FUSIBOND PLASTIC LINED PIPING SYSTEMS

www.FUSIBOND.com

PLASTIC LINING PIPE AND FITTINGS IS OUR ONLY BUSINESS

ISO REGISTERED FIRM

HDPE • PP • PVDF • ECTFE • ETFE • PTFE • PFA

CONTENTS

Fusibond THE ONLY WORLD CLASS COMPANY THAT IS 1st IN TECHNOLOGY, 1st IN QUALITY, 1st IN CAPABILITY, because lining pipe and fittings is our only business.

Using our engineering know-how, developmental expertise and over 65 years of actual experience in the lined pipe business, we have developed the most modern equipment and process in the industry. This state of the art molding technique we call our “FUSION-BOND” system. It is the only way you can be sure of the same seamless uniform plastic wall thickness in fittings that is standard in everyone’s pipe.

Our dense, impact resistant, heavy wall plastic linings in both pipe and fittings are temperature compensated and locked into their metal housings - which then expand and contract as a unit.

Only FUSIBOND cycles every piece of pipe and fitting from ambient through its temperature range prior to shipment.

FUSIBOND the innovator molds all linings in place after our fitting is cast or fabricated. We do not bend, stretch, expand, seam or otherwise distort our homogeneous linings in any way. That’s quality!

FUSIBOND warrants its products 100% as each and every item is spark tested with a minimum of 25,000 volts which insures lining continuity and system longevity once in service.

We can quickly furnish any fitting configuration and pipe pressure rating you require.

ADVANTAGES OF FUSIBOND PLASTIC LININGS

- The most complete lining capability in the industry, offering any fitting configuration imaginable.
- Exclusive uniform plastic wall thickness, not only in pipe but guaranteed in all fittings as well.
- Exclusive in-house fitting manufacturing capabilities - no waiting for foundry runs
- The most complete choice of metals, plastics, and pressure ratings in the industry.
- Maximum corrosion resistance under full vacuum or pressure conditions.
- Exclusive fusion bond and locked-in liners insure against stress cracking over a wider range of applications.
- 1¼", 2½", and 5” pipe and fittings.
- Maximum safety is assured as our system combines the corrosion resistance of plastic with the inherent strength of metal.
- Economy of installation plus material cost savings when compared to exotic metals.
- Interchangeability with any present piping system.
- Easiest and quickest field fabrication tools in the industry.
- Lowest pressure drop system in the lined pipe industry, ½" through 12”.
- Field fabrication pipe-choice of locked in or loose liners.
- Standard ANSI dimensions after lining.
- DIN dimensions also available

LINER DATA

PLASTIC LINER DATA

Liner Characteristics	HDPE	PP	PVDF	ECTFE	ETFE	PTFE	PFA
Service Temperature Range, ºF	-20ºF to 180ºF	-20ºF to 225ºF	-20ºF to 275ºF	-20ºF to 300ºF	-20ºF to 300ºF	-20ºF to 450ºF	-20ºF to 450ºF
Liner Color	Black	Orange or NAT	Black or Natural	Natural	Natural	White	Natural
Color of Liner Identification Band		Orange	Black			White	White
Thermal Conducitivity ("K" Factor) of Liner, BTU-in./hr.-sq. ft.ºF	2.4	0.8	1.18	1.05	1.65	1.7	1.3
Tensile Strength of Liner at Yield, psi	3,500	4,000 - 4,500	4,500 - 6,500	4,300	6,700	3,000	4,000 - 4,500
Elongation of Liner at Yield, %	400	10 - 14	300	200	200 - 300	300	300 - 350
Compressive Strength of Liner at Yield, psi	1,800	5,500 - 8,000	6,000 - 8,500	7,000 - 9,000	7,000 - 9,000	1,700	3,500
Specific Gravity of Liner	0.9 - 0.95	0.90 - 0.92	1.78 - 1.80	1.68	1.72 - 1.74	2.14 - 2.19	2.12 - 2.17

HDPE = high density polyethylene
PP = polypropylene
PVDF = polyvinylidene flouride
ECTFE = ethylene chlorotrifluoro ethylene
ETFE = ethylene tetrafluoroethylene
PTFE = polytetrafluoroethylene
PFA = perfluoroalkoxy

All resins used by Fusibond are virgin. Also available unpigmented food and microchip grades.

HDPE
(HIGH DENSITY POLYETHYLENE)
HDPE is a versitale material which has great chemical and physical properties as well as exceptional abrasion resistance.

POLYPROPYLENE PP
(COPOLYMER)
An excellent polymer with proven chemical resistance in a wide variety of applications. It has good mechanical properties and, unlike the homopolymers, has relatively good cold temperature impact resistance.

KYNAR* FLEX PVDF
(COPOLYMER) (POLYVINYLIDENE FLUORIDE)
A Fluoropolymer with excellent resistance to most chemicals. It has good stability and is resistant to radiation, abrasion, cold temperature and stress cracking. Better than a homopolymer.

HALAR ECTFE**
(ETHYLENE CHLOROTRIFLUORO ETHYLENE)
A Fluoropolymer with exceptional chemical and physical properties. It is superior where permeation, mechanical stress, and abrasion are troublesome.

ETFE Fusion Bonded
(ETHYLENE TETRA FLUOROETHYLENE)
A fluoropolymer with superior chemical and physical properties. It is recommended in high pressure, vacuum, or systems where cold flow and joint creep are a problem. We call it the problem solver.

PTFE
(POLYTETRAFLUOROETHYLENE)
PTFE is an excellent fluoropolymer, virtually inert to all chemicals. It possesses high temperture corrosion resistance to almost all chemicals except Fluorine and Alkali metals. Its non-stick properties minimize or eliminate residue buildup on pipe walls. (vented)

PFA
(PERFLUOROALKOXY)
PFA is a newer melt-processible resin with the same chemical resistance, but with mechanical strength superior to PTFE. It can also be used at somewhat higher temperatures under the same conditions. (vented)

***KYNAR Trademark of Arkema**
****HALAR Trademark of Solvay**

Vacuum Capabilities

HDPE / PP - Full thru 8" larger depending on temperature.

PVDF, ECTFE, ETFE - Full thru 8"

PTFE - Full thru 4" larger, depending on temperature.

PFA - Full thru 4" larger, depending on temperature.

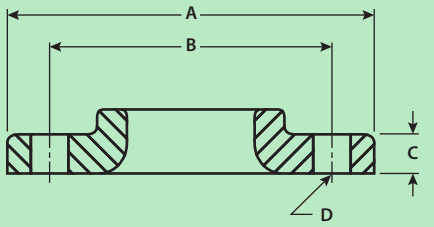
Consult factory for other ratings.

LINER THICKNESS (Heavy Duty)

Pipe Size	HDPE PP	PVDF ECTFE ETFE	PTFE ½" - .150" ¾" - .150"	PFA	Plastic Face Min. O.D. ½" - 1.250" ¾" - 1.563"
1"	.150"	.125"	.150"	.125"	1.875"
1¼"	.150"	.125"	O/A	.125"	2.375"
1½"	.150"	.125"	.150"	.125"	2.688"
2"	.175"	.125"	.150"	.125"	3.438"
2½"	.175"	.125"	O/A	.125"	3.938"
3"	.175"	.125"	.160"	.125"	4.625"
4"	.210"	.145"	.160"	.125"	5.938"
6"	.220"	.160"	.175"	.140"	8.000"
8"	.220"	.190"	.185"	.155"	10.063"
10"	.300"	.250"	.225"	O/A	12.250"
12"	.300"	.285"	.265"	O/A	14.375"

1"-12" Heavy Wall Available

Flange Diminsions

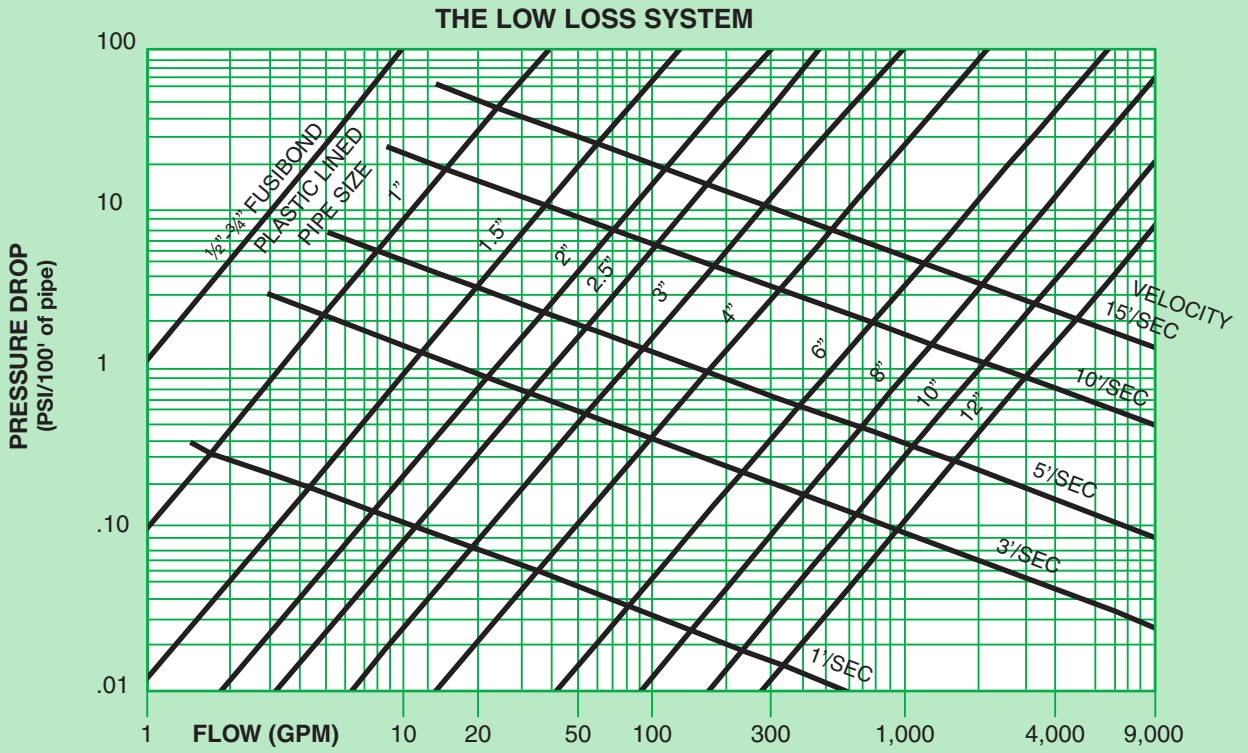


150 lb. Class ANSI B 16.42 and B 16.5 Flange Dimension					Pipe Size	300 lb. Class ANSI B 16.5 Flange Dimension				
A Outside Diameter	B Diameter of Bolt Circle	C Thickness	D No./Size of Bolt Hole	Blind Flg Thickness With Plastic		A Outside Diameter	B Diameter of Bolt Circle	C Thickness	D No./Size of Bolt Hole	Blind Flg Thickness With Plastic
3½"	2⅜"	7/16"	4-⅝"	9/16"	½"	3¾"	2⅝"	9/16"	4-⅝"	11/16"
3⅞"	2¾"	½"	4-⅝"	⅝"	¾"	4⅝"	3¼"	⅝"	4-¾"	¾"
4¼"	3⅛"	9/16"	4-⅝"	11/16"	1"	4⅞"	3½"	11/16"	4-¾"	13/16"
4⅝"	3½"	⅝"	4-⅝"	¾"	1¼"	5¼"	3⅞"	¾"	4-¾"	⅞"
5"	3⅞"	11/16"	4-⅝"	13/16"	1½"	6⅛"	4½"	13/16"	4-⅞"	15/16"
6"	4¾"	¾"	4-¾"	⅞"	2"	6½"	5"	⅞"	8-¾"	1"
7"	5½"	⅞"	4-¾"	1"	2½"	7½"	5⅞"	1"	8-⅞"	1⅛"
7½"	6"	15/16"	4-¾"	1 1/16"	3"	8¼"	6⅝"	1⅛"	8-⅞"	1¼"
9"	7½"	15/16"	8-¾"	1 1/16"	4"	10"	7⅞"	1¼"	8-⅞"	1⅜"
11"	9½"	1"	8-⅞"	1⅛"	6"	12½"	10⅝"	1 7/16"	12-⅞"	1 9/16"
13½"	11¾"	1⅛"	8-⅞"	1¼"	8"	15"	13"	1⅝"	12-1"	1¾"
16"	14¼"	1 3/16"	12-1"	1 5/16"	10"	17½"	15¼"	1⅞"	16-1⅛"	2"
19"	17"	1¼"	12-1"	1⅜"	12"	20½"	17¾"	2"	16-1¼"	2⅛"

PRESSURE DROP

Pressure Drop and Velocity (water) for Fusibond HDPE or Polypropylene Lined Pipe

PVDF, ECTFE, ETFE, PTFE, and PFA lined pipe losses are less than shown.



Fusibond low loss fittings have a large streamlined bore, are round on all corners (especially internally) and the I.D. matches the pipe more exactly than those of our competitors.

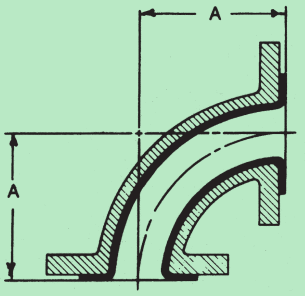
Pressure Drop for Fusibond Fittings in equivalent Feet of Pipe

Size	90° Elbow	45° Elbow	Tee Run	Tee Side	System Inlet/Exit
1"	1.6	.81	1.0	3.3	.18
1¼"	2.1	1.1	1.3	4.4	.26
1½"	2.4	1.3	1.5	5.2	.31
2"	3.1	1.7	1.8	6.6	.43
2½"	3.6	2.0	1.9	7.5	.52
3"	3.6	2.1	1.9	7.7	.55
4"	4.8	2.9	2.2	10	.77
6"	7.2	4.5	3.1	15	1.3
8"	9.8	6.3	3.9	20	1.9
10"	12	8.1	4.6	25	2.4
12"	15	9.7	5.2	30	3.0

Size	A 150# Flanged	A 300# Flanged	H 150#/300#
½ - ¾ - 1"	3½"	4"	5"
1¼"	3¾"	4¼"	5½"
1½"	4"	4½"	6"
2"	4½"	5"	6½"
2½"	5"	5½"	7"
3"	5½"	6"	7¾"
4"	6½"	7"	9"
6"	8"	8½"	11½"
8"	9"	10"	14"
10"	11"	11½"	16½"
12"	12"	13"	19"

90 Degree Elbows

Fig. 200

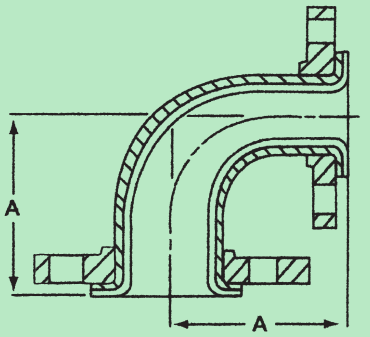


Long Radius Available
Fig. 220 — Dim. H

Size	A 150# Flanged	A 300# Flanged
½ - ¾ - 1"	3½"	4"
1½"	4"	4½"
2"	4½"	5"
2½"	5"	5½"
3"	5½"	6"
4"	6½"	7"
6"	8"	8½"
8"	9"	10"
10"	11"	11½"
12"	12"	13"

Reducing 90 Degree Elbows

Fig. 210

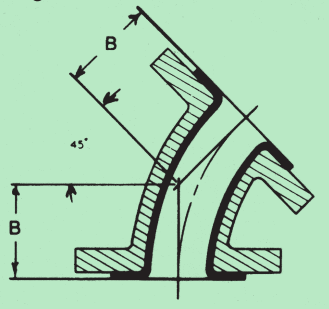


One Flange May Be Fixed

Size	B 150# Flanged	B 300# Flanged
½ - ¾ - 1"	1¾"	2¼"
1¼"	2"	
1½"	2¼"	2¾"
2"	2½"	3"
2½"	3"	3½"
3"	3"	3½"
4"	4"	4½"
6"	5"	5½"
8"	5½"	6"
10"	6½"	7"
12"	7½"	8"

45 Degree Elbows

Fig. 230

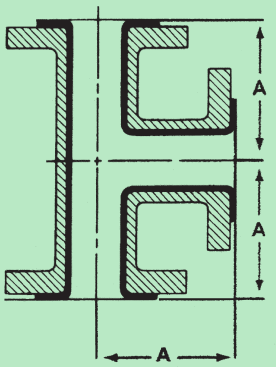


TEES AND INSTRUMENT TEES

Size	A 150#	A 300#
½ - ¾ - 1"	3½"	4"
1½"	4"	4½"
2"	4½"	5"
2½"	5"	5½"
3"	5½"	6"
4"	6½"	7"
6"	8"	8½"
8"	9"	10"
10"	11"	11½"
12"	12"	13"

Standard Tee

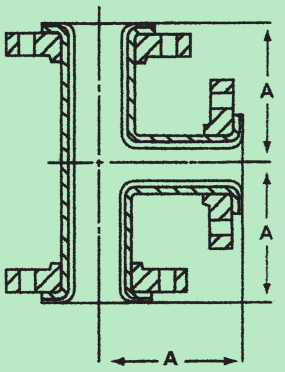
Fig. 240



Size	A 150#	A 300#
½ - ¾ - 1"	3½"	4"
1½"	4"	4½"
2"	4½"	5"
2½"	5"	5½"
3"	5½"	6"
4"	6½"	7"
6"	8"	8½"
8"	9"	10"
10"	11"	11½"
12"	12"	13"

Reducing Tee

Fig. 250



Reducing on run also available. Fig. 255

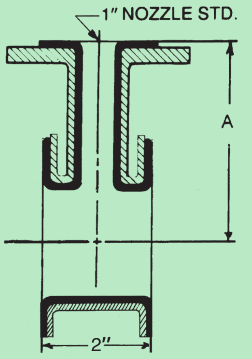
Size	Face to Face	A 150#	A 300#
½ - ¾ - 1"	2"	3½"	4"
1½" x 1"	2"	4"	4½"
2" x 1"	2"	4½"	5"
2½" x 1"	2"	5"	5½"
3" x 1"	2"	5½"	6"
4" x 1"	2"	6½"	7"
6" x 1"	2"	8"	8½"
8" x 1"	2"	9"	10"
10" x 1"	2"	11"	11½"
12" x 1"	2"	12"	13"

Size	Face to Face	A 150#	A 300#
-	-	-	-
1½" x 1½"	4"	4"	4½"
2" x 1½"	4"	4½"	5"
2½" x 1½"	4"	5"	5½"
3" x 1½"	4"	5½"	6"
4" x 1½"	4"	6½"	7"
6" x 1½"	4"	8"	8½"
8" x 1½"	4"	9"	10"
10" x 1½"	4"	11"	11½"
12" x 1½"	4"	12"	13"

Size	Face to Face	A 150#	A 300#
-	-	-	-
-	-	-	-
2" x 2"	4"	4½"	5"
2½" x 2"	4"	5"	5½"
3" x 2"	4"	5½"	6"
4" x 2"	4"	6½"	7"
6" x 2"	4"	8"	8½"
8" x 2"	4"	9"	10"
10" x 2"	4"	11"	11½"
12" x 2"	4"	12"	13"

Instrument Tees, Flanged

Fig. 205F

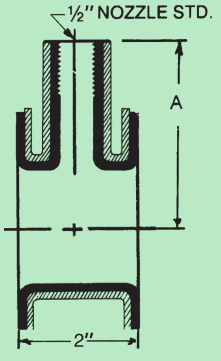


All 1½ + 2" outlets have 4" F/F Std., 3" available.

Size	Face to Face	A 150#
¾ - ½"	2"	3½"
1" x ½"	2"	3½"
1½" x ½"	2"	4"
2" x ½"	2"	4½"
2½" x ½"	2"	5"
3" x ½"	2"	5½"
4" x ½"	2"	6½"
6" x ½"	2"	8"
8" x ½"	2"	9"
10" x ½"	2"	11"
12" x ½"	2"	12"

Instrument Tees, Threaded

Fig. 305T



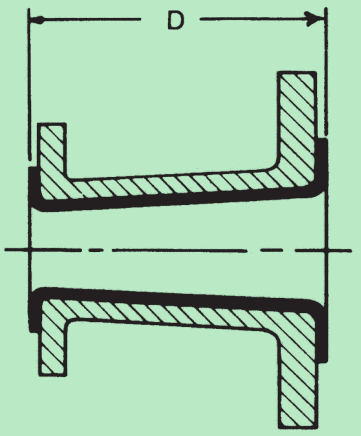
Other NPT sizes available.

CONCENTRIC / ECCENTRIC REDUCERS

Size	D 150#/300# Flanged
1" x SMALLER	4½"
1½" x SMALLER	4½"
2" x SMALLER	5"
2½" x SMALLER	5½"
3" x SMALLER	6"
4" x SMALLER	7"
6" x SMALLER	9"
8" x SMALLER	11"
10" x SMALLER	12"
12" x SMALLER	14"

Concentric Reducer

Fig. 270

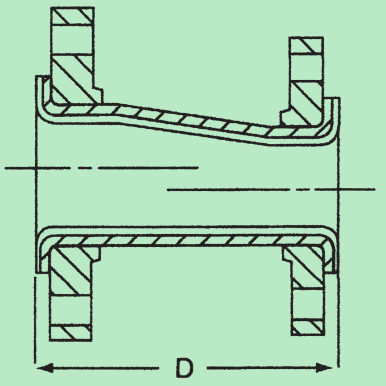


4 X Smaller Conc. Red. fittings are normally Ductile Iron castings with fixed flanges.

Size	D 150#/300# Flanged
1" x SMALLER	4½"
1½" x SMALLER	4½"
2"x SMALLER	5"
2½" x SMALLER	5½"
3" x SMALLER	6"
4" x SMALLER	7"
6" x SMALLER	9"
8" x SMALLER	11"
10" x SMALLER	12"
12" x SMALLER	14"

Eccentric Reducer

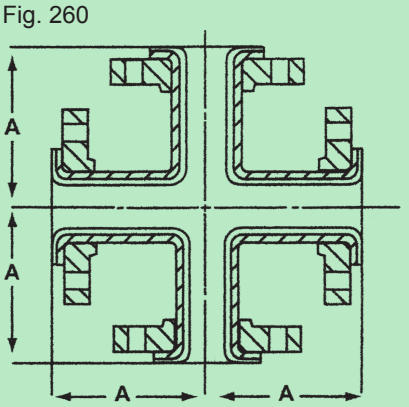
Fig. 280



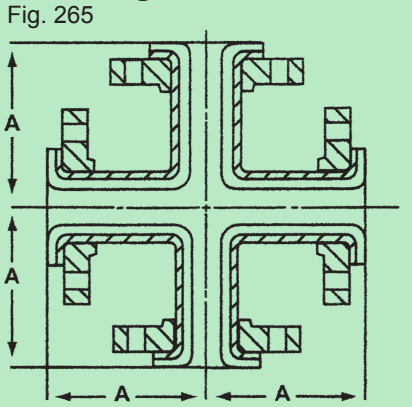
CROSSES / LATERALS / STRAINER TEES

Size	A 150#	A 300#
½ - ¾ - 1"	3½"	4"
1½"	4"	4½"
2"	4½"	5"
2½"	5"	5½"
3"	5½"	6"
4"	6½"	7"
6"	8"	8½"
8"	9"	10"
10"	11"	11½"
12"	12"	13"

Standard Cross
Fig. 260

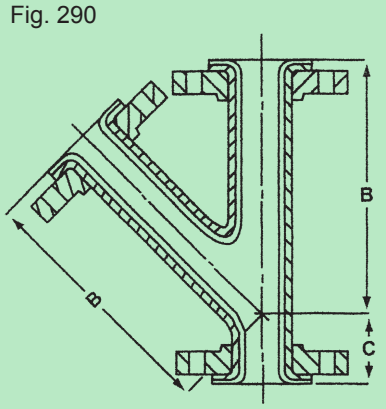


Reducing Cross
Fig. 265

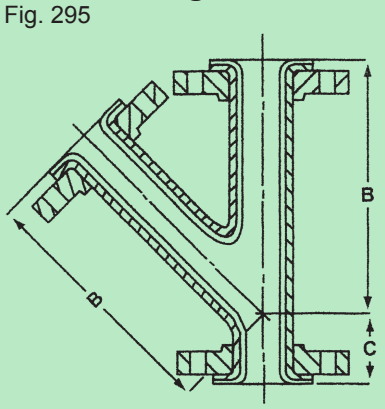


Size	B 150#	C 150#	B 300#	C 300#
½ - ¾ - 1"	5¾"	1¾"	6½"	2"
1½"	7"	2"	8½"	2½"
2"	8"	2½"	9"	2½"
2½"	9½"	2½"	10½"	2½"
3"	10"	3"	11"	3"
4"	12"	3"	13½"	3"
6"	14½"	3½"	17½"	4"
8"	17½"	4½"	20½"	5"
10"	20½"	5"	24"	5½"
12"	24½"	5½"	27½"	6"

45° Lateral
Fig. 290

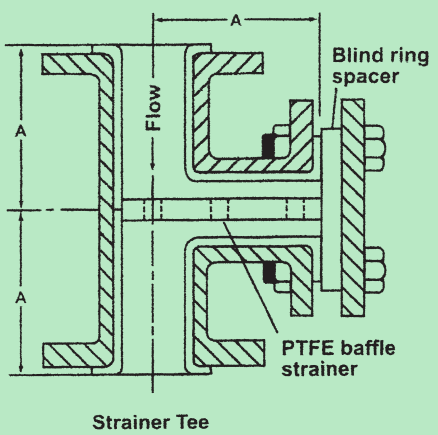


45° Reducing Lateral
Fig. 295



Size	A 150#
1"	3½"
1½"	4"
2"	4½"
2½"	5"
3"	5½"
4"	6½"
6"	8"
8"	9"
10"	11"
12"	12"

Strainer Tee
Fig. 340

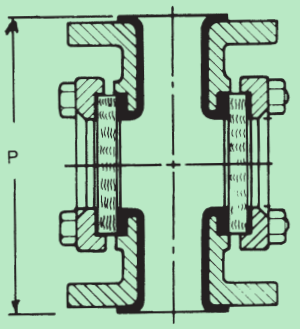


Strainer Tee

SIGHT FLOW / BALL CHECK VALVE / TRUE BASKET STRAINER

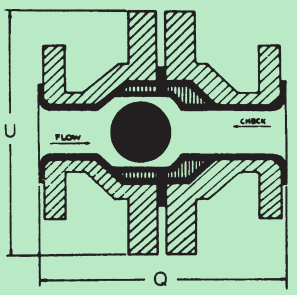
Size	P 150#
½ - ¾ - 1"	7"
1½"	8"
2"	9"
2½"	10"
3"	11"
4"	13"
6"	16"

Sight Flow
Fig. 310



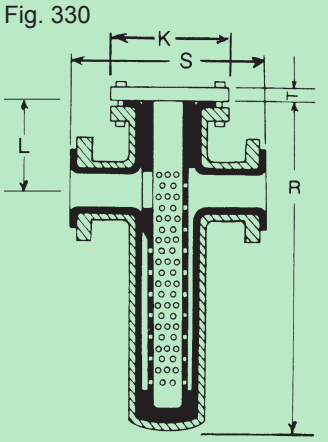
Size	Q 150#	Q 300#	U 150#	CV
½ - ¾ - 1"	6"	7"	6"	40
1½"	7"	8"	7"	90
2"	7"	8"	7½"	200
2½"	O/A	O/A	O/A	O/A
3"	8"	9"	10"	335
4"	10½"	11½"	11"	400
6"	15½"	16½"	16"	625

Ball Check Valve
Use Horizontal or Vertical
Fig. 320



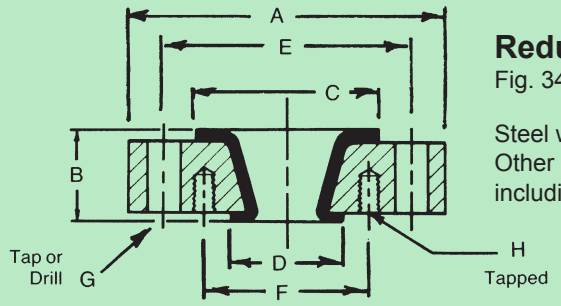
Size	K	L	R	S	T
½ - ¾ - 1"	5"	3"	11 5/16"	8¼"	1 3/16"
1½"	6"	2¾"	12 3/16"	9"	7"
2"	7"	4"	13"	9⅞"	1"
2½"	O/A	O/A	O/A	O/A	O/A
3"	7½"	4½"	15¼"	10⅞"	1¼"
4"	10"	4⅞"	20¼"	14¾"	1¾"
6"	13½"	6¾"	28 9/16"	20"	1 9/16"
8"	16"	7¾"	37¾"	22"	1¾"

True Basket Strainer
Fig. 330



⅛ Holes Std.
Flanged or Threaded
Bottom Drain Available

PLASTIC LINED REDUCING FLANGES



Reducing Flange

Fig. 340

Steel with 150lb. Drilling is standard
Other sizes and thicknesses also available
including 300#

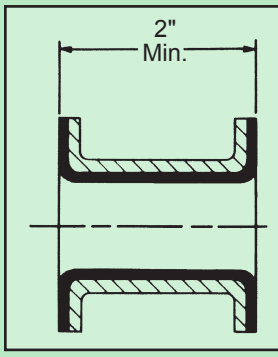
Size	Dimensions		G Bolt Holes		H Bolt Holes		Dia. Bolt Circle		Plastic Face Dia. (Min.)	
	A	B	#	Size	#	Size	E	F	C	D
★ 1" x ½"	4¼"	⅞"	4	½"-13	4	½"-13	3⅛"	2⅜"	1⅞"	1⅜"
★ 1" x ¾"	4¼"	⅞"	4	½"-13	4	½"-13	3⅛"	2¾"	1⅞"	1¾"
★ 1½" x 1"	5"	1⅛"	4	½"-13	4	½"-13	3⅞"	3⅛"	2 11/16"	1⅞"
2" x 1"	6"	1⅛"	4	⅝"-11	4	½"-13	4¾"	3⅛"	3 7/16"	1⅞"
★ 2" x 1½"	6"	1⅛"	4	⅝"-11	4	½"-13	4¾"	3⅞"	3 7/16"	2 11/16"
2½" x 1"	7"	1¼"	4	⅝"-11	4	½"-13	5½"	3⅛"	3 15/16"	1⅞"
2½" x 1½"	7"	1¼"	4	⅝"-11	4	½"-13	5½"	3⅞"	3 15/16"	2 11/16"
★ 2½" x 2"	7"	1¼"	4	⅝"-11	4	⅝"-11	5½"	4¾"	3 15/16"	3 7/16"
3" x 1"	7½"	1⅜"	4	¾"	4	½"-13	6"	3⅛"	4⅝"	1⅞"
3" x 1½"	7½"	1⅜"	4	¾"	4	½"-13	6"	3⅞"	4⅝"	2 11/16"
★ 3" x 2"	7½"	1⅜"	4	⅝"-11	4	⅝"-11	6"	4¾"	4⅝"	3 7/16"
★ 3" x 2½"	7½"	1⅜"	4	⅝"-11	4	⅝"-11	6"	5½"	4⅝"	3 15/16"
4" x 1"	9"	1⅜"	8	¾"	4	½"-13	7½"	3⅛"	5 15/16"	1⅞"
4" x 1½"	9"	1⅜"	8	¾"	4	½"-13	7½"	3⅞"	5 15/16"	2 11/16"
4" x 2"	9"	1⅜"	8	¾"	4	⅝"-11	7½"	4¾"	5 15/16"	3 7/16"
4" x 2½"	9"	1⅜"	8	⅝"-11	4	⅝"-11	7½"	5½"	5 15/16"	3 15/16"
4" x 3"	9"	1⅜"	8	⅝"-11	4	⅝"-11	7½"	6"	5 15/16"	4⅝"
6" x 1"	11"	1⅜"	8	⅞"	4	½"-13	9½"	3⅛"	8"	1⅞"
6" x 1½"	11"	1⅜"	8	⅞"	4	½"-13	9½"	3⅞"	8"	2 11/16"
6" x 2"	11"	1⅜"	8	⅞"	4	⅝"-11	9½"	4¾"	8"	3 7/16"
6" x 2½"	11"	1⅜"	8	⅞"	4	⅝"-11	9½"	5½"	8"	3 15/16"
6" x 3"	11"	1⅜"	8	⅞"	4	⅝"-11	9½"	6"	8"	4⅝"
6" x 4"	11"	1⅜"	8	¾"-10	8	⅝"-11	9½"	7½"	8"	5 15/16"
8" x 1"	13½"	1½"	8	⅞"	4	½"-13	11¾"	3⅛"	10 1/16"	1⅞"
8" x 1½"	13½"	1½"	8	⅞"	4	½"-13	11¾"	3⅞"	10 1/16"	2 11/16"
8" x 2"	13½"	1½"	8	⅞"	4	⅝"-11	11¾"	4¾"	10 1/16"	3 7/16"
8" x 2½"	13½"	1½"	8	⅞"	4	⅝"-11	11¾"	5½"	10 1/16"	3 15/16"
8" x 3"	13½"	1½"	8	⅞"	4	⅝"-11	11¾"	6"	10 1/16"	4⅝"
8" x 4"	13½"	1½"	8	⅞"	8	⅝"-11	11¾"	7½"	10 1/16"	5 15/16"
8" x 6"	13½"	1⅝"	8	¾"-10	8	¾"-10	11¾"	9½"	10 1/16"	8"
10" x 1"	16"	1⅝"	12	1"	4	½"-13	14¼"	3⅛"	12¼"	1⅞"
10" x 1½"	16"	1⅝"	12	1"	4	½"-13	14¼"	3⅞"	12¼"	2 11/16"
10" x 2"	16"	1⅝"	12	1"	4	⅝"-11	14¼"	4¾"	12¼"	3 7/16"
10" x 2½"	16"	1⅝"	12	1"	4	⅝"-11	14¼"	5½"	12¼"	3 15/16"
10" x 3"	16"	1⅝"	12	1"	4	⅝"-11	14¼"	6"	12¼"	4⅝"
10" x 4"	16"	1⅝"	12	1"	8	⅝"-11	14¼"	7½"	12¼"	5 15/16"
10" x 6"	16"	1⅝"	12	1"	8	¾"-10	14¼"	9½"	12¼"	8"
10" x 8"	16"	1⅝"	12	⅞"-9	8	¾"-10	14¼"	11¾"	12¼"	10 1/16"
12" x 1"	19"	1⅝"	12	1"	4	½"-13	17"	3⅛"	14⅜"	1⅞"
12" x 1½"	19"	1⅝"	12	1"	4	½"-13	17"	3⅞"	14⅜"	2 11/16"
12" x 2"	19"	1⅝"	12	1"	4	⅝"-11	17"	4¾"	14⅜"	3 7/16"
12" x 2½"	19"	1⅝"	12	1"	4	⅝"-11	17"	5½"	14⅜"	3 15/16"
12" x 3"	19"	1⅝"	12	1"	4	⅝"-11	17"	6"	14⅜"	4⅝"
12" x 4"	19"	1⅝"	12	1"	8	⅝"-11	17"	7½"	14⅜"	5 15/16"
12" x 6"	19"	1⅝"	12	1"	8	¾"-10	17"	9½"	14⅜"	8"
12" x 8"	19"	1⅝"	12	1"	8	¾"-10	17"	11¾"	14⅜"	10 1/16"
12" x 10"	19"	1⅝"	12	⅞"-9	12	⅞"-9	17"	14¼"	14⅜"	12¼"

★ Note on these sizes only one set of bolt holes is on the vertical center line. The other set straddles the center line.

PLASTIC SPACERS — SOLID OR LINED

Materials
Polypropylene
PTFE

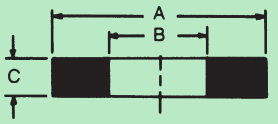
NOTE:
Standard C dimension is 1/2".



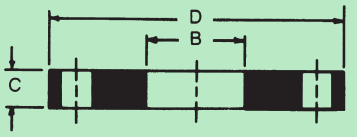
Lined Distance Piece

SIZE — 1" Through 8" STANDARD. Larger on Request

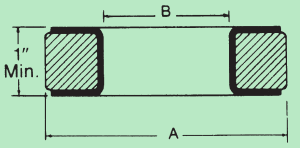
Ring Spacer
Std., Red, Blind



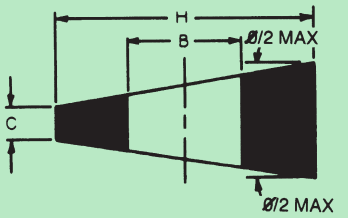
Full Face Spacer
Std., Red, Blind



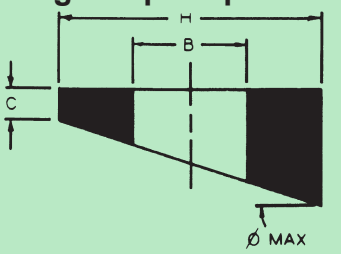
Lined Spacer



Double Taper Spacer



Single Taper Spacer



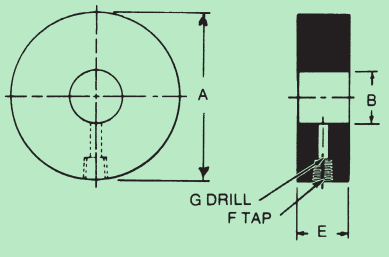
300# Spacers available

Dimensional Data – 150 lb. Plastic Spacers (Thickness 2" Max.)

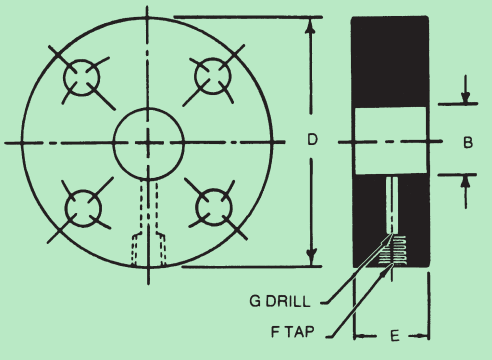
Size	Ring, Full Face, Reducing, Blind and Orifice							Taper		
	Ring A	B	Full Face D	Bolt Holes No.	Bolt Holes Size	Bolt Circle	Weight in Pounds	H	Single ° Max	Double ° Max
1"	2⅝"	1"	4¼"	4	⅝"	3⅛"	0.1	2½"	13½°	27°
1¼"	3"	1¼"	4⅝"	4	⅝"	3½"	0.2	2⅞"	12°	24°
1½"	3⅜"	1½"	5"	4	⅝"	3⅞"	0.3	3¼"	10½°	21°
2"	4⅛"	2"	6"	4	¾"	4¾"	0.4	4"	10°	20°
2½"	4⅞"	2½"	7"	4	¾"	5½"	0.6	4¾"	8½°	17°
3"	5⅜"	3"	7½"	4	¾"	6"	0.7	5¼"	7½°	15°
4"	6⅞"	4"	9"	8	¾"	7½"	1.1	6¾"	7°	14°
6"	8¾"	6"	11"	8	⅞"	9½"	1.8	8⅝"	6½°	13°
8"	11"	8"	13½"	8	⅞"	11¾"	2.9	10¾"	5°	10°
10"	13⅜"	10"	16"	12	1"	14¼"	4.1	13¼"	3½°	7°
12"	16⅛"	12"	19"	12	1"	17"	6.0	16"	3°	6°

Reducing use smallest size for B dim. All dimensions are in inches.

Orifice Ring Spacer



Orifice Full Face Spacer



Minimum Dimension E	Tap NPT F	Drill Size G
1"	¼"	7/16"
1⅛"	⅜"	37/64"
1¼"	½"	45/64"
1½"	¾"	59/64"
1¾"	1"	1 5/32"

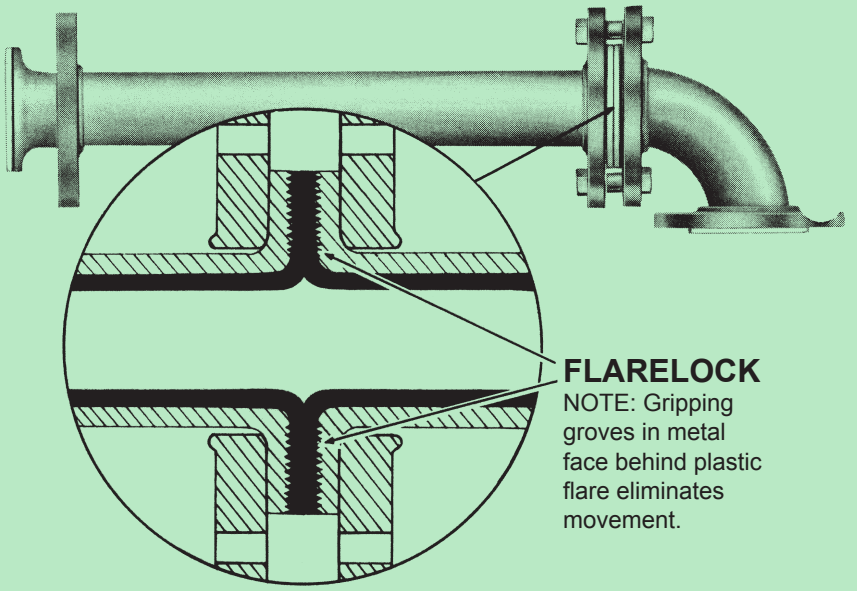
FLARELOCK / LINED FLEXIBLE HOSE / FIELD FLARING TOOLS

Flarelock

Fusibond innovation keeps PTFE joints tight under adverse conditions. Everyone know's PTFE cold flows. At elevated temperatures things get even worse. **"Flarelock"** can solve the problem.

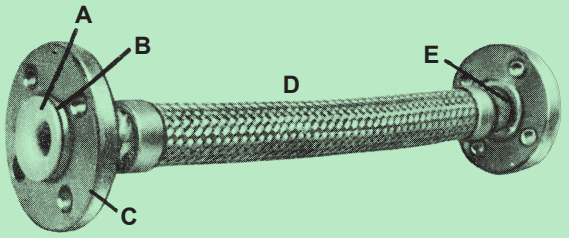
High pressure, cycling temperatures or long straight runs can result in leakage. Only **"Flarelock"** can stand the higher plastic face load necessary to keep the joint tight. Belleville Disc Springs can also be used with the flange bolts to maintain the plastic Face Sealing pressure when extreme conditions are encountered on pipe and fittings.

Flarelock is available thru 12" size. Remember when using a PTFE lined loose flange system **only Flarelock does it better**.



FLARELOCK
NOTE: Gripping groves in metal face behind plastic flare eliminates movement.

Lined Flexible Hose



A PTFE liner. PFA liner or Kynar Flex® Liner
B Carbon steel lap joint stub end. Both ends.
C 150 lb. ANSI flange, DI or steel
D Stainless steel metal hose & braid.
E ⅛" dia. vent holes. Two holes 180° apart each end except Kynar Flex®.

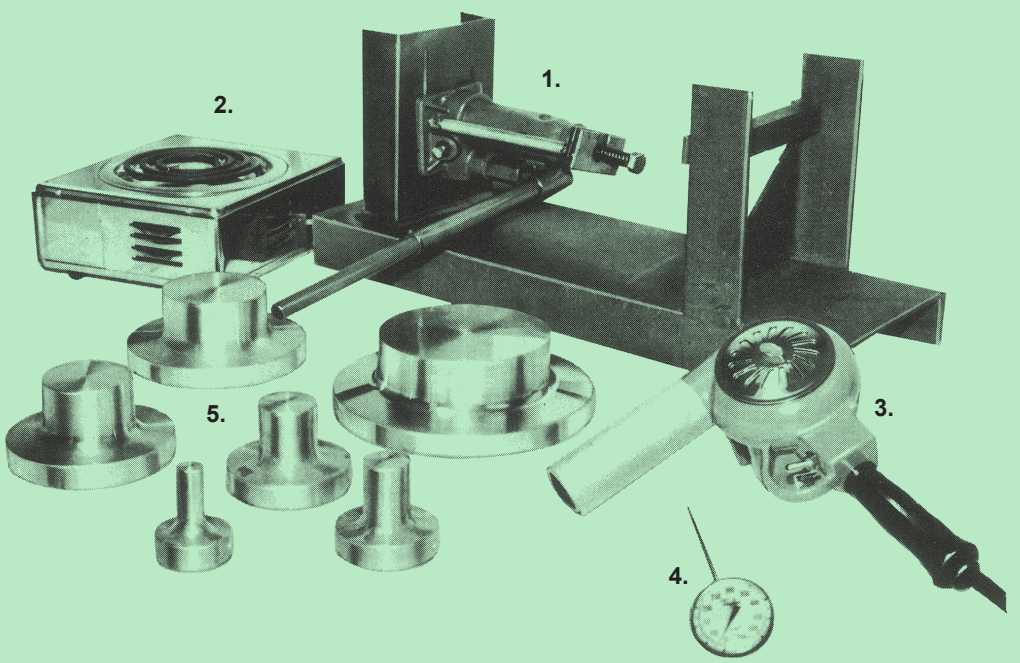
Size	Working Pressure (PSI)		Vacuum @70°F
	@70°F	@350°F	
½ - ¾ - 1"	500	415	30"
1½"	400	330	30"
2"	300	250	30"
3"	200	165	30"
4"	150	120	20"
6"	150	120	20"
8"	125	100	20"
10"	100	80	20"
12"	90	70	20"

Field Flaring Tools

1. Hydraulic Flaring Assembly 1" — 6"
2. Hot Plate
3. Heat Gun
4. Thermometer
5. Flaring Heads

Perfect Faces each and every time with Fusibond Tools. Quick and easy Field Flaring by just heating the head and hydraulically pushing it against the flange face. It's just that fast and simple. Ask for a demonstration.

For complete information ask for our Field Fabrication and installation manual or our instructional DVD.



INFORMATION FOR FUSIBOND LINED PIPE AND FITTINGS

The same installation procedures for conventional flanged steel pipe and fittings can be used to install any of FUSIBOND'S PIPING SYSTEMS. Pipe hangers, supports, anchors, guides and expansion joints or loops should be in compliance with accepted piping practices.

End covers should not be removed until pipe is ready to be bolted into position or sealing faces may become damaged or distorted. If covers are removed for inspection, they should be replaced as soon thereafter as possible. **NEVER** use heat or a chisel to remove bolts as the plastic face may be damaged.

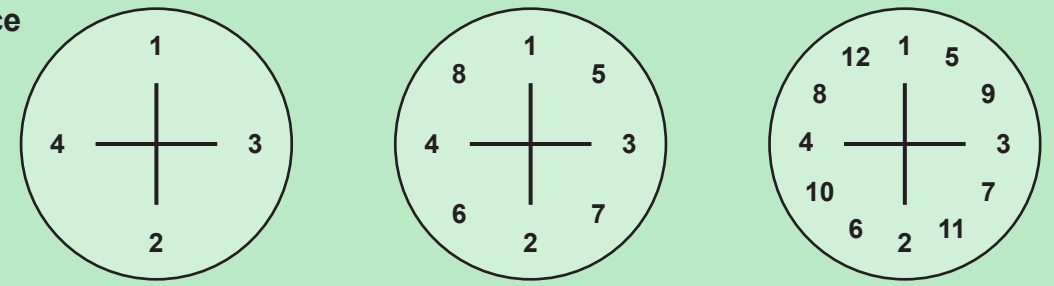
Gaskets are not required with FUSIBOND PIPING except when connected to a flanged face of unlined material. ***Gaskets of the elastomeric type are usually most suitable and should always be approximately the same ID as the lined pipe.***

Bolts should be tightened using the following torques as a guide. Use the criss-cross method shown; **NEVER** clock or counterclockwise. Installation in cold weather may require considerably higher bolt torques.

Pipe Size in Inches		1"	1½"	2"	2½"	3"	4"	6"	8"	10"	12"
Minimum Bolt Torques (ft.-LBS)	PP	20	40	45	55	80	60	120	150	140	160
	PVDF, ECTFE, ETFE	20	50	65	70	80	85	140	180	180	180
	PTFE, PFA, HDPE	10	25	35	40	55	45	65	95	90	100
Number of holes per flange, 150 lb.		4	4	4	4	4	8	8	8	12	12

Note: The values in this table are a guide. In some cases, however, higher torque may be required. Do not exceed twice the given values.

Bolt Torquing Sequence



FLARELOCK joints are recommended where high pressure or temperatures are encountered. Cycling temperatures or long runs can also result in higher plastic face loads. FUSIBOND'S **FLARELOCK** can be used to eliminate joint creep or cold flow, especially with PTFE Lined Systems.

When assembling FUSIBOND PIPING, always use new nuts and bolts. Threads must be cleaned and lubricated and washers are suggested under the turned element (head or nut). Using a torque wrench, cross torque the nuts to one-half (½) the value shown in the table following the sequence shown above. Check carefully to make sure the plastic faces are exactly parallel, then torque to the final value, again following the above sequence.

If a flange leak occurs and the bolts on the leaking side are properly torqued, **DO NOT TIGHTEN FURTHER** or permanent damage to the sealing face may result. The bolts on the opposite side should be loosened a quarter turn at a time and then the bolts on the leaking side should be tightened by the same amount. If the leak persists, the bolts should be removed and the plastic sealing faces examined for scratches or dents across the entire face which could provide a leak path. Any scratches or dents which do not exceed 10% of the liner thickness can be eliminated by hand polishing with fine abrasive emery cloth or filed with a flat, wide, fine tooth file. Larger depressions may be covered using an appropriate gasket.

If leakage occurs after the system has been cycled to elevated temperatures and back to ambient, bolts should be retorqued after the cool down period. No further tightening should be necessary.

NO WELDING OR FLAME CUTTING should be done close to the metal pipe or fittings unless adequate precautions are taken to prevent their being exposed to excessive heat.

Vent holes should not be plugged with paint, cement, etc. The vent holes are necessary only with PTFE/PFA to release gases which may be generated at elevated temperatures and become trapped between the liner and housing. If not vented, these gases may collapse the liner. Vent holes are placed under the flanges for safety. This is essential when flange covers are used with hazardous materials.

Smooth shims 1/32" to 1/16" thick, can be used to facilitate sliding the pipe or fittings into position when making final connections or installing individual sections in an existing line.

To preserve the sealing faces and protect them from damage while not in use, end covers or blind flanges should always be installed immediately on all piping items which are removed from service.

If you require more specific information about the installation of our piping systems, please feel free to contact us.

CHEMICAL RESISTANCE AND LINER SELECTION GUIDE

FUSIBOND offers by far the broadest liner selection of anyone in the industry. This allows you to chose the plastic lining that is most cost effective under your particular operating conditions.

High Density Polyethylene (HDPE) is a versatile material lining with good physical and chemical properties as well as exceptional abrasion resistance. Temperature range is -20°F (-29°C) to180°F (82°C). **Metal is not vented.**

Polypropylene (PP) is the least expensive of all our lining systems. It has proven chemical resistance in a wide variety of applications and because it's a Copolymer it can be used from -20°F (-29°C) to 225°F (107°C). Mechanical properties are good and tensile strength is generally in the 4000 to 4500 PSI range. **Metal is not vented.**

Polyvinylidene Fluoride (PVDF) has excellent mechanical properties and is resistant to most chemicals. It's temperature range is -20°F (-29°C) to 275°F (135°C). Tensile strength is 4500 to 6500 PSI. **Metal is not vented.**

EthyleneChlorotrifluoroEthylene (ECTFE) is a fluoropolymer with exceptional properties. It has by far the best combination of chemical resistance and toughness of any lining we offer. It's superior where temperature cycling, mechanical stress, abrasion, or permeation are a problem. Temperature range is -20°F (-28°C) to 300°F (149°C). Tensile strength is 4300 PSI. **Metal is not vented.**

EthylenetetraFluoroethylene (ETFE) is a fluoropolymer with superior physical properties and chemical resistance, approaching that of PTFE. It's excellent where high pressure, vacuum, or cold flow is a problem. Temperature range is -20°F (-28°C) to 300°F (149°C). Tensile strength is approximately 6700 PSI. **Metal is not vented** and fittings are Fusion Bonded.

Polytetrafluoroethylene (PTFE) is virtually inert to all chemicals except elemental fluorine and molten alkali metals. Over 300°F (149°C) there is no other liner choice. PTFE is softer and has less strength for a given thickness than our other liners so it requires special design considerations. PTFE because of its microporosity has a higher gas permeation rate, which can be improved by increasing the liner thickness, which also helps its overall strength. Special attention to piping alignment and torquing of flange bolts will keep creep or cold flow to a minimum. Temperature range is -20°F (-29°C) to 450°F (232°C). Tensile strength is approximately 3000 PSI. **Metal requires venting.**

Polyfluoroalkoxy (PFA) has the same corrosion resistance as PTFE but is tougher mechanically and does not creep or cold flow like PTFE. Temperature to 450°F (232°C) Tensile strength is 4000 to 4500 PSI. Metal requires venting per ASTM F-1545, however, due to superior permeation resistance it can be furnished unvented.

PTFE AND PFA ARE RESISTANT TO ALL OF THE FOLLOWING CHEMICALS.

Chemical Service	Max. Temp. °F				
	HDPE	PP	PVDF	ECTFE	ETFE
Acetic Acid (Glacial)	70	70	120	120	230
Acetic Acid (50%)		200	200	212	250
AceticAnhydride		NR	NR	73	300
Acetone	NR	NR	NR	130	150
Acretonitrile		70	100	150	150
Acetylchloride		NR	125	121	150
Acrylonitrile	150	125	75	73	150
Aluminum Sulfate (Alum)	180	225	275	300	300
Aluminum Chloride	180	225	275	300	300
Aluminum Fluoride	180	225	170	300	300
Aluminum Hydroxide	180	200	200	300	300
Aluminum Nitrate	180	200	275	300	300
Aluminum Potassium Sulfate		225	275	300	300
Ammonia (Dry Gas)	NR	NR	NR	300	300
Ammonia Liquid	NR	NR	NR	225	230
Ammonium Bifluoride		200	150	300	300
Ammonium Carbonate	180	225	275	300	300
Ammonium Chloride	180	225	275	300	300
Ammonium Fluoride (25%)	180	200	275	300	300
Ammonium Hydroxide (28%)	180	225	225	300	300

Chemical Service	Max. Temp. °F				
	HDPE	PP	PVDF	ECTFE	ETFE
Ammonium Nitrate	140	150	275	300	230
Ammonium Phosphate	180	200	275	300	300
Ammonium Sulfate	180	200	275	300	300
Ammonium Sulfide	140	150	125	300	300
Amyl Acetate		NR	100	121	250
Amyl Alcohol	140	70	275	300	300
Amyl Chloride		NR	275	300	300
Aniline		125	100	212	230
Antimony Trichloride		150	70	73	212
Aqua Regia		70	75	212	212
Arsenic Acid		200	275	300	300
Barium Carbonate	180	200	275	300	300
Barium Chloride	180	200	275	300	300
Barium Hydroxine		200	275	300	300
Barium Sulfide	180	200	275	300	300
Benzaldehyde		70	NR	121	212
Benzene		NR	150	121	212
Benzene Sulfonic Acid	140	70	125	121	212
Benzoic Acid		150	225	250	275
Benzyl Alcohol		75	250	300	300

***Consult factory for additional information or for chemicals, concentrations, or temperatures not listed.**

Chemical Service	Max. Temp. °F				
	HDPE	PP	PVDF	ECTFE	ETFE
Benzyl Chloride		75	275	122	300
Borax	180	175	275	300	300
Boric Acid	180	225	275	300	300
Brine	180	200	275	300	300
Bromine (Dry)		NR	125	121	150
Bromine Water (3%)		70	200	212	230
n-Butyl Alcohol		70	200	250	300
sec-Butyl Alcohol		70	200	250	300
tert-Butyl Alcohol		70	200	250	300
Butylphenol		NR	225	212	230
Butyric Acid		175	225	250	250
n~Butyl Mercaptan			275	300	300
Calcium Bisulfate		210	275	300	300
Calcium Bisulfide	180	210	200	300	300
Calcium Carbonate	180	225	275	300	300
Calcium Chlorate	180	225	275	300	300
Calcium Chloride	180	225	230	300	300
Calcium Hydroxide	180	225	250	300	300
Calcium Hypochlorite	180	150	200	300	300
Calcium Nitrate	180	210	275	300	300
Calcium Sulfate	180	225	275	300	300
Caprylic Acid		125	175	121	212
Carbon Dioxide (Gas)	150	150	250	300	300
Cellosolve		70	275	300	300
Chloride Liquid		NR	200	212	250
Chlorine (5% in CCl_4)		NR	200	250	250
Chlorine Water	150	150	200	212	250
Chlorine Gas (Wet or Dry)		NR	175	212	250
Chlorine Dioxide (15%)	NR	NR	150	250	250
Chloroacetic Acid (50%)	NR	NR	NR	212	230
Chlorobenzene	NR	NR	170	100	212
Chromic Acid	NR	NR	150	212	150
Citric Acid	150	150	275	300	250
Copper Chloride	150	200	275	300	300
Copper Cyanide	150	200	250	300	300
Copper Fluoride	150	200	250	300	300
Copper Nitrate	150	200	275	300	300
Copper Sulfate	150	200	275	300	300
Corn Oil	140	175	275	300	300
Cottonseed Oil	150	150	275	300	300

Chemical Service	Max. Temp. °F				
	HDPE	PP	PVDF	ECTFE	ETFE
Cresol		NR	150	212	275
Cresylic Acid		NR	150	121	275
Crotonaldehyde		NR	100	73	212
Cyclohexane		NR	250	300	300
Cyclohexanol		70	150	140	250
Cyclohexanone		NR	75	121	300
Diethyl Cellosolve			275	300	300
Diilsobutylene		125	275	300	275
Distilled Water		212	275	300	300
Ethyl Alcohol	175	175	230	300	300
Ethyl Chloride	NR	NR	250	75	300
Ethylene Bromide	NR	NR	225	75	300
Ethylene Chloride	NR	NR	275	75	300
Ethylene Glycol	140	125	275	300	300
Ethylene Oxide	NR	NR	200	300	230
Fatty Acids		150	275	300	300
Ferric Chloride (50%)	180	225	275	300	300
Ferric Nitrate	180	210	230	300	300
Ferric Sulfate	180	210	275	300	300
Ferrous Chloride	180	210	275	300	300
Ferrous Nitrate	180	210	275	300	300
Ferrous Sulfate	180	210	275	300	300
Formaldehyde (37%)	140	140	120	121	230
Formic Acid	140	150	250	212	275
Fructose	180	225	275	300	300
Glucose	180	225	275	300	300
Glycerine	180	225	275	300	300
Glycol	150	150	275	300	275
Heptane	NR	NR	275	300	300
Hexane	NR	75	275	300	300
Hydriodic Acid		150	275	300	300
Hydrobromic Acid (50%)	150	150	275	300	300
Hydrochloric Acid (2%)	180	225	275	300	300
Hydrochloric Acid (10%)	180	200*	275	300	300
Hydrochloric Acid (20%)	180	200*	275	300	300
Hydrochloric Acid Cone. (36%)	180	150*	275	250	300
Hydrocyanic Acid		150	275	300	300
Hydrofluoric Acid (35%)	150	150	250	250	275
Hydrofluoric Acid (70%)	100	100	200	240	250
Hydrofluoric Acid (100%)	NR	NR	200	240	230

***Consult factory for additional information or for chemicals, concentrations, or temperatures not listed.**

Chemical Service	Max. Temp. °F				
	HDPE	PP	PVDF	ECTFE	ETFE
Hydrofluosilicic Acid	140	140	275	300	300
Hydrogen	140	140	250	300	300
Hydrogen Chloride (Dry)	150	150	275	300	300
Hydrogen Cyanide		NR	275	300	300
Hydrogen Peroxide (30%)	140	70	200	121	250
Hydrogen Peroxide (90%)	70	70	70	121	150
Hydrogen Sulfide (Dry)	150	150	275	300	300
Hydrogen Sulfide (Wet)	150	150	225	121	300
Hypochlorous Acid	140	150	70	300	300
Iodine	NR	NR	150	212	230
Iodine Solution (10%)	NR	75	150	212	212
Lactic Acid	125	125	125	73	250
Lard Oil	125	125	275	250	300
Lauric Acid		150	225	212	250
Lauryl Chloride		150	250	212	275
Lead Acetate	180	210	230	300	300
Lemon Oil		NR	250	212	300
Linoleic Acid		125	250	212	275
Linseed Oil	150	150	275	212	300
Lubricating Oil	70	70	275	300	300
Magnesium Carbonate	180	225	275	300	300
Magnesium Chloride	180	225	275	300	300
Magnesium Hydroxide	180	225	275	300	300
Magnesium Nitrate	180	225	275	300	300
Magnesium Sulfate	180	225	250	300	300
Maleic Acid	140	140	250	212	275
Malic Acid	140	125	250	212	275
Mercuric Chloride (40%)	150	150	250	212	275
Mercuric Cyanide	150	150	250	212	275
Mercuric Nitrate	150	150	275	212	275
Mercury	150	150	275	300	275
Methane		70	275	212	250
Methyl Alcohol	150	150	275	300	300
Methyl Bromide		NR	275	300	300
Methyl Cellosolve		75	275	300	300
Methyl Chloride		NR	275	75	300
Methyl Sulfuric Acid	120	120	125	121	212
Milk	180	210	250	212	250
Mineral Oil	125	125	275	300	300
Naphtha		125	275	300	300

Chemical Service	Max. Temp. °F				
	HDPE	PP	PVDF	ECTFE	ETFE
Naphthalene		210	200	140	300
Nickel Chloride	180	210	250	300	300
Nickel Nitrate	180	210	275	300	300
Nickel Sulfate	180	210	275	300	300
Nitric Acid (10%)	150	150	175	250	250
Nitric Acid (30%)	120	120	125	212	150
Nitric Acid-Cone (70%)	NR	NR	NR	212	75
Nitric Acid-Fuming (90%)	NR	NR	NR	150	75
Nitrobenzene		120	75	104	300
Nitrogen Dioxide		70	170	250	212
Nitrous Acid		NR	210	212	212
Oleic Acid		70	250	212	275
Oleum (Fuming Sulfuric Acid)		NR	NR	73	120
Oxalic Acid	70	70	125	121	230
Oxygen Gas		125	275	300	300
Ozone		NR	225	300	212
Palmitic Acid		175	250	212	275
Perchlorethylene		NR	275	150	275
Perchloric Acid (10%)		150	200	121	230
Perchloric Acid (72%)		75	125	121	150
Phenol (10%)	150	150	175	121	230
Phenol (100%)	140	140	125	121	212
Phosphoric Acid (30%)	180	225	275	300	300
Phosphoric Acid (85%)	180	200	225	300	275
Phthalic Acid (Ortho)	70	70	200	250	212
Polyvinyl Acetate		75	238	300	300
Potassium Bromide	180	225	275	300	300
Potassium Carbonate	180	225	275	300	300
Potassium Chlorate	170	200	200	300	300
Potassium Chloride	180	210	275	300	300
Potassium Cyanide	180	210	275	300	300
Potassium Dichromate	180	225	275	300	300
Potassium Ferrocyanide	170	210	275	300	300
Potassium Hydroxide	170	200	NR	300	212
Potassium Nitrate	175	175	250	200	300
Potassium Permanganate (20%)	140	140	250	300	300
Potassium Sulfate	180	225	275	300	300
Potassium Sulfide	170	210	275	300	300
Propyl Alcohol	140	140	150	170	212
Salicylic Acid		120	200	121	250

***Consult factory for additional information or for chemicals, concentrations, or temperatures not listed.**

Chemical Service	Max. Temp. °F				
	HDPE	PP	PVDF	ECTFE	ETFE
Sea Water	180	212	275	300	300
Silver Cyanide		210	275	300	300
Silver Nitrate	180	225	275	300	300
Sodium Acetate	170	210	230	300	300
Sodium Benzoate	170	210	275	300	300
Sodium Bicarbonate	180	225	275	300	300
Sodium Bisulfate	180	225	275	300	300
Sodium Bisulfite	180	225	275	300	300
Sodium Bromide		225	275	300	300
Sodium Carbonate	180	225	275	300	300
Sodium Chlorate	170	200	250	300	300
Sodium Chloride	180	225	275	300	300
Sodium Cyanide	180	225	275	300	300
Sodium Fluoride	170	210	275	300	300
Sodium Hydroxide (10%)	170	210	75	300	230
Sodium Hydroxide (50%)	170	210	NR	250	230
Sodium Hypochlorite (15%)	125	125*	200	250	300
Sodium Nitrate	175	175	275	300	300
Sodium Nitrite	175	175	275	300	300
Sodium Peroxide		125	200	300	300
Sodium Phosphate	175	175	275	300	300
Sodium Silicate		210	275	300	300
Sodium Sulfate		225	275	300	300
Sodium Sulfide	150	150	275	300	300
Sodium Sulfite	150	150	275	300	300
Sodium Thiosulfate	150	150	275	300	300
Stannic Chloride	175	225	275	300	300
Stannous Chloride	175	175	275	300	300
Stearic Acid	170	170	250	121	300
Sulfur	140	140	250	212	250
Sulfur Dioxide	70	70	175	121	230
Sulfur Trioxide	NR	NR	NR	70	75
Sulfuric Acid (10%)	180	225	250	275	300
Sulfuric Acid (30%)	170	200	250	250	300
Sulfuric Acid (60%)	150	175	250	250	300
Sulfuric Acid (93%)		140*	200	250	300
Sulfuric Acid (96%)		NR	150	250	300
Sulfuric Acid (98%)		NR	150	250	300
Sulfuric Acid-Fuming (Oleum)	NR	NR	NR	100	120
Sulfurous Acid	150	150	210	212	230

Chemical Service	Max. Temp. °F				
	HDPE	PP	PVDF	ECTFE	ETFE
Tall Oil		150	275	300	300
Tannic Acid	165	175	225	212	275
Tartaric Acid	150	150	250	212	275
Trichloroacetic Acid		70	125	121	212
Trichloroethylene		NR	250	73	275
Trisodium Phosphate	150	150	275	300	275
Urea	170	200	250	212	275
Vinyl Acetate		NR	250	121	275
Water	180	212	250	300	300
Zinc Chloride	170	210	250	300	300
Zinc Nitrate		210	250	300	300
Zinc Sulfate	170	210	250	300	300

***Consult factory for additional information or for chemicals, concentrations, or temperatures not listed.**

BOLT AND STUD LENGTH REQUIREMENTS

F x F = Fixed x Fixed

F x R = Fixed x Rotatable

R x R = Rotatable x Rotatable

ANSI Class 150 bolt and stud length requirements							
Flange Size	Stud Length			Bolt Length			Bolt Size
	F x F	F x R	R x R	F x F	F x R	R x R	
1"	3"	3¼"	3¼"	2½"	2¾"	2¾"	½-13
1½"	3¼"	3½"	3½"	2¾"	3"	3"	½-13
2"	4"	4"	4¼"	3¼"	3¼"	3½"	⅝-11
2½"	4¼"	4½"	4½"	3½"	3¾"	4"	⅝-11
3"	4¼"	4½"	4½"	3½"	3¾"	4"	⅝-11
4"	4¼"	4½"	4½"	3½"	3¾"	4"	⅝-11
6"	5"	5"	5¼"	4¼"	4¼"	4½"	¾-10
8"	5"	5¼"	5½"	4¼"	4½"	4¾"	¾-10
10"	5½"	5¾"	6"	4½"	4¾"	5¼"	⅞-9
12"	5½"	5¾"	6¼"	4¾"	5"	5½"	⅞-9

ANSI Class 300 bolt and stud length requirements						
Flange Size	Stud Length			Bolt Length		
	F x F	F x R	R x R	F x F	F x R	R x R
1"	3½"	3¾"	3¾"	3"	3¼"	3¼"
1½"	4"	4¼"	4½"	3½"	3¾"	3¾"
2"	4"	4"	4¼"	3¼"	3½"	3¾"
3"	4¾"	5¼"	5¼"	4¼"	4¾"	4¾"
4"	5"	5½"	5½"	4½"	5"	5"
6"	5½"	5¾"	6"	4¾"	5¼"	5¼"
8"	6¼"	7"	7"	5¼"	5¾"	6¼"
10"	7"	7¼"	7¾"	6"	6¼"	6¾"
12"	7¾"	8"	8¼"	6½"	6¾"	7"

Note: Bolt/ Stud lengths for both Class 150 and 300 are calculated to include two threads past the nut, then rounded to the nearest 1/4", to result in a commercially available length. Lengths include flat washers on both sides.

MANUFACTURING SPECIFICATIONS FOR FUSIBOND PLASTIC LINED PIPE AND FITTINGS

1. SCOPE

1.1 This standard covers Fusibond pipe and fittings to be lined with HDPE, PP, PVDF, ECTFE, ETFE, PTFE, and PFA.

2. MATERIALS AND MANUFACTURING STANDARDS

2.1 Pipe shall be carbon steel schedule 10 through 80, (standard wall unless specified otherwise) Maximum length is 20'-0". (ductile iron, galvanized or stainless special order)

2.2 Pipe grade may be E.R.W. (electric resistance welded) ASTM A-587, low carbon steel for the chemical industry, A-53 or A-106 seamless, unless otherwise specified.

2.3 Pipe flanges shall be cast ductile iron or forged steel. (Galvanized or stainless special order) All dimensions meet ANSI B, 16.42, or 16.5.

2.3.1 150 lb. ANSI ductile iron flanges shall conform to ASTM A-395 or A-536. Lap joint or threaded.

2.3.2 150 lb. and 3001b. ANSI, or higher pressure rated forged steel flanges shall conform to ASTM A-105, Lap joint, threaded or weld type.

2.4 Fittings shall be castings or fabricated steel with applicable flanges, in accordance with paragraph 2.3.

2.4.1 150 lb. ANSI cast ductile iron fittings shall conform to ASTM A-395 or A-536 or be fabricated from schedule 40 carbon steel pipe, using accepted industry processing methods, i.e. cold van stone flaring, bending, welding, etc. Flanges shall be lap joint ductile iron as described in paragraph 2.3.1.

2.4.2 150 lb. and 300 lb. ANSI fittings shall be fabricated from standard forged steel weld fittings or schedule 40 carbon steel pipe in accordance with ASTM A-234 and accepted industry processing methods, i.e. cold van stone flaring, bending, welding, etc. Flanges shall be forged steel lap joint or weld type as described in paragraph 2.3.2.

2.5 Linings employed in both pipe and fittings shall have the minimum uniform wall thickness shown on page 4.

2.6 All linings must be seamless and homogeneous.

2.6.1 Plastic shall be mechanically swaged into pipe or molded in place only after the fitting or pipe is cast or completely fabricated.

2.6.2 Bending, expanding, thinning or distorting the lining in any way is not permitted.

2.6.3 Flaring or machining of the plastic face is to be performed only after the lining is temperature compensated and stabilized by cycling each pipe spool or fitting from ambient through its temperature range.

3. QUALITY ASSURANCE AND INSPECTION

3.1 All pipe and fittings shall be visually inspected for any imperfections prior to lining.

3.2 Interior of pipe and fittings shall be smooth, clean and free of burrs or other imperfections. All corners in contact with the lining are to be radiused and welds ground smooth. (1/8" R min.)

3.3 All welding operations must be performed prior to lining.

3.4 After lining, all pipe and fittings must individually pass a minimum of 25,000 volt nondestructive electrostatic spark test.

3.5 That portion of the lining forming the flange gasket sealing surface shall be free of scratches, dents or any defect measuring greater than 10% of the lining thickness.

3.6 After thorough inspection, all fittings and pipe spools shall have the plastic raised face protected with minimum 1/2" thick plywood end covers. They should not be removed until the pipe or fitting is ready for installation. If protective covers are removed for inspection, they should be replaced as soon thereafter as possible.

STORAGE / SAFETY / PAINTING

To obtain maximum performance from plastic lined piping products, it is important that the flared or molded end faces of the pastic are protected from damage during storage, handling and installation. The following should be considered when handling plastic-lined piping products.

- Store indoors or under cover.
- Products are shipped with a protective coating. This coating is only a primer and is not meant for outdoor exposure without a suitable topcoat. Protective end caps are not designed for prolonged outdoor exposure.
- The protective end caps on all pipe and fittings should be left in place until the pipe is ready to be installed. Do not damage the plastic sealing faces when removing the end caps.
- Avoid rough handling of plastic lined pipe in temperatures below freezing. Plasic becomes brittle in low temperatures, and is more susceptible to cracking during rough handling.
- Never put the lifts of a forklift inside of the pipe to transport. This can damage the plastic liner.
- The following temperature guidelines should be followed for plastic lined piping products:

Do not store plastic lined pipe in temperatures below 0°F. Avoid storing plastic lined piping products where they will be exposed to ultraviolet light for long periods of time.

Safety Precautions for Plastic Lined Pipe Fabrication

Plastic-lined pipe can be fabricated on-site by properly certified personnel. When field fabricating, adequate ventilation (such as exhaust fans) should be used. Overheating of the plastic can cause it to degrade and generate vapors.

Avoid breathing vapors. Vapors can cause severe irritation to skin, eyes, and respiratory tract. When field fabricating, never heat the plastic with a torch or open flame.

Painting Plastic Lined Piping Products

All pipe, fittings, and valves supplied have a protective coating applied to minimize oxidation during shipping and handling. Refer to NACE guidelines and recommendations for sandblasting and selection of an appropriate primer and topcoat suitable for your plant environmental conditions.

It's important that the raised plastic face on all plastic lined piping components is protected from damage during sandblastirg and painting. Make sure that the protective end caps remain in place at all times during these operations, and direct the sandblasting away from the face of the flange. As an extra precaution, you may want to remove the protective end cap, apply protective tape over the plastic face, and then replace the cap before sandblasting and painting. If the exterior of the pipe is to be treated with a heat curable protective coating, exercise caution during the heating process. Never apply heat in excess of the liners maximum temperature rating.

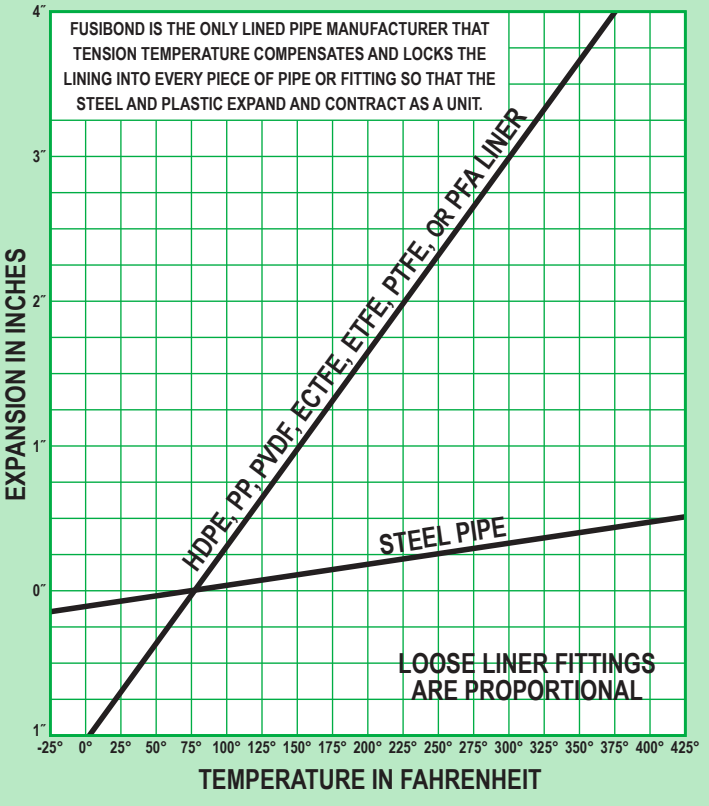
Vent holes on PTFE/PFA lined pipe and PTFE/PFA lined fittings should not be plugged with paint. The holes are part of the venting system needed to prevent possible gas buildup behind the liner and possible liner collapse. Pipe, fittings and valves can be special ordered without paint.

PIPE
Lined pipe can be fabricated with either a loose or locked in liner. A locked in liner reduces the effect of the difference in expansion coefficient between the metal and the liner. A loose liner, when extensively thermal cycled, can result in cracking at the flange surface since that is the only place where the liner is restrained. Loose liners tend to roll back and forth at the flanges when heated to an elevated temperature due to the differences in expansion between the metal and liner. Loose liners tend to·collapse when operated under high vacuum at elevated temperatures. In addition, loose liners provide a space for gas build-up between the liner and the pipe and result in corrosion and liner collapse. Weep holes which can be used to initially prevent this problem are readily blocked by paint, rust, and insulating materials. Weep holes can also create problems of structural corrosion of the metal pipe. Weep holes are commonly used with PTFE and PFA due to the poor permeation characteristics. PFA does not always need to be vented.

FITTINGS
For lined pipe to be attractive and viable, a total system is required including tees, elbows, crosses, standard reducing and special configurations. The method of fabrication of the fittings is key to the total system reliability. The ASTM specifies that no welding is permitted on the fitting after the liner is molded into place. Some of the lined fittings on the market do not comply with this part of the ASTM with a resulting loss in reliability.

PRESSURE AND VACUUM LIMITATIONS
Lined pipe is available in 150 and 300 pound pressure rated pipe. Higher pressure pipe is available on special order. Bonded lined pipe can operate at full vacuum. Vacuum collapse capability of loose lined pipe is dependent on liner thickness.

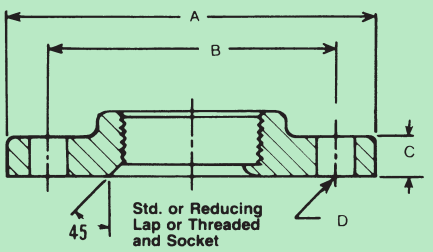
EXPANSION AND CONTRACTION OF COMPETITORS
LOOSE 20' LENGTHS OF PLASTIC LINERS VS STEEL PIPE



MECHANICAL PROPERTIES / TWO PIECE FIELD FAB. FLANGES / MINIMUM FLANGED PIPE SPOOL LENGTHS

Minimum Pipe Spool Lengths in Inches

Size (NPS)	Class 150	Class 300
½"	3"	3¼"
¾"	3"	3⅜"
1"	3"	3⅝"
1½"	3⅜"	4"
2"	3½"	4¼"
3"	4"	5⅛"
4"	4⅜"	5½"
6"	5½"	6⅜"
8"	6½"	7½"
10"	8½"	9⅞"
12"	8½"	10⅜"

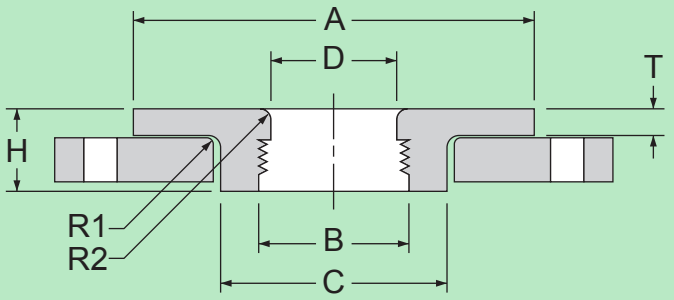


METAL	ASTM STANDARD
Ductile Iron Cast Steel	A 395 A536 A 216 Grade WCB
Fabricated Steel Components	A 234 A 587 A 181 A 105 A 106 Grade B

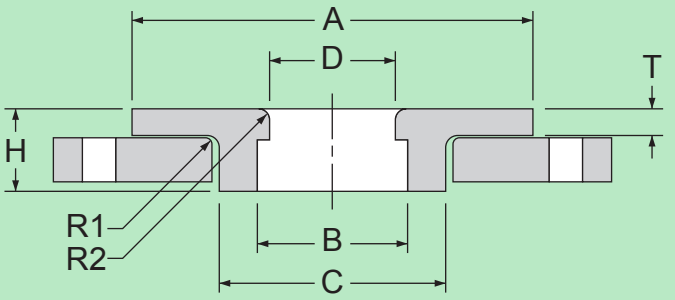
Size of Flange	Overall Dia. A	Hub Dia. B	Thickness C		Overall Thick-ness D	Bolt Holes E		Bolt Circle Dia. F
			D.I.	Steel		No	Size	
1"	4¼"	1 15/16"	7/16"	½"	11/16"	4	⅝"	3⅛"
1¼"	4⅝"	2 5/16"	½"	9/16"	13/16"	4	⅝"	3½"
1½"	5"	2 9/16"	9/16"	⅝"	⅞"	4	⅝"	3⅞"
2"	6"	3 1/16"	⅝"	11/16"	1"	4	¾"	4¾"
2½"	7"	3 9/16"	11/16"	13/16"	1⅛"	4	¾"	5½"
3"	7½"	4¼"	¾"	⅞"	1 3/16"	4	¾"	6"
4"	9"	5 5/16"	15/16"	⅞"	1 5/16"	8	¾"	7½"
6"	11"	7 9/16"	1"	1"	1 9/16"	8	⅞"	9½"
8"	13½"	9⅝"	1⅛"	1⅛"	1¾"	8	⅞"	11¾"

Rotating, Two Piece, Field Fabrication Flanges - Welded and Threaded

Threaded Hub



Welded Hub



Pipe Size	A	B	C	D	H	T	R1	R2
1"	2.00"	1.36"	1.73"	1.094"	1.06"	0.18"	0.06"	0.25"
1½"	2.88"	1.95"	2.35"	1.661"	1.19"	0.20"	0.09"	0.25"
2"	3.63"	2.44"	2.88"	2.132"	1.31"	0.23"	0.13"	0.25"
3"	5.00"	3.57"	4.17"	3.138"	1.50"	0.30"	0.13"	0.25"
4"	6.19"	4.57"	5.30"	4.096"	1.62"	0.34"	0.13"	0.25"
6"	8.50"	6.72"	7.52"	6.160"	1.99"	0.43"	0.13"	0.25"
8"	10.63"	8.72"	9.62"	8.076"	2.25"	0.50"	0.20"	0.25"

FUSIBOND HAS IT ALL

PLASTIC LINING PIPE AND FITTINGS IS OUR ONLY BUSINESS

HDPE • PP • PVDF • ECTFE • ETFE • PTFE • PFA

FUSIBOND PIPING SYSTEMS INC.

2615 CURTISS ST. • DOWNERS GROVE, IL 60515
630-969-4488 • FAX 630-969-2355 • E-MAIL: SALES@FUSIBOND.COM

ISO REGISTERED FIRM