the heater bushings must be between 253ºC (488ºF) and 288ºC (550ºF).

HANDLING AND INSTALLATION

If external conditions require the use of a Temperstick*, use the correct Temperstick to check the bushings temperature.

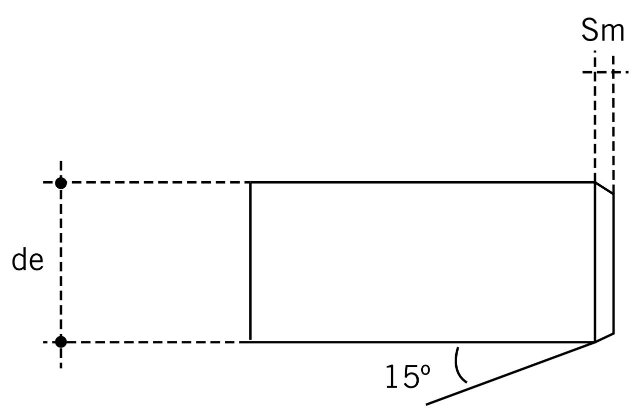
CAUTION:
Do not use the Temperstick on the parts of the bushings that will come in contact with pipe or fittings.

*Should welding be performed outdoors in cold and/or windy weather conditions, it is advisable to double-check the thermostat reading with a Temperstick. Should the Temperstick indicate insufficient tool temperature, simply increase the thermostat setting by small increments until the Temperstick deposit on the tool evaporates. After any changes to the temperature dial, the red light will come on. You must wait for the green indicator to light before using the Temperstick.

Pipe and Fitting Preparation

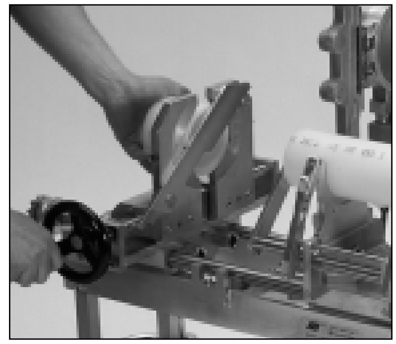
- Cut the pipe at right angles and chamfer the newly cut edge.

Outside Diameter (de) (in)	(mm)	Chamfer depth Sm
½	20	4 mm 5/32 inches
¾	25	
1	32	
1¼	40	
1½	50	
2	63	5 mm 1/5 inches
2½	75	
3	90	
4	110	

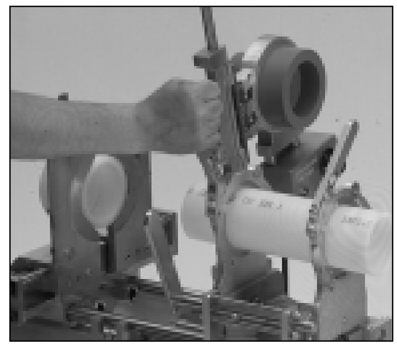


- Clean all traces of oil or grease on the weld surfaces from the fitting and pipe.

- Position the fitting in the V-blocks, on the left side of the machine, flush with the crossbar. Tighten the clamps using the hand wheel on the front of the machine.

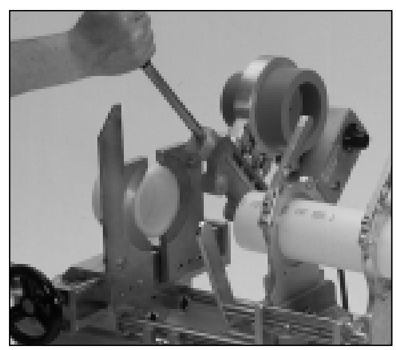


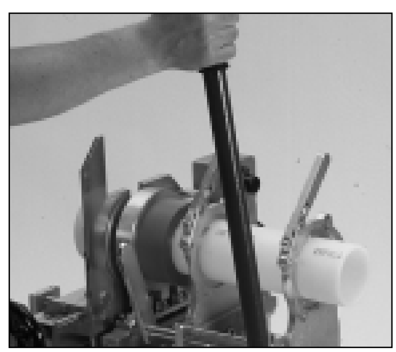
- Position the pipe in the pipe clamps flush with the retractable pipe stop and clamp into place. Then, retract both the clamp crossbar and the pipe stop before starting the fusion process.



Heating Procedure

- Lower the heating mirror into position between the pipe and fitting. Using the compression lever, push the pipe and fitting toward the heater bushings until they are completely engaged. Use the appropriate “Heating, Welding and Cooling Times” chart on the next page to determine how long to leave the pipe and fitting in the heater bushings.





- The following charts show the appropriate time, that the pipe and fitting should be held on the heater bushings. **Heating time starts from the moment of full insertion of both pipe and fitting.**

Specifically:

If the pipe and fitting do not fit tightly on the heater bushing, the heating time should be started when the components have swelled to just contact the surface of the heater bushings.

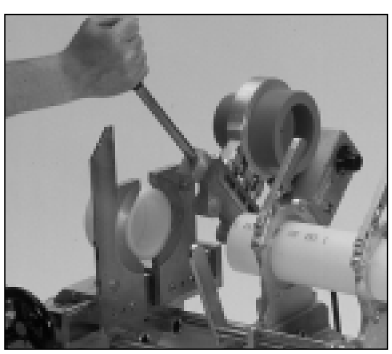
Heating, Welding and Cooling Times - SF Polypro

Polypropylene pipes to: DVS 2207 Part 11				
Diameter (mm)	**Minimum Thickness (mm)(T)**	**Heating Time (s)**	**Welding Time (s)**	**Cooling Time (min)**
20	2.5	5	4	2
25	2.7	7		
32	3	8	6	4
40	3.7	12		
50	4.6	16		
63	3.6	24	8	6
75	4.3	30		
90	6.1	40		
110	6.3	50	10	8

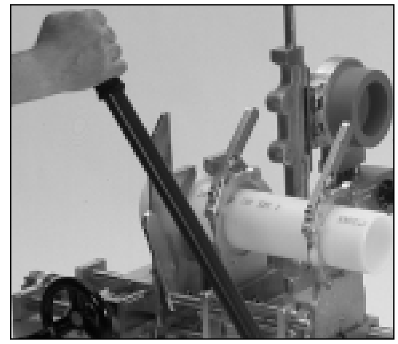
(T) For a correctly executed weld, we recommend using pipe wall thicknesses greater than 2 mm (0.08").

Joining Procedure

- After the correct amount of time has passed, push the compression lever back. Remove the pipe and fitting from the heater bushings. Quickly raise the mirror to the vertical position; then press the pipe and fitting together again by moving the compression lever until it bottoms out on the insertion depth stop. Hold the completed joint in position for 10 seconds, then release the clamps and remove the joined pipe and fitting from the machine.



- Clean the heater bushings by wiping them off with a clean, dry cloth after each joint. There should not be large amounts of material left on the heater bushings if the fusion is done properly.



Joint Testing

Working or test pressure must not be applied to a joint until the indicated cooling time has elapsed in ambient temperature conditions. The system should be hydrostatically tested in accordance with the local codes and regulations.

We recommend that a pressure test is conducted after completing the first 20 or 30 joints to ensure that the project is satisfactory.

CAUTION: Do not test with air or gas.

Site Pressure Testing

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

Generally a test pressure of 1½ times the safe working pressure for the pipe installed is adequate. Whenever possible, it is recommended that hydrostatic testing is 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).

Hydrostatic Test Procedure

1. Fully inspect the installed piping for evidence of mechanial abuse and dry or suspect joints.
2. Split the system into convenient test sections not exceeding 1000 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 sytem 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 1½ 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 pressurization is commenced.

   Any joint leaks should be repaired and allowed to fully cure before re-pressurizing.

Contact your nearest IPEX Customer Service Center with any questions regarding applications or specifications not included in this manual.

NOTES

SALES AND CUSTOMER SERVICE

Canadian Customers call

Toll free: (866) 473-9462

U.S. Customers call

Toll free: (800) 463-9572

www.ipexinc.com

About IPEX

IPEX is a leading supplier of thermoplastic piping systems. We provide our customers with one of the world's largest and most comprehensive product lines. All IPEX products are backed by over 50 years of experience. With state-of-the-art manufacturing facilities and distribution centers across North America, the IPEX name is synonymous with quality and performance.

Our products and systems have been designed for a broad range of customers and markets. Contact us for information on:

- PVC, CPVC, PP, ABS, PEX and PE pipe and fittings (1/4" to 48")
- Industrial process piping systems
- Double containment systems
- Acid waste systems
- High purity systems
- Municipal pressure and gravity piping systems
- Plumbing and mechanical pipe systems
- Electrical systems
- Telecommunications and utility piping systems
- Irrigation systems
- Radiant heating systems

WARRANTY: All IPEX products are guaranteed against defects resulting from faulty workmanship or materials. If any such product is found to be defective by reason of faulty workmanship or materials, upon written notice and return of the product, the defective product will be replaced by IPEX free of charge, including shipping charges for the replacement product. Claims for labour costs and other expenses required to replace such defective product or to repair any damage resulting from the use thereof will not be allowed by IPEX. Our liability is limited to the price paid for the defective product. IPEX will not be bound by any warranty, other than above set forth, unless such warranty is in writing.

This literature is published in good faith and is believed to be reliable. However, IPEX does not represent and/or warrant in any manner the information and suggestions contained in this brochure. Data presented is the result of laboratory tests and field experience.

IPEX maintains a policy of ongoing product improvement. This may result in modification of features and/or specifications without notice.

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Committed to Excellence