IPP

IMPROVED PIPING PRODUCTS

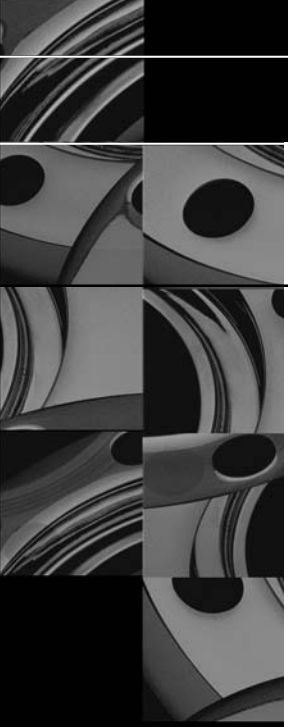
Deltaflex®

Flanges

The Modern
High-Performance
Solution.

2004

IMPROVED PIPING PRODUCTS



To Our Valued Customers

Improved Piping Products (IPP), Inc. is the sole manufacturer of the IPP Deltaflex ® backup ring and slip-on welded flange, a technological breakthrough in the flange industry. Our patented design brings cost effectiveness and greater safety to an industry where savings and risk management are a necessity in maintenance and construction of various projects.

We have specialized in flange design since 1979 and furnish IPP Deltaflex ® backup rings to a broad cross section of industrial and municipal users worldwide. IPP backup rings are made to exacting specifications and conform to the high standards of quality assurance.

Please take a few minutes to review the Technical Information Section. It will give you a better understanding of how IPP technology has reduced the cost of flange/backup rings while maintaining their structural integrity. We also offer a video for group presentations of our technical offerings. Note the sizes available from 1/2 inch to 63 inches along with unmatched inventory.

If you have any questions about the advantages of IPP Deltaflex ® flanges, please contact :

IPP Deltaflex® pipe flanges for superior performance on:

Stainless Steel • HDPE • PVDF • FRP • PVC
And Carbon Steel Piping Systems

IMPROVED PIPING PRODUCTS

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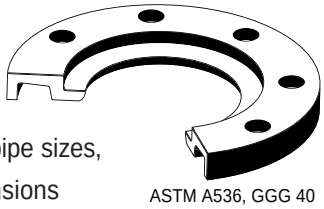
IPP Deltaflex® Flanges

DUCTILE IRON

For use on HDPE and stainless steel stub-ends

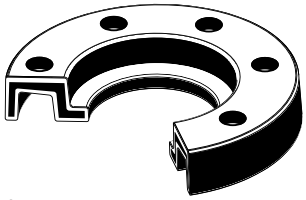


ASTM A536, GGG 40

Lap Joints

BUP-SDR	ANSI
DIPS	Ductile iron pipe sizes,
DF2DI	Metric dimensions

Cast ductile iron backup rings



ASTM A536, GGG 40

Polypropylene

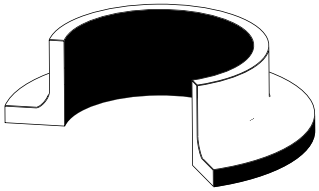
PPDA	Metric
PPDI	ANSI

Polypropylene encapsulated glass reinforced ductile iron

PPDI	DIN/ANSI Combination

HDPE FLANGE ADAPTERS

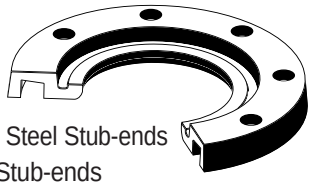
PESE-SDR



PE 3408
ASTM d 3350

STAINLESS STEEL

For use on HDPE and stainless steel stub-ends



ASTM A351 CF8M 316
ASTM A351 CF8 304

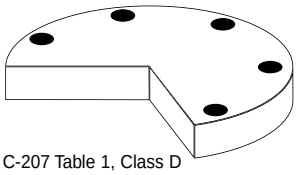
Lap Joints

SS-SDR	For HDPE & Steel Stub-ends
BUSO-LW	For Slip-on Stub-ends
BUSO-SW	For Slip-on Stub-ends

Cast stainless steel backup rings

Blind Flange

BSS

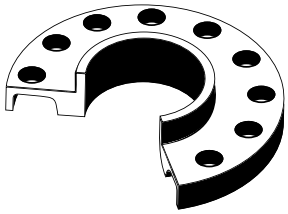


AWWA C-207 Table 1, Class D

Welded Slip-on

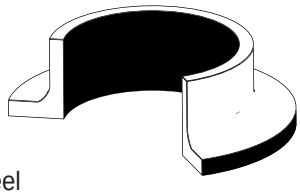
SOHP	High Pressure

Slip-on welded flange



ASTM A182F 316L
ASTM A351 CF3M 316L

Welded Slip-on Stub-end



ASTM A351 CF3M 316L

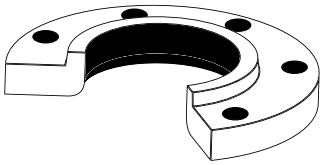
SOSE	Stainless steel

Cast slip-on welded stub-end designed for use with modified I.D. Deltaflex® flanges

Modern High Performance Flanges

IPP Deltaflex® Flanges

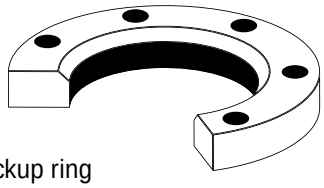
STANDARD FLANGES IN DUCTILE IRON



LJ-DI

Ductile iron lap-joint flange
ANSI B16.5 dimensions

ASTM A395

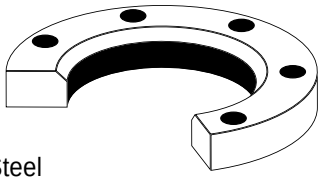


BU-DI

Light-weight ductile iron backup ring
IPS and AFR dimensions

ASTM A536

CARBON STEEL FLANGES



PS-BUPP Flange
BPS Blind Plate Steel

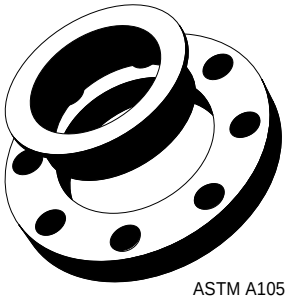
Plate steel (chamfered) backup ring
AWWA C-207 dimensions

ASTM A36

IPP SYSTEMS

Duoflange

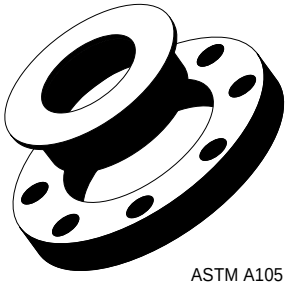
Slip-on stub-end and flange in forged steel



ASTM A105

Field Flare Flange

Socket weld or threaded stub-end and flange for plastic lined pipe systems



ASTM A105

IPP Deltaflex® Flange Engineering

Improved Piping Products, Inc. (IPP) has patented the second generation convoluted pipe back-up rings and markets that technology under the registered trade name IPP Deltaflex® pipe flanges/backup rings. The unique design technology significantly reduces the weight of a flange without reducing its pressure performance.

IPP has employed and continues to employ qualified, full time stress analysts. The finite element analysis (FEA) tool utilized by IPP is ANSYS 5.3. Using these tools the company has examined the stress levels inside standard piping flange joints and in the adjacent pipe walls. From this analysis IPP has confirmed that nationally recognized pipe flanges are very conservatively stressed while the adjacent pipe walls often exceed allowable code stress values, in many cases approaching the yield point of the piping material. See figure 1 below and the Technical Information section on pages 28 – 31 "IPP Deltaflex® Flange Performance on Steel Stub-ends."

In response to this IPP Deltaflex® flanges are designed to allowable code stress levels with a safety factor of two. Even with this generous safety factor IPP Deltaflex® flanges are much lower stressed than the abutting pipe wall material. Therefore a properly selected IPP Deltaflex® flange is not the weakest link in a pipe system when the adjacent pipe wall is closely examined. See figure 2.

IPP Deltaflex® flanges are safe, functional structures with an attractive economic dimension. They conserve material and energy resources from manufacture to point of installation. The lower weight translates into several benefits:

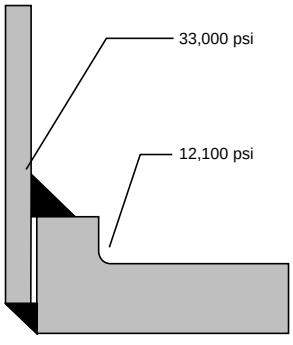
- Lower cost of raw material and energy
- Reduced shipping costs
- Ease of handling and installation

The IPP Deltaflex® flanges can be substituted for a conventional pipe flange as called out in ANSI B16.5, B16.47 and AWWA C207. Its unique cross section can save up to 40% of the weight of one of these national pipe standard flanges. Some installation practices have thinned the standard flanges for economic reasons. In these instances using IPP Deltaflex® flanges design principles can reduce the critically high stress levels to a stated safety factor. This performance is achieved by using IPP Deltaflex® flange engineering to increase the section modulus of the flange without increasing its weight.

IPP has installed literally millions of its patented convoluted flanges in the entire spectrum of code controlled commercial and industrial pipe systems. To our knowledge there has never been a reported failure of an IPP Deltaflex® flange in operation in sizes to 63" and ANSI pressure categories through Class 400 (34" size). The design technology has consistently been the specification choice of world renowned piping engineers.

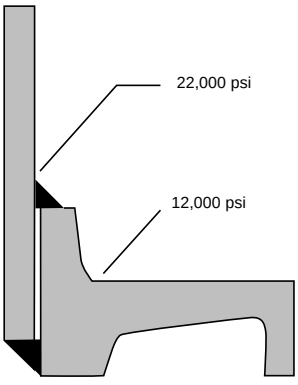
The IPP Deltaflex® flange truly satisfies the claim of being a modern high performance pipe flange. Pound for pound there exists no other pipe flange that can safely carry structural loads as efficiently as an IPP Deltaflex® flange.

We welcome your inquiry and presentation request.



A. Standard 24" slip-on

FIGURE 1

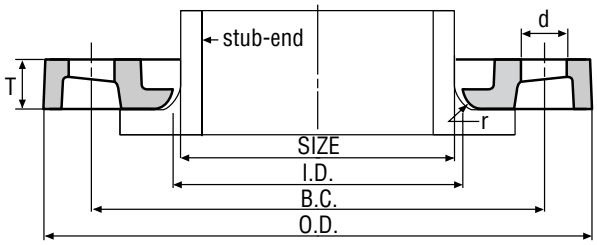


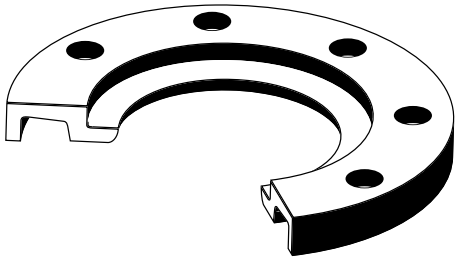
B. IPP Deltaflex 24" slip-on

FIGURE 2

SS-SDR

Stainless Steel Flange/Backup Ring





- **Description** Utilizes the patented IPP Deltaflex® flange cross section.
- **Utilization** HDPE, stainless steel, and carbon steel stub-ends.
- **Materials** Cast in stainless steel ASTM A351CF8M (316), CF8 (304), tensile 70,000 psi; yield 30,000 psi; 30% elongation.
- **Dimensions** Bolt circle is ANSI/B16.5 class 150. Mates with ANSI B16.5, B16.47, AWWA C207.
- **Finish** Net shape to fully machined.

Pipe Diameter	IPP Product Code*	Outside Dia. O.D.	Flange Thickness T	Inside Dia. I.D.	Bolt Count N	Dia. Bolt Hole B.D.	Bolt Circle B.C.	Radius r	Weight lbs/pc	Operating[1] Pressure
1"	**SS316-SDR7-01**	4.25	0.56	1.38	4	0.63	3.13	0.13	2.0	267
1 1/2"	**SS316-SDR7-0150**	5.00	0.69	1.97	4	0.63	3.88	0.22	2.0	267
2"	**SS316-SDR7-02**	6.00	0.75	2.46	4	0.75	4.75	0.27	3.0	267
2"	**SS316-SDR11-02**	6.00	0.40	2.46	4	0.75	4.75	0.27	2.0	160
3"	**SS316-SDR7-03**	7.50	0.94	3.60	4	0.75	6.00	0.33	5.0	267
3"	**SS316-SDR13.5-03**	7.50	0.40	3.60	4	0.75	6.00	0.33	3.0	128
4"	**SS316-SDR7-04**	9.00	0.94	4.60	8	0.75	7.50	0.39	6.0	267
4"	**SS316-SDR13.5-04**	9.00	0.50	4.60	8	0.75	7.50	0.39	5.0	128
6"	**SS316-SDR7-06**	11.00	1.00	6.75	8	0.88	9.50	0.44	9.0	267
6"	**SS316-SDR13.5-06**	11.00	0.60	6.75	8	0.88	9.50	0.44	6.0	128
8"	**SS316-SDR7-08**	13.50	1.12	8.75	8	0.88	11.75	0.44	12.0	267
8"	**SS316-SDR13.5-08**	13.50	0.70	8.75	8	0.88	11.75	0.44	9.0	128
10"	**SS316-SDR7-10**	16.00	1.27	10.92	12	1.00	14.25	0.50	20.0	267
10"	**SS316-SDR7.3-10**	16.00	1.19	10.92	12	1.00	14.25	0.42	18.0	250
10"	**SS316-SDR13.5-10**	16.00	0.90	10.92	12	1.00	14.25	0.42	12.0	128
12"	**SS316-SDR7-12**	19.00	1.77	12.92	12	1.00	17.00	0.50	37.0	267
12"	**SS316-SDR11-12**	19.00	1.25	12.92	12	1.00	17.00	0.42	24.0	160
12"	**SS316-SDR13.5-12**	19.00	1.05	12.92	12	1.00	17.00	0.42	21.0	128
14"	**SS316-SDR7-14**	21.00	1.78	14.18	12	1.13	18.75	0.41	50.0	267
14"	**SS316-SDR9.3-14**	21.00	1.38	14.18	12	1.13	18.75	0.50	40.0	183
14"	**SS316-SDR17-14**	21.00	1.13	14.18	12	1.13	18.75	0.41	25.0	100
16"	**SS316-SDR7-16**	23.50	2.17	16.19	16	1.13	21.25	0.40	67.0	267
16"	**SS316-SDR13.5-16**	23.50	1.44	16.19	16	1.13	21.25	0.50	52.0	160
16"	**SS316-SDR17-16**	23.50	1.25	16.19	16	1.13	21.25	0.41	31.0	80
18"	**SS316-SDR7-18**	25.00	2.06	18.20	16	1.25	22.75	0.40	67.0	267
18"	**SS316-SDR11-18**	25.00	1.56	18.20	16	1.25	22.75	0.50	57.0	160
18"	**SS316-SDR21-18**	25.00	1.34	18.20	16	1.25	22.75	0.41	33.0	80
20"	**SS316-SDR7-20**	27.50	2.27	20.25	20	1.25	25.00	0.31	90.0	267
20"	**SS316-SDR13.5-20**	27.50	1.69	20.25	20	1.25	25.00	0.50	69.0	128
20"	**SS316-SDR21-20**	27.50	1.47	20.25	20	1.25	25.00	0.38	39.0	80

1. Operating pressure on HDPE stub-ends at a safety factor of two.

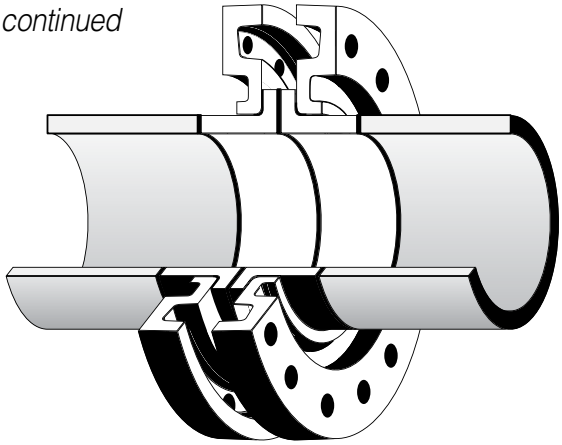
*Material code, either 316 or 304

IPP has the engineering capability to design in-house any back-up flange in the IPP Deltaflex® flange shape to any design pressure and temperature conditions at dramatic savings in cost.

Continued for sizes 22" through 63" on pg. 5

SS-SDR

continued



Stainless Steel Flange/Backup Ring

Pipe Diameter	IPP Product Code	Outside Dia. O.D.	Flange Thickness T	Inside Dia. I.D.	Bolt Count N	Dia. Bolt Hole B.D.	Bolt Circle B.C.	Radius r	Weight lbs/pc	Operating[1] Pressure
22"	**SS316-SDR7-22**	29.50	2.43	22.25	20	1.38	27.25	0.31	106.0	267
22"	**SS316-SDR13.5-22**	29.50	1.81	22.25	20	1.38	27.25	0.50	78.0	128
22"	**SS316-SDR21-22**	29.50	1.54	22.25	20	1.38	27.25	0.38	50.0	80
24"	**SS316-SDR7-24**	32.00	2.60	24.25	20	1.38	29.50	0.31	116.0	267
24"	**SS316-SDR13.5-24**	32.00	1.88	24.25	20	1.38	29.50	0.50	97.0	128
24"	**SS316-SDR26-24**	32.00	1.60	24.25	20	1.38	29.50	0.38	65.0	64
26"	**SS316-SDR11-26**	34.25	2.50	26.38	24	1.38	31.75	0.50	119.0	160
26"	**SS316-SDR21-26**	34.25	2.20	26.38	24	1.38	31.75	0.31	96.0	80
28"	**SS316-SDR11-28**	36.50	2.68	28.38	28	1.38	34.00	0.50	134.0	160
28"	**SS316-SDR21-28**	36.50	2.30	28.38	28	1.38	34.00	0.31	109.0	80
30"	**SS316-SDR7-30**	38.75	3.80	30.38	28	1.38	36.00	0.31	302.0	267
30"	**SS316-SDR13.5-30**	38.75	2.75	30.38	28	1.38	36.00	0.50	174.0	128
30"	**SS316-SDR26-30**	38.75	2.18	30.38	28	1.38	36.00	0.31	121.0	64
32"	**SS316-SDR13.5-32**	41.75	2.85	32.38	28	1.63	38.50	0.50	199.0	128
32"	**SS316-SDR26-32**	41.75	2.36	32.38	28	1.63	38.50	0.31	145.0	64
34"	**SS316-SDR13.5-34**	43.75	3.30	34.38	32	1.63	40.50	0.20	228.0	128
34"	**SS316-SDR17-34**	43.75	2.95	34.38	32	1.63	40.50	0.50	209.0	100
34"	**SS316-SDR26-34**	43.75	2.68	34.38	32	1.63	40.50	0.31	168.0	64
36"	**SS316-SDR17-36**	46.00	3.00	36.38	32	1.63	42.75	0.50	230.0	100
36"	**SS316-SDR32.5-36**	46.00	2.35	36.38	32	1.63	42.75	0.31	167.0	50
40"	**SS316-SDR21-40**	50.75	3.45	39.75	36	1.63	47.25	0.50	341.0	80
42"	**SS316-SDR21-42**	53.00	3.25	42.38	36	1.63	49.50	0.50	330.0	80
42"	**SS316-SDR39-42**	53.00	2.48	42.38	36	1.63	49.50	0.31	223.0	40
48"	**SS316-SDR26-48**	59.50	3.50	48.50	44	1.63	56.00	0.50	405.0	64
48"	**SS316-SDR52-48**	59.50	2.45	48.50	44	1.63	56.00	0.25	291.0	30
54"	**SS316-SDR26-54**	66.25	3.86	54.62	44	1.88	62.75	0.50	513.0	64
54"	**SS316-SDR52-54**	66.25	2.80	54.62	44	1.88	62.75	0.19	365.0	30
63"/60	**SS316-SDR26-60**	73.00	3.54	64.02	52	1.88	69.25	0.20	495.0	51
63"/60	**SS316-SDR52-63**	73.00	3.23	64.02	52	1.88	69.25	0.51	455.0	32

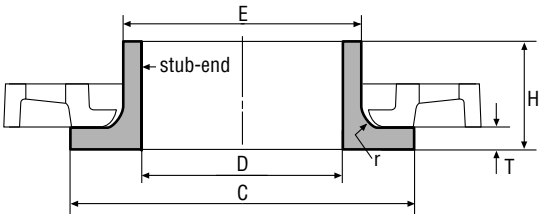
1. Operating pressure on HDPE stub-ends at a safety factor of two.

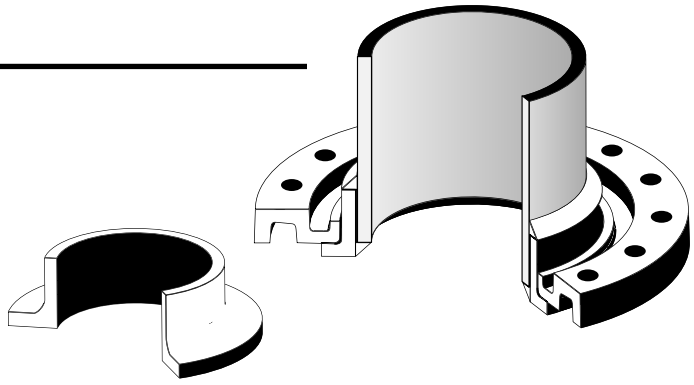
*Material code, either 316 or 304

IPP has the engineering capability to design, in-house, any back-up flange in the IPP Deltaflex® flange shape to any design pressure and temperature conditions at dramatic savings in cost

Stub-ends, Class 150

SOSE 316L Weldable Slip-on Stub-end





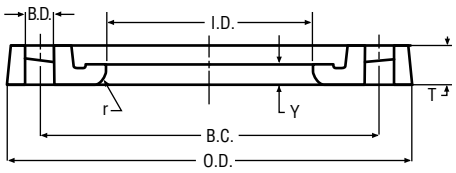
- **Description** Standard slip-on stub-end in stainless steel to mate with BUSO-LW and BUSO-SW flanges, page 7.
- **Benefits** Significantly reduces pipe wall stress due to flexibility of the components.
- **Utilization** Two-piece system with multiple backing ring choices. The IPP Deltaflex® flange line is designed to fit with a modified inside diameter.
- **Material** Cast ASTM A351 CF3M (316L) for the stub-end. Backing rings may be ductile iron, carbon steel, stainless steel. See page 7.
- **Dimensions** Interchangeable with an ANSI B16.5 class 150 system. Foot print same as ANSI B16.5 slip-on flange. Bolt lengths may vary.
- **Installation** No special equipment necessary.
- **Finish** Net shape, machined weld surfaces, standard serrations.

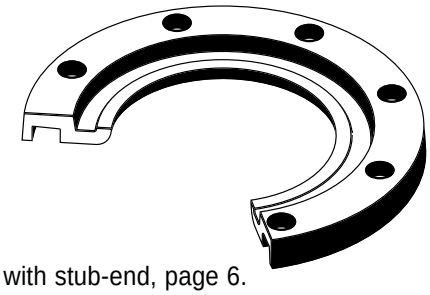
Pipe Size	Product Code	Outside Diameter Stub-end C	Inside Diameter Stub-end D	E	H	Thickness T	Radius r	Weight (lbs.)	Operating Pressure
1"	**SOSE-316L-0100**	2.00	1.36	1.73	0.69	0.18	0.06	0.2	275
1 1/2"	**SOSE-316L-0150**	2.88	1.95	2.35	0.88	0.20	0.09	0.5	275
2"	**SOSE-316L-0200**	3.63	2.44	2.88	1.00	0.23	0.13	1.0	275
3"	**SOSE-316L-0300**	5.00	3.57	4.17	1.19	0.30	0.13	2.0	275
4"	**SOSE-316L-0400**	6.19	4.57	5.30	1.31	0.34	0.13	3.0	275
6"	**SOSE-316L-0600**	8.50	6.72	7.58	1.56	0.43	0.13	6.0	275
8"	**SOSE-316L-0800**	10.63	8.72	9.62	1.75	0.44	0.20	9.0	275
10"	**SOSE-316L-1000**	12.75	10.88	11.79	1.94	0.45	0.25	12.0	200
12"	**SOSE-316L-1200**	15.00	12.88	13.79	2.19	0.45	0.25	16.0	175
14"	**SOSE-316L-1400**	16.25	14.14	15.16	2.25	0.53	0.25	20.0	185
16"	**SOSE-316L-1600**	18.50	16.16	17.16	2.50	0.53	0.25	25.0	160
18"	**SOSE-316L-1800**	21.00	18.18	19.24	2.69	0.53	0.25	33.0	165
20"	**SOSE-316L-2000**	23.00	20.20	21.26	2.88	0.73	0.25	42.0	150
24"	**SOSE-316L-2400**	27.25	24.25	25.31	3.25	0.73	0.50	57.0	155

BUS0-LW / BUSO-SW

Stainless Steel Flange/Backup Rings

(for slip-on stub-end SOSE-316L)





- **Description** Utilizes the patented IPP Deltaflex® flange cross section. Use with stub-end, page 6.
- **Utilization** Stainless steel slip-on stub-ends.
- **Material** Cast in stainless steel ASTM A351CF8M (316), CF8 (304), tensile 70,000 psi; yield 30,000 psi; 30% elongation.
- **Dimensions** Bolt circle is ANSI/B16.5 class 150. Mates with ANSI B16.5. Inside diameter is modified to fit stub-end SOSE-316L.
- **Finish** Net shape to fully machined.

BUSO-LW

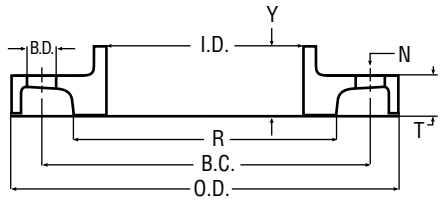
Pipe Diameter	Product Code	Outside Dia. O.D.	Flange Thick. T	Inside Dia. I.D.	Y	Bolt Count N	Bolt Hole B.D.	Bolt Circle B.C.	Radius r	Weight lbs/pc	Operating[1] Pressure
2"	**BUSO-LW316-0200**	6.00	.40	2.95	0.4	4	0.75	4.75	0.13	2.0	230
3"	**BUSO-LW316-0300**	7.50	.40	4.24	0.4	4	0.75	6.00	0.13	3.0	155
4"	**BUSO-LW316-0400**	9.00	.50	5.39	0.4	8	0.75	7.50	0.13	4.0	150
6"	**BUSO-LW316-0600**	11.00	.60	7.61	0.5	8	0.88	9.50	0.13	6.0	150
8"	**BUSO-LW316-0800**	13.50	.70	9.69	0.5	8	0.88	11.75	0.20	9.0	140
10"	**BUSO-LW316-1000**	16.00	.90	11.92	0.5	12	1.00	14.25	0.25	12.0	140
12"	**BUSO-LW316-1200**	19.00	1.05	13.92	0.6	12	1.00	17.00	0.25	21.0	125
14"	**BUSO-LW316-1400**	21.00	1.13	15.29	0.6	12	1.13	18.75	0.25	26.0	115
16"	**BUSO-LW316-1600**	23.50	1.25	17.29	0.6	16	1.13	21.25	0.25	32.0	100
18"	**BUSO-LW316-1800**	25.00	1.34	19.37	0.6	16	1.25	22.75	0.25	34.0	90
20"	**BUSO-LW316-2000**	27.50	1.47	21.39	0.6	20	1.25	25.00	0.25	41.0	80
24"	**BUSO-LW316-2400**	32.00	1.60	25.44	0.8	20	1.38	29.50	0.25	59.0	70

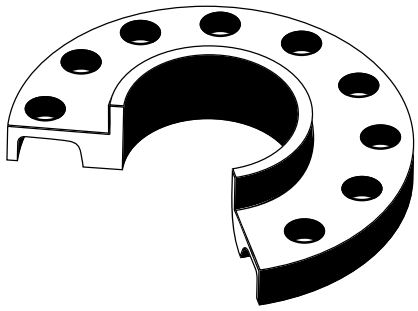
BUSO-SW

1"	**BUSO-SW316-0100**	4.25	0.56	1.79	0.22	4	0.63	3.13	0.06	1.0	275
1 1/2"	**BUSO-SW316-0150**	5.00	0.69	2.43	0.26	4	0.63	3.88	0.09	2.0	275
2"	**BUSO-SW316-0200**	6.00	0.75	2.95	0.30	4	0.75	4.75	0.13	3.0	275
3"	**BUSO-SW316-0300**	7.50	0.94	4.24	0.50	4	0.75	6.00	0.13	5.0	275
4"	**BUSO-SW316-0400**	9.00	0.94	5.39	0.50	8	0.75	7.50	0.13	6.0	275
6"	**BUSO-SW316-0600**	11.00	1.00	7.61	0.56	8	0.88	9.50	0.13	9.0	275
8"	**BUSO-SW316-0800**	13.50	1.12	9.69	0.56	8	0.88	11.75	0.20	14.0	275
10"	**BUSO-SW316-1000**	16.00	1.19	11.92	0.60	12	1.00	14.25	0.25	20.0	200
12"	**BUSO-SW316-1200**	19.00	1.25	13.92	0.60	12	1.00	17.00	0.25	30.0	175
14"	**BUSO-SW316-1400**	21.00	1.38	15.29	0.80	12	1.13	18.75	0.25	39.0	185
16"	**BUSO-SW316-1600**	23.50	1.44	17.29	0.92	16	1.13	21.25	0.25	46.0	160
18"	**BUSO-SW316-1800**	25.00	1.56	19.37	0.95	16	1.25	22.75	0.25	55.0	165
20"	**BUSO-SW316-2000**	27.50	1.69	21.39	1.00	20	1.25	25.00	0.25	68.0	150
24"	**BUSO-SW316-2400**	32.00	1.88	25.44	1.00	20	1.38	29.50	0.25	92.0	155

DFSOHP

Welded Slip-on Flange (275 psi)





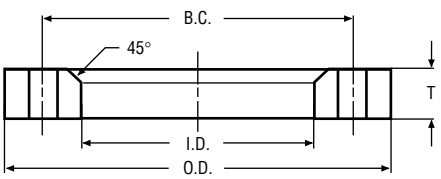
- **Description** Utilizes the patented IPP Deltaflex® flange cross section.
- **Utilization** Welded slip-on flange, 275 psi and 450 psi test pressure.
- **Material** Forged through 10"; ASTM A182F316L tensile 70,000 psi; yield 25,000 psi; 30% elongation.
- **Material** Cast above 10" ASTM A351CF3M (316L) tensile 70,000; yield 30,000 psi; 30% elongation.
- **Dimensions** Bolt circle is ANSI B16.5 Class 150. Mates with ANSI B16.5; AWWA C207, 150 lb.
- **Finish** Machined, flat face, raised face, standard serrations.
- **Additional** Stocked in 316L. Available in 304L.

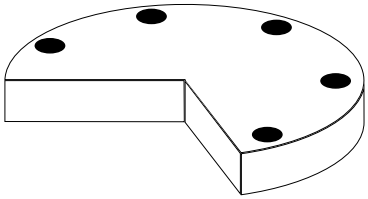
Pipe Diameter	IPP Product Code	Outside Dia. O.D.	Flange Thick. T	Inside Dia. I.D.	Hub Thick. Y	Raised Face Dia. R	Bolt Count N	Bolt Hole B.D.	Bolt Circle B.C.	Weight lbs/pc	Operating[1] Pressure
1" forged	**SO 0100 316L275**	4.25	0.56	1.36	0.69	2.00	4	0.63	3.13	1.5	275
1 1/2" forged	**SO 0150 316L275**	5.00	0.69	1.95	0.88	2.87	4	0.63	3.87	2.0	275
2" forged	**SO 0200 316L275**	6.00	0.75	2.44	1.00	3.62	4	0.75	4.75	3.5	275
3" forged	**SO 0300 316L275**	7.50	0.94	3.57	1.19	5.00	8	0.75	6.00	5.0	275
4" forged	**SO 0400 316L275**	9.00	0.94	4.57	1.31	6.19	8	0.75	7.50	7.0	275
6" forged	**SO 0600 316L275**	11.00	1.00	6.72	1.56	9.51	8	0.88	9.50	11.0	275
8" forged	**SO 0800 316L275**	13.50	1.13	8.72	1.75	10.63	8	0.88	11.75	17.0	275
10" forged	**SO 1000 316L275**	16.00	1.19	10.88	1.94	12.76	12	1.00	14.25	25.0	275
12" cast	**SO 1200 316L275**	19.00	1.25	12.88	2.19	15.00	12	1.00	17.00	36.0	275
14" cast	**SO 1400 316L275**	21.00	1.38	14.14	2.24	16.26	12	1.12	18.75	47.0	275
16" cast	**SO 1600 316L275**	23.50	1.44	16.16	2.50	18.50	16	1.12	21.25	61.0	275
18" cast	**SO 1800 316L275**	25.00	1.57	18.18	2.68	20.98	16	1.26	22.75	76.0	275
20" cast	**SO 2000 316L275**	27.52	1.69	20.20	2.87	22.99	20	1.26	25.00	92.0	275
24" cast	**SO 2400 316L275**	32.00	1.89	24.25	3.27	27.24	20	1.37	29.50	135.0	275
30" cast	**SO 3000 316L90**	38.74	1.00	30.19	3.23	33.74	28	1.37	36.00	136.0	90
36" cast	**SO 3600 316L90**	45.98	1.12	36.22	3.74	40.23	32	1.65	42.75	198.0	90

1. Safety factor of 2.

BSS

BSS - Blind Stainless Steel





- **Material** ASTM A240, 316 Stainless Steel
- **Dimensions** Class 150 Bolt circle in accordance with ANSI B16.5, B16.47 and AWWA C207
- **Finish** Pickled and Passivated for enhanced corrosion resistance.

Pipe Diameter	IPP Product Code	Outside Dia. O.D.	Flange Thick. T	Bolt Count N	Bolt Hole B.D.	Bolt Circle B.C.	Weight lbs/pc	Operating[1] Pressure
2"	**BSS-316-02**	6.00	0.63	4	0.75	4.75	58	275
3"	**BSS-316-03**	7.50	0.63	4	0.75	6.00	8	275
4"	**BSS-316-04**	9.00	0.63	8	0.75	7.50	11	275
6"	**BSS-316-06**	11.00	0.69	8	0.88	9.50	18	236
8"	**BSS-316-08**	13.50	0.69	8	0.88	11.75	28	156
10"	**BSS-316-10**	16.00	0.69	12	1.00	14.25	39	105
12"	**BSS-316-12**	19.00	0.81	12	1.00	17.00	65	97
14"	**BSS-316-14**	21.00	0.94	12	1.13	18.75	91	116
16"	**BSS-316-16**	23.50	1.00	16	1.13	21.25	122	102
18"	**BSS-316-18**	25.00	1.06	16	1.25	22.75	146	97
20"	**BSS-316-20**	27.50	1.13	20	1.25	25.00	186	92
22"	**BSS-316-22**	29.50	1.19	20	1.38	27.25	226	86
24"	**BSS-316-24**	32.00	1.25	20	1.38	29.50	281	82
28"	**BSS-316-28**	36.50	1.31	28	1.38	34.00	383	69
30"	**BSS-316-30**	38.75	1.38	28	1.38	36.00	454	66

1. Manufactured to the AWWA C207-86 table 1 blind flange dimensions.

Performance of Standard Flanges on HDPE Stub-ends

*WARNING: Do not use pressure ratings stated in AWWA C207 for HDPE Pipe

	STAINLESS STEEL								DUCTILE IRON				CARBON STEEL			
Nominal Pipe Size	AWWA C2071 2-D[2] (1-D)		Plate Sizes 1/2" Thickness		3/4" Thickness		1" Thickness		BU-DI (IPS) Chamfered		LJ-DI (IPS)[3] B16.5 Lap Joint		2-D[2] (1-D) AWWA-C207		4-E[2] (3-E) AWWA-C207	
	Op Press	Weight	Op Press	Weight	Op Press	Weight	Op Press	Weight	Op Press	Weight	Op Press	Weight	Op Press	Weight	Op Press	Weight
1/2"									275	1.0	275	.9				
1/4"									275	1.4	275	1.3				
1"									275	1.6	275	1.7				
1 1/4"									275	1.9						
1 1/2"									275	2.1	275	2.8	275	3.0		
2"	275	4.3	168	3.4	267	5.1	267	6.8	275	2.9	275	4.3	275	4.2	275	5.0
2 1/2"									275	4.0			275	5.7	275	8.0
3"	275	6.2	168	4.9	267	7.4	267	9.8	275	4.3	275	7.9	275	6.1	275	8.0
4"	200	8.6	148	6.8	267	10.2	267	13.7	247	6.8	275	10.7	239	8.4	275	13.0
5"	202	9.8	123	7.8	267	11.7	267	15.6	210	7.6			247	9.6	275	15.0
6"	160	11.9	123	8.6	267	12.9	267	17.2	210	9.3	275	14.7	227	11.7	275	17.0
8"	97	16.6	87	12.0	197	18.0	267	24.1	120	13.2	275	23.9	117	16.3	275	28.0
10"	57	21.6	60	15.7	135	23.5	239	31.3	74	17.2	275	32.3	68	21.2	275	37.0
12"	49	33.0	39	20.4	89	30.6	158	40.7	69	29.3	275	55.0	60	32.3	275	59.0
14"	60	51.6	34	27.4	75	41.2	134	54.9	67	35.8			77	50.5	275	77.0
16"	52	66.3	25	33.1	57	49.7	100	66.3	46	41.8			63	64.9	275	99.0
18"	48	71.1	21	33.5	47	50.3	84	67.1	53	51.7			60	69.6	275	106.0
20"	46	89.7	15	39.7	33	59.5	58	79.4	45	58.6			56	87.8	275	134.0
22"	44	102.0	13	42.9	31	64.3	55	85.7					50	99.9	275	185.0
24"	40	125.0	12	50.0	30	75.0	51	100.0	40	85.1			49	122.0	275	190.0
26"		144.0	9	55.0	20	82.4	36	110.0						141.0		
28"	32	159.0	8	60.7	18	91.0	30	121.0					38	156.0		
30"	34	185.0			15	101.0	25	134.0	28	112.0			39	181.0	188	295.0
32"	34	240.0			15	120.0	23	160.0					41	235.0		
34"	32	253.0												248.0		
36"	32	298.0			9	137.0	16	183.0	26	177.0			39	292.0	143	433.0
40"																
42"	27	408.0					11	233.0					33	400.0	117	627.0
48"	20	483.0					9	276.0					24	473.0	91	781.0
54"	22	702.0					7	330.0					27	687.0	82	987.0
55"																
60"																
63"																

Operating pressure ratings in PSI and unit weights in lbs; flanges mate with ANSI B16.5, B16.1, B16.47, MSSP44.

1. The pressure ratings in this table are for free floating rings on an HDPE stub-end.
2. AWWA 1-D and 3-E are actually 2-D and 4-E respectively in AWWA C207-94 86 version.
3. LJ-DI flanges have the dimensions specified in ANSI B16.5 but are made of ductile iron ASTM A395.

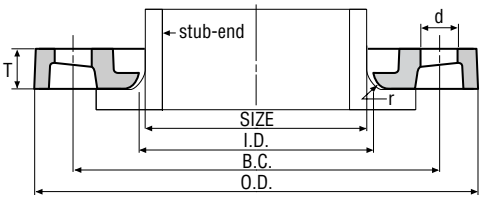
***AWWA C207- 2D** flanges will not perform to the 150 psi called out in C207 when used on HDPE stub-ends. This specification should read “for steel pipe only.” Do not use AWWA C207-2D to specify flanges for HDPE stub-ends. See page 24 for details. *Compare to IPP Deltaflex® flange operating pressures on each specification sheet.*

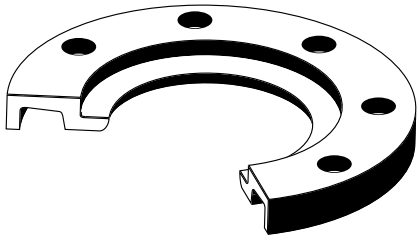
IPP has thoroughly scrutinized all flange designs with the use of special computer software to determine the Von Mises stress levels present in all of its flange structures as well as those of national standards.

The comparative weights of IPP Deltaflex® flanges vs some conventional flanges indicates that for any given nominal pipe size, the IPP Deltaflex® back-up flange is lighter in weight than a conventional lap joint flange. This is due to the innovative geometry employed by the IPP Deltaflex® flange… it is designed so that the flange material mass is allocated to the exact critical load bearing locations in the flange structure.

BUP-SDR

Convoluted Flange/Backup Ring



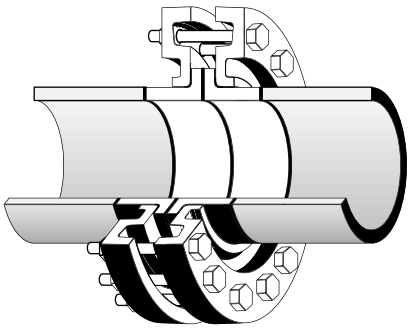


- **Description** Utilizes the patented IPP Deltaflex® flange cross section.
- **Utilization** HDPE and PP thermoplastic piping systems.
- **Materials** Ductile iron, ASTM A536-84.
- **Dimensions** Mate with all 150 lb flanges, ANSI B16.5, B16.47, B16.1 AWWA C207.
- **Finish** Red oxide primed, hot dip galvanized, epoxy coated.

Pipe Diameter	IPP Product Code	Outside Dia. O.D.	Flange Thickness T	Inside Dia. I.D.	Bolt Count N	Dia. Bolt Hole B.D.	Bolt Circle B.C.	Radius r	Weight lbs/pc	Operating[1] Pressure
1/2"	**BUP-SDR7-0050C**	3.50	0.50	0.90	4	0.63	2.38	0.13	1.0	267
3/4"	**BUP-SDR7-0075C**	3.88	0.50	1.11	4	0.63	2.75	0.13	1.0	267
1"	**BUP-SDR7-01C**	4.25	0.56	1.38	4	0.63	3.13	0.13	1.0	267
1 1/4"	**BUP-SDR7-0125C**	4.63	0.63	1.72	4	0.63	3.50	0.19	2.0	267
1 1/2"	**BUP-SDR7-0150C**	5.00	0.69	1.97	4	0.63	3.88	0.25	2.0	267
2"	**BUP-SDR7-02C**	6.00	0.75	2.46	4	0.75	4.75	0.31	3.0	267
2"	**BUP-SDR11-02B**	6.00	0.50	2.63	4	0.75	4.75	0.20	1.5	160
2 1/2"	**BUP-SDR7-0250C**	7.00	0.88	2.97	4	0.75	5.50	0.31	4.0	267
3"	**BUP-SDR7-03C**	7.50	0.94	3.60	4	0.75	6.00	0.40	4.0	267
3"	**BUP-SDR11-03B**	7.50	0.53	3.75	4	0.75	6.00	0.28	2.5	160
4"	**BUP-SDR7-04C**	9.00	0.94	4.60	8	0.75	7.50	0.40	5.5	267
4"	**BUP-SDR11-04B**	9.00	0.55	4.75	8	0.75	7.50	0.28	3.5	160
5"	**BUP-SDR7-05C**	10.00	0.94	5.69	8	0.88	8.50	0.44	6.0	267
6"	**BUP-SDR7-06C**	11.00	1.00	6.75	8	0.88	9.50	0.40	7.0	267
6"	**BUP-SDR11-06B**	11.00	0.63	6.88	8	0.88	9.50	0.28	4.5	160
8"	**BUP-SDR7-08C**	13.50	1.12	8.75	8	0.88	11.75	0.40	11.0	267
8"	**BUP-SDR11-08B**	13.50	0.85	8.88	8	0.88	11.75	0.28	8.0	160
10"	**BUP-SDR7-10C**	16.00	1.19	10.92	12	1.00	14.25	0.40	16.0	267
10"	**BUP-SDR11-10B**	16.00	0.98	11.00	12	1.00	14.25	0.31	12.0	160
12"	**BUP-SDR7-12C**	19.00	1.50	12.92	12	1.00	17.00	0.40	23.0	267
12"	**BUP-SDR9.3-12B**	19.00	1.25	13.13	12	1.00	17.00	0.31	22.0	192
12"	**BUP-SDR11-12B**	19.00	1.25	13.13	12	1.00	17.00	0.28	20.0	160
14"	**BUP-SDR7-14C**	21.00	1.63	14.18	12	1.13	18.75	0.40	37.0	267
14"	**BUP-SDR11-14B**	21.00	1.38	14.38	12	1.13	18.75	0.31	30.0	160
16"	**BUP-SDR7-16C**	23.50	1.88	16.19	16	1.13	21.25	0.40	49.0	267

1. Operating pressure on an HDPE stub-end with a safety factor of 2.

Continued for sizes 16" through 63" on pg. 12



BUP-SDR

continued

Convoluted Flange/Backup Ring

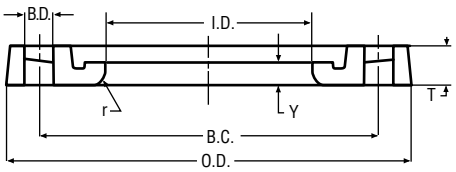
Pipe Diameter	IPP Product Code	Outside Dia. O.D.	Flange Thickness T	Inside Dia. I.D.	Bolt Count N	Dia. Bolt Hole B.D.	Bolt Circle B.C.	Radius r	Weight lbs/pc	Operating[1] Pressure
16"	**BUP-SDR11-16B**	23.50	1.65	16.38	16	1.13	21.25	0.35	40.0	160
18"	**BUP-SDR7-18C**	25.00	1.80	18.20	16	1.25	22.75	0.40	48.0	267
18"	**BUP-SDR9-18C**	25.00	1.75	18.20	16	1.25	22.75	0.40	48.0	200
18"	**BUP-SDR11-18B**	25.00	1.67	18.38	16	1.25	22.75	0.35	45.0	160
20"	**BUP-SDR9-20B**	27.50	2.06	20.38	20	1.25	25.00	0.31	61.0	200
20"	**BUP-SDR11-20B**	27.50	1.81	20.38	20	1.25	25.00	0.40	55.0	160
22"	**BUP-SDR9-22B**	29.50	2.13	22.38	20	1.38	27.25	0.31	72.0	200
22"	**BUP-SDR11-22B**	29.50	2.00	22.38	20	1.38	27.25	0.37	65.0	160
24"	**BUP-SDR9-24B**	32.00	2.13	24.38	20	1.38	29.50	0.31	91.0	200
24"	**BUP-SDR11-24B**	32.00	2.17	24.38	20	1.38	29.50	0.40	80.0	160
26"	**BUP-SDR7-26B**	34.25	2.53	26.38	24	1.38	31.75	0.31	109.0	267
26"	**BUP-SDR11-26B**	34.25	2.38	26.38	24	1.38	31.75	0.31	104.0	160
26"	**BUP-SDR17-26B**	34.25	2.00	26.38	24	1.38	31.75	0.25	83.0	100
28"	**BUP-SDR9-28B**	36.50	2.60	28.38	28	1.38	34.00	0.31	126.0	200
28"	**BUP-SDR11-28B**	36.50	2.50	28.38	28	1.38	34.00	0.31	116.0	160
28"	**BUP-SDR17-28B**	36.50	2.06	28.38	28	1.38	34.00	0.50	92.0	100
30"	**BUP-SDR9-30B**	38.75	2.68	30.38	28	1.38	36.00	0.31	153.0	200
30"	**BUP-SDR13.5-30B**	38.75	2.50	30.38	28	1.38	36.00	0.31	143.0	128
30"	**BUP-SDR26-30B**	38.75	2.06	30.38	28	1.38	36.00	0.25	104.0	65
32"	**BUP-SDR9-32B**	41.75	2.84	32.38	28	1.63	38.50	0.31	175.0	200
32"	**BUP-SDR13.5-32B**	41.75	2.63	32.38	28	1.63	38.50	0.31	168.0	128
32"	**BUP-SDR26-32B**	41.75	2.06	32.38	28	1.63	38.50	0.50	111.0	65
34"	**BUP-SDR11-34B**	43.75	2.93	34.38	32	1.63	40.50	0.31	191.0	160
34"	**BUP-SDR17-34B**	43.75	2.69	34.38	32	1.63	40.50	0.31	181.0	100
34"	**BUP-SDR26-34B**	43.75	2.14	34.38	32	1.63	40.50	0.31	137.0	60
36"	**BUP-SDR11-36B**	46.00	3.14	36.38	32	1.63	42.75	0.31	225.0	160
36"	**BUP-SDR17-36B**	46.00	2.75	36.38	32	1.63	42.75	0.31	196.0	100
36"	**BUP-SDR32.5-36B**	46.00	2.06	36.38	32	1.63	42.75	0.50	129.0	50
40"	**BUP-SDR13.5-40M**	50.75	3.50	39.75	36	1.63	47.25	0.31	307.0	128
40"	**BUP-SDR19-40M**	50.75	TBA	39.75	36	1.63	47.25	TBA	TBA	89
40" *	**BUP-SDR99-40M**	53.00	2.00	40.00	36	1.63	49.50	0.50	181.0	16
42"	**BUP-SDR13.5-42B**	53.00	3.53	42.38	36	1.63	49.50	0.31	396.0	128
42"	**BUP-SDR21-42B**	53.00	3.00	42.38	36	1.63	49.50	0.31	277.0	80
42"	**BUP-SDR39-42B**	53.00	2.26	42.38	36	1.63	49.50	0.31	253.0	40
42"	**BUP-SDR99-42B**	53.00	2.00	42.38	36	1.63	49.50	0.50	157.0	16
48"	**BUP-SDR17-48B**	59.50	3.82	48.50	44	1.63	56.00	0.25	400.0	100
48"	**BUP-SDR26-48B**	59.50	3.50	48.50	44	1.63	56.00	0.25	332.0	64
48"	**BUP-SDR51-48B**	59.50	2.40	48.50	44	1.63	56.00	0.25	301.0	30
54"	**BUP-SDR19-54B**	66.25	4.10	54.62	44	1.88	62.75	0.19	516.0	89
54"	**BUP-SDR26-54B**	66.25	3.75	54.62	44	1.88	62.75	0.19	464.0	64
54"	**BUP-SDR51-54B**	66.25	2.57	54.62	44	1.88	62.75	0.19	318.0	30
63"/60	**BUP-SDR19-6360B**	73.00	3.15	64.00	52	1.88	69.25	0.20	437.0	64
63"/60	**BUP-SDR51-6360B**	73.00	2.80	64.00	52	1.88	69.25	0.10	277.0	32
63"/66	**BUP-SDR19-6366B**	80.00	4.24	64.00	52	1.88	76.00	0.19	890.0	64
63"/66	**BUP-SDR51-6366B**	80.00	TBA	64.00	52	1.88	76.00	TBA	TBA	32

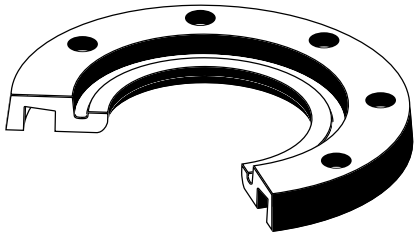
1. Operating pressure on an HDPE stub-end with a safety factor of 2.

* 42" Dimensions with a 40" I.D.

BUPP-DIPS

Back-up Ring in Ductile Iron Pipe Sizes



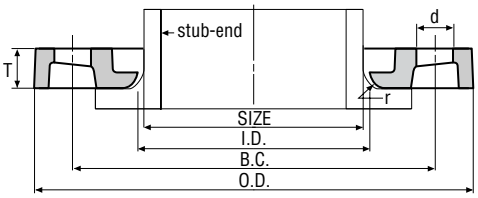


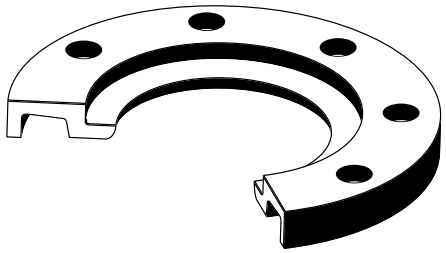
- **Description** Utilizes the patented IPP Deltaflex® flange cross section.
- **Utilization** Backing flange for use on HDPE, sized to mate with cast (ductile) iron pipe systems.
- **Material** Cast in ductile iron A536 (65/45/12) tensile 65,000 psi; yield 45,000 psi; 12% elongation.
- **Dimensions** Bolt circle is ANSI/B16.5 class 150. Mates with ANSI B16.5, B16.1, AWWA C207.
- **Finish** Blue primer, hot dipped galvanized, epoxy coated.

Pipe Diameter	Product Code	Outside Dia. O.D.	Flange Thick. T	Inside Dia. I.D.	Y	Bolt Count N	Bolt Hole B.D.	Bolt Circle B.C.	Radius r	Approx. Weight lbs/pc	HDPE[1] Operating Pressure	Steel[2] Operating Pressure
4"	**DIPS-FM-0400**	9.00	0.94	4.90	0.27	8	0.75	7.50	.44	5.1	275	275
6"	**DIPS-FM-0600**	11.00	1.00	7.00	0.28	8	0.88	9.50	.50	7.0	275	275
8"	**DIPS-FM-0800**	13.50	1.12	9.13	0.30	8	0.88	11.75	.50	10.5	275	275
10"	**DIPS-FM-1000**	16.00	1.19	11.25	0.60	12	1.00	14.25	.50	15.3	275	275
12"	**DIPS-FM-1200**	19.00	1.50	13.37	0.63	12	1.00	17.00	.50	24.4	275	275
14"	**DIPS-FM-1400**	21.00	1.63	15.48	0.70	12	1.13	18.75	.50	36.1	200	275
16"	**DIPS-FM-1600**	23.50	1.88	17.59	0.70	16	1.13	21.25	.50	48.3	200	275
18"	**DIPS-FM-1800**	25.00	1.75	19.70	0.88	16	1.25	22.75	.50	47.9	200	275
20"	**DIPS-FM-2000**	27.50	2.06	21.85	0.48	20	1.25	25.00	.50	60.7	200	275
24"	**DIPS-FM-2400**	32.00	2.13	26.05	0.60	20	1.38	29.50	.50	90.4	200	275

1. Operating pressure on an HDPE stub-end with a safety factor of 2.
2. Operating pressure on a steel stub-end with a safety factor of 1.5.

Metric Flanges ISO/DIN Dimensions



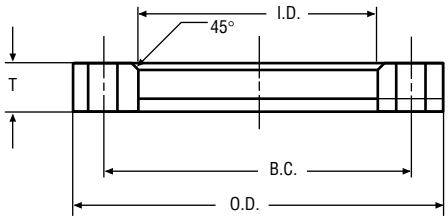


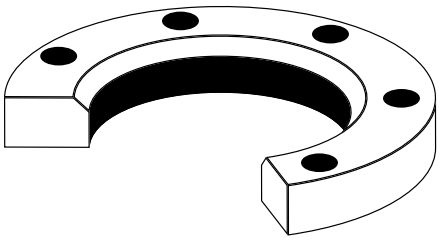
- **Description** Utilizes the patented IPP Deltaflex® flange cross section.
- **Utilization** Backing flange for use on metric, DIN, British standards pipe.
- **Material** Cast in GGG40 ductile iron.
- **Dimensions** Mating dimensions DIN 2501 PN10,16. Operating Pressure PN 16, 10, 6, 4 di ≙ DIN 16963T4, DIN 2673, DIN 2633, 2632 British standards BS4504.
- **Finish** Red oxide primer, hot dipped galvanized, epoxy coated.

DN Flge. Size	DA Pipe O.D.	Product Code	Bolting PN	Flge. I.D. di	Flge. O.D. D	Bolt Circle k	Flge. Thick. b	Dia. Bolt Hole d	Bolt Count n	Metric Bolting M	Radius r	Weight kg	PN bar
40	**50**	**DF2DI 50-10**	10/16	62	150	110	14	18	4	M16	3	1.1	16
50	**63**	**DF2DI 63-10**	10/16	78	165	125	14	18	4	M16	3	1.2	16
65	**75**	**DF2DI 75-10**	10/16	92	185	145	14	18	4	M16	3	1.5	16
80	**90**	**DF2DI 90-10**	10/16	108	200	160	16	18	8	M16	3	1.8	16
100	**110**	**DF2DI 110-10**	10/16	128	220	180	16	18	8	M16	3	2.0	16
100	**125**	**DF2DI 125-10**	10/16	135	220	180	16	18	8	M16	3	1.9	16
125	**140**	**DF2DI 140-10**	10/16	158	250	210	16	18	8	M16	3	2.3	16
150	**160**	**DF2DI 160-10**	10/16	178	285	240	16	22	8	M20	3	2.9	16
150	**180**	**DF2DI 180-10**	10/16	188	285	240	16	22	8	M20	3	2.8	16
200	**200**	**DF2DI 200-10**	10	235	340	295	18	22	8	M20	3	3.9	10
		DF2DI 200-16	16	235	340	295	23	22	12	M20	3	4.4	16
200	**225**	**DF2DI 225-10**	10	238	340	295	18	22	8	M20	3	3.9	10
		DF2DI 225-16	16	238	340	295	23	22	12	M20	3	4.3	16
250	**250**	**DF2DI 250-10**	10	288	395	350	22	22	12	M20	3	5.8	10
		DF2DI 250-16	16	288	405	355	28	26	12	M24	3	7.3	16
250	**280**	**DF2DI 280-10**	10	294	395	350	22	22	12	M20	3	5.6	10
		DF2DI 280-16	16	294	405	355	28	26	12	M24	3	7.2	16
300	**315**	**DF2DI 315-10**	10	338	445	400	26	22	12	M20	3	7.3	10
		DF2DI 315-16	16	338	460	410	34	26	12	M24	3	9.5	16
350	**355**	**DF2DI 355-10**	10	376	505	460	30	22	16	M20	4	12.4	10
		DF2DI 355-16	16	376	520	470	39	26	16	M24	4	15.8	16
400	**400**	**DF2DI 400-10**	10	430	565	515	34	26	16	M24	4	15.6	10
400	**400**	**DF2DI 400-16**	16	430	580	525	43	30	16	M27	4	18.7	16
450	**450**	**DF2DI 450-10/16**	16	485	640	585	28	30	20	M27	6.5	11.2	10
500	**500**	**DF2DI 500-10/16**	16	533	715	650	44	33	20	M30	7	24.0	10
500	**450**	**DF2DI 450-10**	10	517	670	620	42	26	20	M24	6	26.1	10
500	**500**	**DF2DI 500-10**	10	533	670	620	38	26	20	M24	4	22.7	10
600	**560**	**DF2DI 560-10**	10	618	780	725	50	30	20	M27	7	42.1	10
600	**630**	**DF2DI 630-10**	16	645	780	725	40	30	20	M27	4	31.9	10
600	**560**	**DF2DI 560-10/16**	16	633	840	770	59	36	20	M33	8	39.5	10
600	**630**	**DF2DI 630-10/16**	16	645	840	770	55	36	20	M33	8.5	38.5	10
700	**710**	**DF2DI 710-6**	10	740	895	840	45	30	24	M27	5	44.0	6
800	**800**	**DF2DI 800-6**	10	843	1015	950	53	33	24	M30	5	60.5	6
900	**900**	**DF2DI 900-6**	10	947	1115	1050	56	33	28	M30	5	67.2	6
1000	**1000**	**DF2DI 1000-6**	10	1050	1230	1160	62	36	28	M33	5	86.0	6
1200	**1200**	**DF2DI 1200-4**	10	1260	1455	1380	68	39	32	M36	6	122.5	4
1400	**1400**	**DF2DI 1400-4**	10	1436	1675	1590	76	42	36	M39	6	159.4	4
1600	**1600**	**DF2DI 1600-4**	10	1637	1915	1820	92	48	40	M45	6	239.4	4

BU-DI

Conventional Cross Section in Ductile Iron





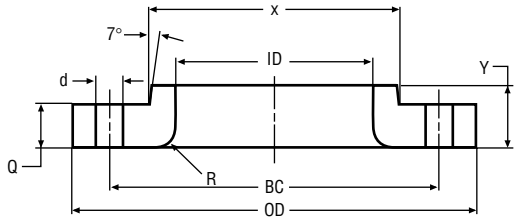
- **Description** A conventional cross section (reduced section modulus) in ductile iron.
- **Utilization** A back-up ring for IPS or AFR connections. Buttweld or integrally flared stub-ends.
- **Material** Cast in ductile iron A536. Tensile strength 80,000 psi, yield 55,000 psi, elongation 6%.
- **Dimensions** Vital dimensions AWWA C207. Mates with ANSI B16.5, B16.47; AWWA C207.
- **Finish** Red oxide primer, hot dipped galvanized.

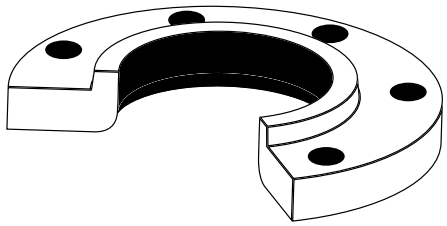
		Outside		Inside Dia. of Flanges For		Bolt	Bolt	Bolt	Approx	HDPE[1]
Pipe Diameter	Product Code	Dia. O.D.	Thick. T	Stub-end I.D.	AFR I.D.	Count N	Hole B.D.	Circle B.C.	Weight Ea.	Operating Pressure
1/2"	**BU-DI-0050**	3.50	0.44	0.91	–	4	0.63	2.38	1.0	275
3/4"	**BU-DI-0075**	3.88	0.50	1.09	–	4	0.63	2.75	1.2	275
1	**BU-DI-0100**	4.25	0.50	1.38	–	4	0.63	3.13	1.4	275
1 1/4"	**BU-DI-0125**	4.63	0.50	1.72	–	4	0.63	3.50	1.7	275
1 1/2"	**BU-DI-0150**	5.00	0.50	1.97	–	4	0.63	3.88	2.0	275
2"	**BU-DI-0200**	6.00	0.50	2.44	2.75	4	0.75	4.75	3.0	275
2 1/2"	**BU-DI-0250**	7.00	0.50	2.94	3.25	4	0.75	5.50	4.0	275
3"	**BU-DI-0300**	7.50	0.50	3.56	4.00	4	0.75	6.00	4.5	275
4"	**BU-DI-0400**	9.00	0.56	4.56	5.00	8	0.75	7.50	6.5	210
5"	**BU-DI-0500**	10.00	0.56	5.63	6.25	8	0.88	8.50	7.0	247
6"	**BU-DI-0600**	11.00	0.63	6.75	7.25	8	0.88	9.50	8.5	210
8"	**BU-DI-0800**	13.50	0.63	8.75	9.44	8	0.88	11.75	12.0	120
10"	**BU-DI-1000**	16.00	0.63	10.88	11.81	12	1.00	14.25	16.0	74
12"	**BU-DI-1200**	19.00	0.75	12.88	13.62	12	1.00	17.00	27.0	69
14"	**BU-DI-1400**	21.00	0.75	14.19	14.81	12	1.13	18.75	32.0	67
16"	**BU-DI-1600**	23.50	0.75	16.19	16.81	16	1.13	21.25	40.0	46
18"	**BU-DI-1800**	25.00	0.88	18.19	18.81	16	1.25	22.75	45.0	53
20"	**BU-DI-2000**	27.50	0.88	20.25	20.88	20	1.25	25.00	53.0	45
24"	**BU-DI-2400**	32.00	1.00	24.25	24.88	20	1.38	29.50	78.0	40
30"	**BU-DI-3000**	38.75	1.00	30.38	–	28	1.38	36.00	112.0	28
36"	**BU-DI-3600**	46.00	1.00	36.50	–	32	1.38	42.75	176.5	26

1.Operating pressure on an HDPE stub-end with a safety factor of 2.

LJ-DI

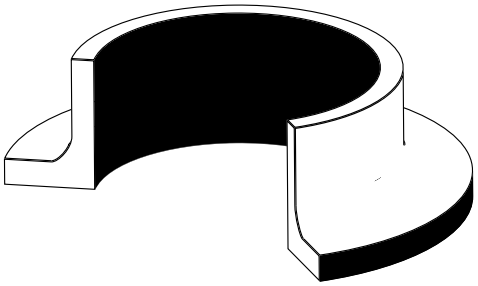
ANSI Lap Joint Flange in Ductile Iron





- **Description** An ANSI B16.5 lap joint cross section.
- **Utilization** A high pressure back-up ring for HDPE flange, adapters and type A, B, C steel stub-ends.
- **Material** Cast in ductile iron A395 heat treated. Tensile strength 60,000 psi; yield 40,000 psi; elongation 18%.
- **Dimensions** Vital dimensions ANSI B16.5. Mates with ANSI B16.5, AWWA C207 systems.
- **Finish** Red oxide primer or hot dipped galvanized.

Pipe Diameter	Product Code	Outside Dia. O.D.	Inside Dia. I.D.	Hub at Base X	Length thru Hub Y	Thick-ness Q	Bolt Circle BC	Bolt Hole Dia d	Number of Holes n	Radius at Bore r	ANSI B16.5 A395 Weight lbs	HDPE Operating Pressure
1.2"	**LJ-DI-0050**	3.50	.90	1.19	0.63	0.44	2.38	0.63	4	0.13	1.0	275
3/4"	**LJ-DI-0075**	3.88	1.11	1.50	0.63	0.50	2.75	0.63	4	0.13	1.5	275
1"	**LJ-DI-0100**	4.25	1.38	1.94	0.69	0.56	3.12	0.63	4	0.13	2.0	275
1 1/2"	**LJ-DI-0150**	5.00	1.97	2.56	0.88	0.69	3.88	0.63	4	0.25	3.0	275
2"	**LJ-DI-0200**	6.00	2.46	3.06	1.00	0.75	4.75	0.75	4	0.31	4.5	275
3"	**LJ-DI-0300**	7.50	3.60	4.25	1.19	0.94	6.00	0.75	4	0.38	8.5	275
4"	**LJ-DI-0400**	9.00	4.60	5.31	1.31	0.94	7.50	0.75	8	0.44	11.5	275
6"	**LJ-DI-0600**	11.00	6.75	7.56	1.56	1.00	9.50	0.88	8	0.50	15.5	275
8"	**LJ-DI-0800**	13.50	8.75	9.69	1.75	1.12	11.75	0.88	8	0.50	26.0	275
10"	**LJ-DI-1000**	16.00	10.92	12.00	1.94	1.19	14.25	1.00	12	0.50	38.5	275
12"	**LJ-DI-1200**	19.00	12.92	14.38	2.19	1.25	17.00	1.00	12	0.50	59.0	275

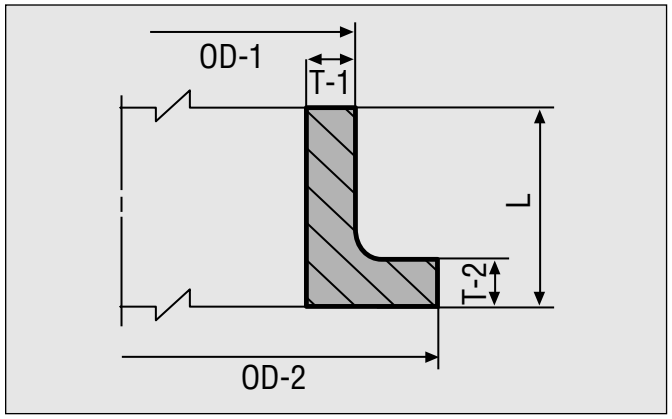


High Density Polyethylene Flange Adapters

Property	Test Method	Unit	Nominal Value
Density	ASTM D 1505	Gm/cm^3	.955
Melt Index	ASTM D 1238 (Condition E)	Gm/10min	.11
ESCR	ASTM D 1693	F_{0_2} Hours	>5000
Flexural Modulus	ASTM D 790	Psi	135,000
Tensile Strength	ASTM D 638	Psi	3,200
HDB@73.4° F	ASTM D 2837	Psi	1,600
UV Stabilizer	ASTM D 1603	%C	>2
Hardness	ASTM D 2240	Shore “D”	65
Tensile Strength @ Yield (Type IV Spec.)	ASTM D 638 (2"/min)	Psi	3,200
Tensile Strength @ Break (Type IV Spec.)	ASTM D 638	Psi	5,000
Elongation @ Break	ASTM D 638	%, minimum	750
Modulus of Elasticity	ASTM D 638	Psi	130,000
Linear Thermal Expansion Coefficient	ASTM D 696	In/in/° F	$1.2x10^{-4}$
Thermal Conductivity	ASTM D 177	BTU-IN/ft^2/hrs/° F	2.7
Brittleness Temperature	ASTM D 746	° F	<-180
Heat Fusion Condition	–	Psi@° F	75@400°

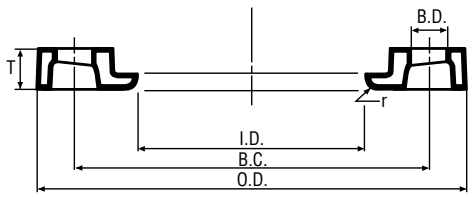
Specifications		
Material Designation	PPI	PE3408
Cell Classification	ASTM D 3350	345434C

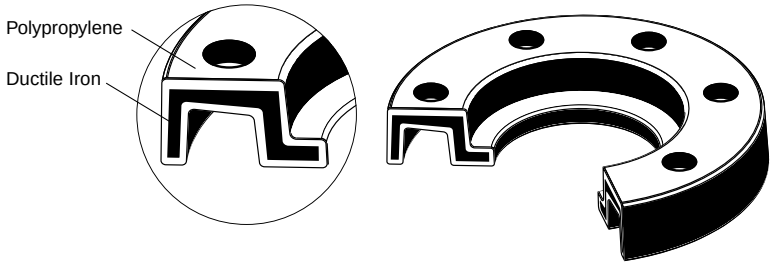
Dimensions (inches) for High Density Polyethylene Flange Adaptors								
Pipe Size (Inch)	**SDR**	**Product Code**	**OD-1**	**T-1**	**L**	**OD-2**	**T-2**	**Weight (Lbs)**
2”	**11**	**PESE-SDR11-02**	2.37	0.22	5.98	4.00	0.40	0.5
2”	**17**	**PESE-SDR17-02**	2.37	0.14	5.98	4.00	0.40	0.5
3”	**11**	**PESE-SDR11-03**	3.50	0.32	5.98	5.00	0.60	1.0
3”	**17**	**PESE-SDR17-03**	3.50	0.20	5.98	5.00	0.60	1.0
4”	**11**	**PESE-SDR11-04**	4.50	0.41	5.98	6.60	0.80	2.0
4”	**17**	**PESE-SDR17-04**	4.50	0.26	5.98	6.60	0.80	1.0
6”	**11**	**PESE-SDR11-06**	6.63	0.60	7.99	8.50	0.80	4.0
6”	**17**	**PESE-SDR17-06**	6.63	0.39	7.99	8.50	0.80	3.0
8”	**11**	**PESE-SDR11-08**	8.63	0.78	9.02	10.60	0.80	7.0
8”	**17**	**PESE-SDR17-08**	8.63	0.51	9.02	10.60	0.80	5.0
10”	**11**	**PESE-SDR11-10**	10.75	0.98	9.02	12.80	1.30	11.0
10”	**17**	**PESE-SDR17-10**	10.75	0.63	9.02	12.80	0.90	8.0
12”	**11**	**PESE-SDR11-12**	12.75	1.16	10.79	15.00	1.50	19.0
12”	**17**	**PESE-SDR17-12**	12.75	0.75	10.79	15.00	1.00	12.0
14”	**11**	**PESE-SDR11-14**	14.00	1.27	11.00	17.50	1.70	25.0
14”	**17**	**PESE-SDR17-14**	14.00	0.82	11.00	17.50	1.10	16.0
16”	**11**	**PESE-SDR11-16**	16.00	1.45	12.00	20.00	1.90	35.0
16”	**17**	**PESE-SDR17-16**	16.00	0.94	12.00	20.00	1.20	23.0
18”	**11**	**PESE-SDR11-18**	18.00	1.64	12.00	21.10	2.10	42.0
18”	**17**	**PESE-SDR17-18**	18.00	1.06	12.00	21.10	1.40	28.0
20”	**11**	**PESE-SDR11-20**	20.00	1.82	12.00	23.50	2.30	53.0
20”	**17**	**PESE-SDR17-20**	20.00	1.18	12.00	23.50	1.50	36.0
22”	**11**	**PESE-SDR11-22**	22.00	2.00	12.00	25.60	2.50	65.0
22”	**17**	**PESE-SDR17-22**	22.00	1.29	12.00	25.60	1.60	43.0
24”	**11**	**PESE-SDR11-24**	24.00	2.18	14.00	27.90	2.90	90.0
24”	**17**	**PESE-SDR17-24**	24.00	1.41	14.00	27.90	1.80	59.0



PPDI

Polypropylene Encapsulated Ductile Iron, ANSI Flanges/Backup Rings for use on HDPE and PP Piping Systems. Pressure Rated with Safety Factors



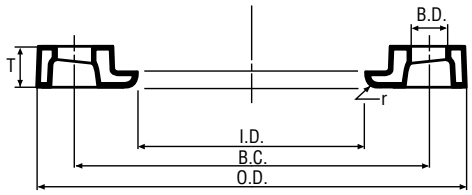


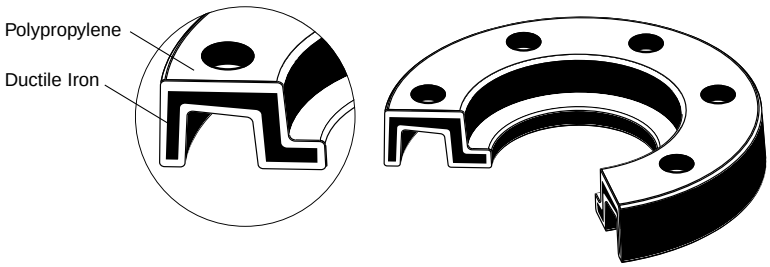
- **Description** A highly corrosion resistant flange for HDPE stub-ends. Full Polypropylene fiberglass reinforced injection molded Deltaflex convoluted flange.
- **Utilization** An economic alternative where corrosion resistance of flanges is advisable.
- **Dimensions** Bolt circles are ANSI B16.5, class 150. Mates with ANSI B16.5, B16.47, AWWA C207.
- **Material** Glass reinforced polypropylene with IPP Deltaflex ductile iron insert (ASTM A536).

Pipe Diameter	Product Code	Outside Dia. O.D.	Flange Thick. T	Inside Dia. I.D.	Bolt Count N	Bolt Hole B.D.	Bolt Circle B.C.	Radius r	Weight lbs/pc	HDPE[1] Operating Pressure
2"	**PPDI-SDR13.5-02**	6.50	0.71	2.46	4	0.75	4.75	0.28	1.5	128
3"	**PPDI-SDR13.5-03**	7.80	0.71	3.60	4	0.75	6.00	0.35	2.0	128
4"	**PPDI-SDR13.5-04**	9.21	0.71	4.60	8	0.75	7.50	0.35	2.5	128
6"	**PPDI-SDR13.5-06**	11.57	0.79	6.75	8	0.87	9.50	0.35	4.0	128
8"	**PPDI-SDR13.5-08**	13.86	1.10	8.75	8	0.87	11.75	0.35	7.5	128
10"	**PPDI-SDR13.5-10**	16.61	1.22	10.92	12	1.02	14.25	0.35	10.5	128
12"	**PPDI-SDR13.5-12**	19.37	1.61	12.92	12	1.02	17.00	0.35	17.5	128
14"	**PPDI-SDR13.5-14**	21.26	1.61	14.38	12	1.14	18.75	0.35	23.0	128
16"	**PPDI-SDR13.5-16**	23.82	1.75	16.19	12	1.14	21.25	0.35	30.0	128
18"	**PPDI-SDR13.5-18**	25.51	1.91	18.38	16	1.26	22.75	0.35	34.0	128
20"	**PPDI-SDR13.5-20**	27.87	2.13	20.38	20	1.26	25.00	0.35	42.0	128
24"	**PPDI-SDR13.5-24**	32.52	2.24	24.38	20	1.38	29.50	0.35	58.5	128
28”	**PPDI-SDR13.5-28**	36.95	2.99	28.39	28	1.38	34.00	0.35	105.0	128
30"	**PPDI-SDR13.5-30**	39.45	3.13	30.38	28	1.38	36.00	0.35	119.0	128
36"	**PPDI-SDR13.5-36**	46.65	3.86	36.38	32	1.61	42.75	0.35	197.0	128

1. Operating pressure on an HDPE stub-end with a safety factor of two.

Polypropylene Encapsulated Ductile Iron, ANSI Flanges/Backup Rings for use on HDPE and PP Piping Systems. Pressure Rated with Safety Factors





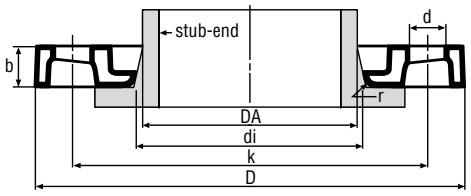
- **Description** A highly corrosion resistant flange for HDPE flange adapters. Full Polypropylene fiberglass reinforced injection molded Deltaflex convoluted flange.
- **Utilization** An economic alternative where corrosion resistance of flanges is advisable.
- **Dimensions** Bolt circles are ANSI B16.5, class 150. Mates with ANSI B16.5, B16.47, AWWA C207.
- **Material** Glass reinforced polypropylene with IPP Deltaflex ductile iron insert (ASTM A536).

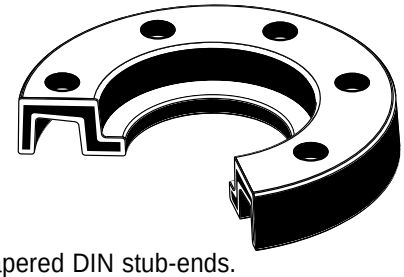
Pipe Diameter	Product Code	Outside Dia. O.D.	Flange Thick. T	Inside Dia. I.D.	Bolt Count N	Bolt Hole B.D.	Bolt Circle B.C.	Radius r	Weight lbs/pc	HDPE[1] Operating Pressure
2"	**PPDI-SDR7-02**	6.46	0.71	2.63	4	0.75	4.75	0.28	1.8	275
3"	**PPDI-SDR7-03**	7.72	0.73	3.75	4	0.75	6.00	0.28	2.4	275
4"	**PPDI-SDR7-04**	9.33	0.98	4.75	8	0.75	7.50	0.35	4.2	275
6"	**PPDI-SDR7-06**	11.69	1.18	7.09	8	0.88	9.50	0.35	7.1	275
8"	**PPDI-SDR7-08**	13.94	1.34	8.88	8	0.88	11.75	0.35	11.6	275
10"	**PPDI-SDR7-10**	16.73	1.52	11.00	12	1.00	14.25	0.35	16.0	275
12"	**PPDI-SDR7-12**	19.57	2.01	13.19	12	1.00	17.00	0.35	28.2	275
14"	**PPDI-SDR7-14**	21.34	2.05	14.38	12	1.13	18.75	0.35	35.7	275
16"	**PPDI-SDR7-16**	23.90	2.44	16.38	16	1.13	21.25	0.35	66.4	275
18"	**PPDI-SDR7-18**	25.51	2.44	18.38	16	1.25	22.75	0.35	60.6	275
20"	**PPDI-SDR7-20**	27.99	2.68	20.38	20	1.25	25.00	0.35	93.5	275
22"	**PPDI-SDR7-22**	30.31	3.19	22.38	20	1.38	27.25	0.35	104.9	275
24”	**PPDI-SDR7-24**	32.52	3.19	24.38	20	1.38	29.50	0.35	142.2	275
28"	**PPDI-SDR7-28**	37.20	3.90	28.38	28	1.38	34.00	0.35	224.4	275
30"	**PPDI-SDR7-30**	39.21	3.90	30.38	28	1.38	36.00	0.35	247.1	275

1. Operating pressure on an HDPE flange adapters with a safety factor of two.

PPDA

Polypropylene Encapsulated Ductile Iron, ANSI Flanges/Backup Rings for use on DIN HDPE and PP Piping Systems. Pressure Rated with Safety Factors





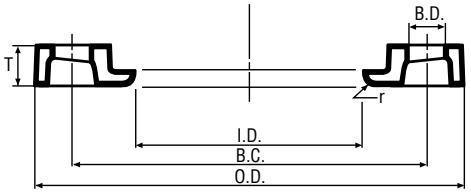
- **Description** A highly corrosion resistant flange to fit metric HDPE pipe and tapered DIN stub-ends. Full polypropylene fiberglass reinforced injection molded encapsulation of an IPP Deltaflex® lightweight convolute metal insert.
- **Utilization** An economic alternative where corrosion resistance of flanges is advisable.
- **Dimensions** Mating to DIN 2501 PN10, 16 bolt circles or British Standards BS4504.
- **Material** Glass reinforced polypropylene with convolute ductile iron insert (GGG40, ASTM A536).

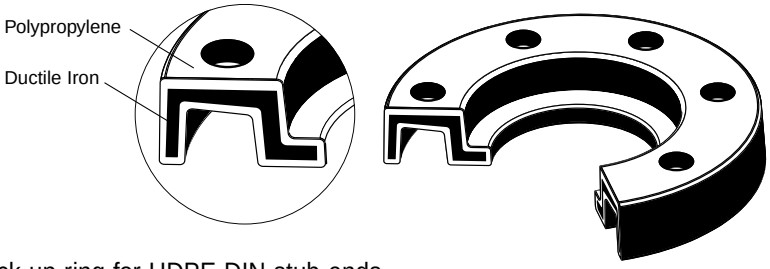
DN Flge. Size	DA Pipe O.D.	Product Code	Bolting PN	Flge. I.D. di	Flge. O.D. D	Bolt Circle k	Flge. Thick. b	Dia. Bolt Hole d	Bolt Count n	Metric Bolting M	Radius r	Weight kg	Oper. Pressure PN bar	Press. psi
40	**50**	**PPDA 50-10\16 ***	10\16	62	156	110	19	18	4	M16	3	0.8	16	230
50	**63**	**PPDA 63-10\16 ***	10\16	78	171	125	20	18	4	M16	3	0.9	16	230
65	**75**	**PPDA 75-10\16 ***	10\16	92	191	145	21	18	4	M16	3	1.1	16	230
80	**90**	**PPDA 90-10\16 ***	10\16	108	206	160	21	18	8	M16	3	1.2	16	230
100	**110**	**PPDA 110-10\16***	10\16	128	226	180	22	18	8	M16	3	1.6	16	230
100	**125**	**PPDA 125-10\16***	10\16	135	226	180	23	18	8	M16	3	1.5	16	230
125	**140**	**PPDA 140-10\16***	10\16	159	261	210	25	18	8	M16	3	1.8	16	230
150	**160**	**PPDA 160-10\16***	10\16	178	296	240	28	22	8	M20	3	2.2	16	230
150	**180**	**PPDA 180-10\16***	10\16	188	296	240	27	22	8	M20	4	2.1	16	230
200	**200**	**PPDA 200-10**	10	235	350	295	25	22	8	M20	3	3.2	10	145
200	**200**	**PPDA 200-10\16***	10	235	350	295	32	22	8	M20	4	3.6	16	230
200	**200**	**PPDA 200-16**	16	235	350	295	32	22	8	M20	4	3.2	16	230
200	**225**	**PPDA 225-10**	10	238	352	295	24	22	8	M20	3	2.9	10	145
200	**225**	**PPDA 225-10\16***	10	238	350	295	31	22	8	M20	4	4.0	16	230
200	**225**	**PPDA 225-16**	16	238	350	295	31	22	12	M20	4	3.2	16	230
250	**250**	**PPDA 250-10**	10	288	407	350	29	22	12	M20	3	4.0	10	145
250	**250**	**PPDA 250-10\16***	10	288	412	350	36	22	12	M20	4	5.2	16	230
250	**250**	**PPDA 250-16**	16	288	420	355	36	26	12	M24	3	5.2	16	230
250	**280**	**PPDA 280-10**	10	294	407	350	26	22	12	M20	3	3.5	10	145
250	**280**	**PPDA 280-10\16***	10	294	412	350	35	22	12	M20	4	5.0	16	230
250	**280**	**PPDA 280-16**	16	294	420	355	35	26	12	M24	3	4.6	16	230
300	**315**	**PPDA 315-10**	10	338	459	400	33	22	12	M20	3	4.9	10	145
300	**315**	**PPDA 315-10\16***	10	338	462	400	42	22	12	M20	4	6.6	16	230
300	**315**	**PPDA 315-16**	16	338	476	410	42	26	12	M24	3	6.7	16	230
350	**355**	**PPDA 355-10**	10	376	520	460	43	22	16	M20	4	8.4	10	145
350	**355**	**PPDA 355-10\16***	10	376	525	460	52	22	16	M20	6	11.0	16	230
350	**355**	**PPDA 355-16**	16	376	538	470	52	26	16	M24	4	11.7	16	230
400	**400**	**PPDA 400-10**	10	430	580	515	45	26	16	M24	4	10.2	10	145
400	**400**	**PPDA 400-10\16***	10	430	586	515	56	26	16	M24	6	15.3	16	230
400	**400**	**PPDA 400-16**	16	430	600	525	56	30	16	M28	4	15.4	16	230
500	**450**	**PPDA 450-10**	10	517	687	620	47	27	20	M24	6	15.3	10	145
500	**500**	**PPDA 500-10**	10	533	687	620	44	27	20	M24	4	14.5	10	145
600	**560**	**PPDA 560-10**	10	618	798	725	55	30	20	M27	7	23.0	10	145
600	**630**	**PPDA 630-10**	10	645	797	725	46	30	24	M27	4	19.2	10	145

Product codes marked with a 10\16* are standard products. Other sizes are available as special orders.
10\16 * refers to a flange with a PN 10 bolt circle and a PN 16 bar pressure rating.
Operating pressures are at a safety factor of two.

PPDI, DIN I.D. - ANSI BOLTING

Polypropylene Encapsulated Ductile Iron, ANSI Flanges/Backup Rings for use on DIN HDPE and PP Piping Systems. Pressure Rated with Safety Factors





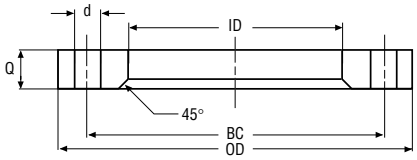
- **Description** A highly corrosion resistant back-up ring for HDPE DIN stub-ends.
  Full polypropylene fiberglass reinforced injection molded Deltaflex® convoluted back-up rings.
- **Utilization** An economic alternative where corrosion resistance of back-up rings is advisable.
- **Dimensions** Inside diameter is for DIN piping. Bolting configuration mates with ANSI B16.5 class 150, B16.47 class 150 series A and AWWA C207.
- **Material** Glass reinforced polypropylene with IPP Deltaflex ductile iron insert (ASTM A536).

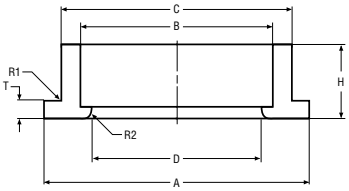
Pipe Dia.	Flange Nom. Size	Product Codes	Outside Dia. O.D.	Flange Thick. T	Inside Dia. I.D.	Bolt Count N	Bolt Hole B.D.		Bolt Circle B.C.		Radius r	Weight lbs/pc		HDPE[1] Operating Pressure
mm	inch		mm	mm	mm		mm	inch	mm	inch	mm	kg/pc	lbs/pc	bar
63	**2”**	**PPDI-SDR7-063**	164	18.0	78	4	19	0.75	120.5	4.75	4	0.8	1.8	16
90	**3”**	**PPDI-SDR7-090**	196	18.5	108	4	19	0.75	152.5	6.00	4	1.0	2.3	16
110	**4”**	**PPDI-SDR7-110**	237	25.0	128	8	19	0.75	190.5	7.50	4	1.8	3.9	16
125	**4”**	**PPDI-SDR7-125**	237	25.0	135	8	19	0.75	190.5	7.50	4	1.8	3.9	16
160	**6”**	**PPDI-SDR7-160**	297	30.0	178	8	22	0.88	241.5	9.50	4	3.2	7.1	16
180	**6”**	**PPDI-SDR7-180**	297	30.00	188	8	22	0.88	241.5	9.50	4	3.2	7.1	16
200	**8”**	**PPDI-SDR7-200**	354	34.0	235	8	22	0.88	298.5	11.75	4	5.1	11.2	16
225	**8”**	**PPDI-SDR7-225**	354	34.0	238	8	22	0.88	298.5	11.75	4	5.1	11.2	16
250	**10”**	**PPDI-SDR7-250**	425	38.5	288	12	26	1.00	362.0	14.25	4	6.9	15.2	16
280	**10”**	**PPDI-SDR7-280**	425	38.5	294	12	26	1.00	362.0	14.25	4	6.9	15.2	16
315	**12”**	**PPDI-SDR7-315**	497	51.0	338	12	26	1.00	432.0	17.00	6	12.8	28.2	16
355	**14”**	**PPDI-SDR7-355**	542	52.0	376	12	29	1.13	476.5	18.75	6	16.0	35.3	16
400	**16”**	**PPDI-SDR7-400**	607	62.0	430	16	29	1.13	540.0	21.25	6	29.5	65.0	16
450	**18”**	**PPDI-SDR7-450**	648	62.0	517	16	32	1.25	578.0	22.75	6	23.5	51.8	16
500	**20”**	**PPDI-SDR7-500**	711	68.0	530	20	32	1.25	635.0	25.00	6	41.3	91.0	16
560	**22”**	**PPDI-SDR7-560**	770	81.0	618	20	35	1.38	692.0	27.25	6	42.7	94.1	16
630	**24”**	**PPDI-SDR7-630**	826	81.0	645	20	35	1.38	749.5	29.50	6	61.6	135.8	16
710	**28”**	**PPDI-SDR7-710**	945	99.0	737	28	35	1.38	863.5	34.00	6	99.3	218.9	16

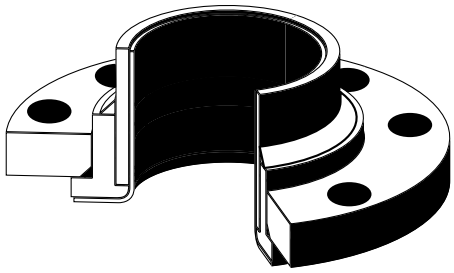
1. Operating pressure on an HDPE stub-end with a safety factor of two.

2. IPP recommends washers be used for bolting.

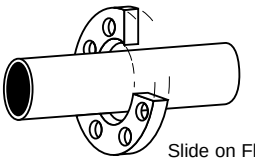
Plastic Lined Pipe System

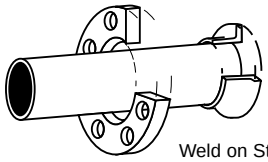


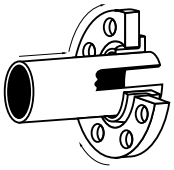




- **Description** A socket stub-end and a rotating back up flange system for fabricating plastic lined steel pipe. Available in either a threaded socket stub-end or a slip-on socket stub-end for welded construction.
- **Utilization** Eliminates expensive flaring equipment. Rotating back up flange allows easy bolt hole alignment in fit up.
- **Dimensions** Standard flanges are 150# ANSI B16.5 bolt circles, mates with ANSI, AWWA. 300# class flanges available.
- **Material** ASTM A105 for stub-end; A395 and A105 for flanges. Stainless steel sockets and flanges are available.


Slide on Flange


Weld on Stub-end


Fit up

Just cut and prepare pipe and plastic liner. Slip flange over the pipe end. Thread or weld the stub-end on the pipe. Install the plastic liner and flare. Bolt the system up. You're finished.

Slip-On Socket Stub-end Dimensions

Pipe Size	IPP Product Code	A	D	C	B	H	T	L	R1	R2	ASTM A105 Slip-on lbs	Operating Pressure
1"	**SOC SE 0100**	2.00	1.09	1.73	1.36	1.06	0.18	0.25	0.06	0.25	0.3	275
1 1/2"	**SOC SE 0150**	2.88	1.66	2.35	1.95	1.19	0.20	0.25	0.09	0.25	0.6	275
2"	**SOC SE 0200**	3.63	2.13	2.88	2.44	1.31	0.23	0.25	0.13	0.25	1.0	275
3"	**SOC SE 0300**	5.00	3.13	4.17	3.57	1.50	0.30	0.25	0.13	0.25	2.2	275
4"	**SOC SE 0400**	6.19	4.10	5.30	4.57	1.62	0.34	0.25	0.13	0.25	3.6	275
6"	**SOC SE 0600**	8.50	6.16	7.52	6.72	1.99	0.43	0.25	0.13	0.25	6.9	275
8"	**SOC SE 0800**	10.63	8.08	9.62	8.72	2.25	0.50	0.25	0.20	0.25	11.0	275
10"	**SOC SE 1000**	12.75	10.14	11.79	10.88	1.94	0.50	0.38	0.25	0.37	12.8	275
12"	**SOC SE 1200**	15.00	12.25	13.79	12.88	2.19	0.50	0.38	0.25	0.37	16.7	275

* **Back Up Flange Dimensions: Modified Bore and Hub**

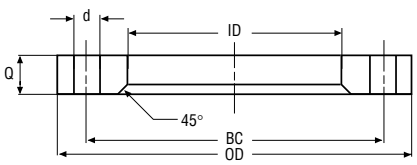
Pipe Dia.	IPP Product Codes Ductile Iron, A395	Forged Steel, A105	O.D.	I.D.	Q	R	B.C.	d	n	ASTM A395 Modified lbs	ASTM A105 Modified lbs	Operating Pressure
1"	**LJ-DI-0100 MB**	**BU/SO FG 0100ST**	4.25	1.79	.56	0.07	3.12	.62	4	1.4	1.9	275
1 1/2"	**LJ-DI-0150 MB**	**BU/SO FG 0150ST**	5.00	2.43	.69	0.09	3.88	.62	4	2.4	2.9	275
2"	**LJ-DI-0200 MB**	**BU/SO FG 0200ST**	6.00	2.95	.75	0.13	4.75	.75	4	3.7	4.7	275
3"	**LJ-DI-0300 MB**	**BU/SO FG 0300ST**	7.50	4.24	.94	0.13	6.00	.75	4	6.8	7.2	275
4"	**LJ-DI-0400 MB**	**BU/SO FG 0400ST**	9.00	5.39	.94	0.13	7.50	.75	8	9.1	9.9	275
6"	**LJ-DI-0600 MB**	**BU/SO FG 0600ST**	11.00	7.61	1.00	0.13	9.50	.87	8	11.6	13.3	275
8"	**LJ-DI-0800 MB**	**BU/SO FG 0800ST**	13.50	9.69	1.12	0.20	11.75	.87	8	18.7	20.3	275
10"	**LJ-DI-1000 MB**	**BU/SO FG 1000ST**	16.00	11.92	1.19	0.25	14.25	1.00	12	25.9	27.2	275
12"	**LJ-DI-1200 MB**	**BU/SO FG 1200ST**	19.00	13.92	1.25	0.25	17.00	1.00	12	41.7	43.5	275

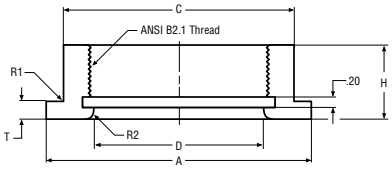
ANSI B16.5 style available in ASTM A395 ductile iron and ASTM A105 forged steel

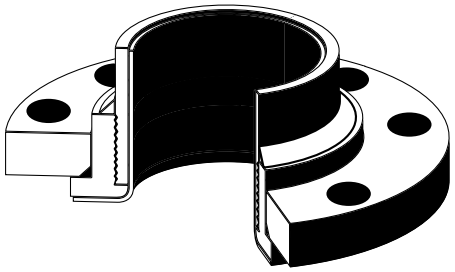
Thread-on Field Flare System

Socket Type

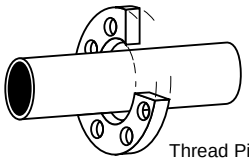
Plastic Lined Pipe System



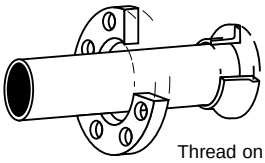




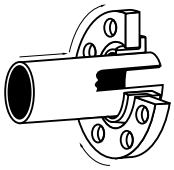
- **Description** A socket stub-end and a rotating back up flange system for fabricating plastic lined steel pipe. Available in either a threaded socket stub-end or a slip-on socket stub-end for welded construction.
- **Utilization** Eliminates expensive flaring equipment. Rotating back up flange allows easy bolt hole alignment in fit up.
- **Dimensions** Standard flanges are 150# ANSI B16.5 bolt circles, mates with ANSI, AWWA. 300# class flanges are available.
- **Material** ASTM A105 for stub-end; ASTM A395 and A105 for flanges. Stainless steel sockets and flanges are available.



Thread Pipe and Slide on Flange



Thread on Stub-end



Fit up

Just cut and prepare pipe and plastic liner. Slip flange over the pipe end. Thread or weld the stub-end on the pipe. Install the plastic liner and flare. Bolt the system up. You're finished.

Threaded Socket Stub-End Dimensions

Pipe Size	IPP Product Code	A	D	C	H	T	L	R1	R2	ASTM A105 Threaded lbs	Operating Pressure
1"	**TH SE 0100**	2.00	1.09	1.73	1.06	0.18	0.25	0.06	0.25	0.4	275
1 1/2"	**TH SE 0150**	2.88	1.66	2.35	1.19	0.20	0.25	0.09	0.25	0.8	275
2"	**TH SE 0200**	3.63	2.13	2.88	1.31	0.23	0.25	0.13	0.25	1.2	275
3"	**TH SE 0300**	5.00	3.14	4.17	1.50	0.30	0.25	0.13	0.25	2.6	275
4"	**TH SE 0400**	6.19	4.10	5.30	1.62	0.34	0.25	0.13	0.25	4.2	275
6"	**TH SE 0600**	8.50	6.16	7.52	1.99	0.43	0.25	0.13	0.25	8.4	275
8"	**TH SE 0800**	10.63	8.08	9.62	2.25	0.50	0.25	0.20	0.25	13.5	275

Back Up Flange Dimensions: Modified Bore and Hub*

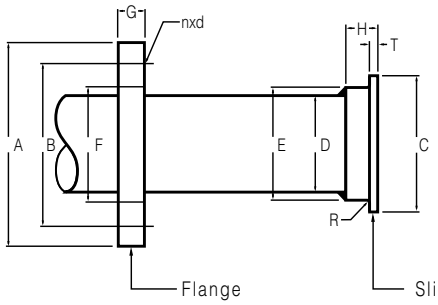
Pipe Dia.	IPP Product Codes Ductile Iron, A395	Forged Steel, A105	O.D.	I.D.	Q	R	B.C.	d	n	ASTM A395 Modified lbs	ASTM A105 Modified lbs	Operating Pressure
1"	**LJ-DI-0100 MB**	**BU/SO FG 0100ST**	4.25	1.79	.56	0.07	3.12	.63	4	1.4	1.9	275
1 1/2"	**LJ-DI-0150 MB**	**BU/SO FG 0150ST**	5.00	2.43	.69	0.09	3.88	.63	4	2.4	2.9	275
2"	**LJ-DI-0200 MB**	**BU/SO FG 0200ST**	6.00	2.95	.75	0.13	4.75	.75	4	3.7	4.7	275
3"	**LJ-DI-0300 MB**	**BU/SO FG 0300ST**	7.50	4.24	.94	0.13	6.00	.75	4	6.8	7.2	275
4"	**LJ-DI-0400 MB**	**BU/SO FG 0400ST**	9.00	5.39	.94	0.13	7.50	.75	8	9.1	9.9	275
6"	**LJ-DI-0600 MB**	**BU/SO FG 0600ST**	11.00	7.61	1.00	0.13	9.50	.88	8	11.6	13.3	275
8"	**LJ-DI-0800 MB**	**BU/SO FG 0800ST**	13.50	9.69	1.12	0.20	11.75	.88	8	18.7	20.3	275

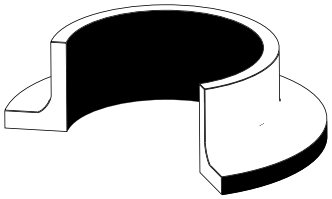
ANSI B16.5 style available in ASTM A395 ductile iron and ASTM A105 forged steelANSI B16.5 style available in ASTM A395 ductile iron and ASTM A105 forged steel

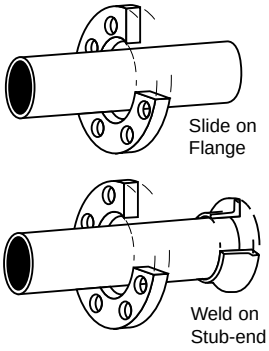
Weld-On Duoflange System

Slip-on Type

Slip-On Stub-End With Flange







- **Description** Standard slip-on stub-end in carbon steel with backing flange.
- **Utilization** Two-piece system for quick installation to 275 psi.
  Meets section VIII, division 1 ASME pressure vessel code.
- **Material** Two flanges available, ductile iron A395 (60/40/18), A105 forged steel.
- **Dimensions** Completely interchangeable with an ANSI B16.5 class 150 system.
- **Installation** No special equipment needed for installation.
  Reduces pipe wall stress compared to ANSI B16.5 or AWWAC207.
- **Finish** Flange is black primer, stub-end is red primer.

Slip-on Stub-End SOSE

Pipe Diameter	IPP Product Code	C	D	E	H	T	R	Flange BUSO Weight (lbs.)	Stub-End Weight (lbs.)	Total Weight (lbs.)	Operating Pressure
1"	SOSE 0100	2.00	1.36	1.73	.69	.18	.06	1.5	.5	2.0	275
1 1/2"	SOSE 0150	2.88	1.95	2.35	.88	.20	.09	2.5	.5	3.0	275
2"	SOSE 0200	3.63	2.44	2.88	1.00	.23	.13	4.0	1.0	5.0	275
2 1/2"	SOSE 0250	4.13	2.94	3.52	1.13	.29	.13	6.5	1.5	8.0	275
3"	SOSE 0300	5.00	3.57	4.17	1.19	.30	.13	7.5	2.0	9.5	275
4"	SOSE 0400	6.19	4.57	5.30	1.31	.34	.13	10.0	3.0	13.0	275
5"	SOSE 0500	7.31	5.66	6.40	1.44	.37	.13	11.0	4.0	15.0	275
6"	SOSE 0600	8.50	6.72	7.52	1.56	.43	.13	12.5	5.5	18.0	275
8"	SOSE 0800	10.63	8.72	9.62	1.75	.44	.20	20.0	8.5	28.5	275
10"	SOSE 1000	12.75	10.88	11.79	1.94	.453	.25	26.0	11.5	37.5	275
12"	SOSE 1200	15.00	12.88	13.79	2.19	.453	.25	42.0	15.5	57.5	275
14"	SOSE 1400	16.25	14.14	15.16	2.25	.53	.25	60.5	19.5	80.0	275
16"	SOSE 1600	18.50	16.16	17.16	2.50	.53	.25	74.5	24.5	99.0	275
18"	SOSE 1800	21.00	18.18	19.24	2.69	.53	.25	78.0	32.5	110.5	275
20"	SOSE 2000	23.00	20.20	21.26	2.88	.73	.25	100.0	41.0	141.0	275
24"	SOSE 2400	27.25	24.25	25.31	3.25	.73	.50	141.0	56.0	197.0	275

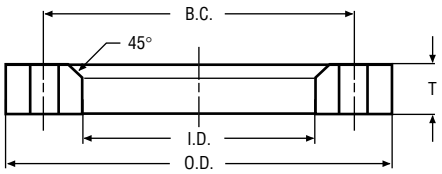
Flange Modified Bore

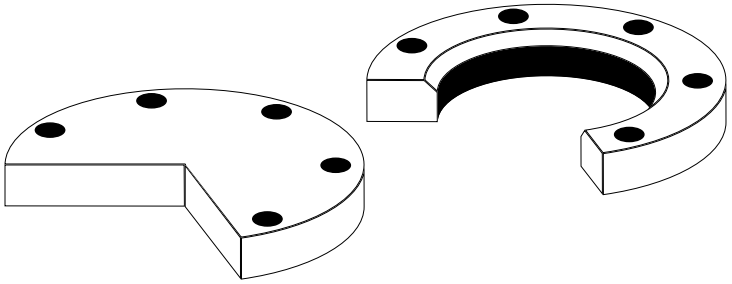
Pipe Dia.	IPP Product Codes Ductile Iron, A395	Forged Steel, A105	A	F	G	B	nxd	ASTM A395 Modified lbs	ASTM A105 Modified lbs	Operating Pressure
1"	LJ-DI-0100 MB	BU/SO FG 0100ST	4.25	1.79	.56	3.12	4x.63	1.5	1.5	275
1 1/2"	LJ-DI-0150 MB	BU/SO FG 0150ST	5.00	2.43	.69	3.88	4x.63	2.5	3.0	275
2"	LJ-DI-0200 MB	BU/SO FG 0200ST	6.00	2.95	.75	4.75	4x.75	4.0	4.5	275
2 1/2"		BU/SO FG 0250ST	7.00	3.61	.88	5.50	4x.75	–	6.5	275
3"	LJ-DI-0300 MB	BU/SO FG 0300ST	7.50	4.24	.94	6.00	4x.75	7.0	7.5	275
4"	LJ-DI-0400 MB	BU/SO FG 0400ST	9.00	5.39	.94	7.50	8x.75	9.5	10.0	275
5"		BU/SO FG 0500ST	10.00	6.53	.94	8.50	8x.88	–	11.0	275
6"	LJ-DI-0600 MB	BU/SO FG 0600ST	11.00	7.61	1.00	9.50	8x.88	12.0	12.5	275
8"	LJ-DI-0800 MB	BU/SO FG 0800ST	13.50	9.69	1.12	11.75	8x.88	19.0	20.0	275
10"	LJ-DI-1000 MB	BU/SO FG 1000ST	16.00	11.92	1.19	14.25	12x1.00	26.0	26.0	275
12"	LJ-DI-1200 MB	BU/SO FG 1200ST	19.00	13.92	1.25	17.00	12x1.00	42.0	42.0	275
14"		BU/SO FG 1400ST	21.00	15.29	1.38	18.75	12x1.13	–	60.5	275
16"		BU/SO FG 1600ST	23.50	17.29	1.44	21.25	16x1.13	–	74.5	275
18"		BU/SO FG 1800ST	25.00	19.37	1.56	22.75	16x1.25	–	78.0	275
20"		BU/SO FG 2000ST	27.50	21.39	1.69	25.00	20x1.25	–	100.0	275
24"		BU/SO FG 2400ST	32.00	25.44	1.88	29.50	20x1.25	–	141.0	275

*Weight for the BUSO and SOSE combination.

PS-BUPP / BPS

PS-BUPP—Chamfered Plate Steel for HDPE
BPS—Blind Plate Steel





- **Description** An AWWA C207 cross section, chamfered in plate steel. Blind to AWWA C207-86[2], table 1.
- **Utilization** A low pressure back-up ring and blind for HDPE. Ring has 45° chamfer or radius.
- **Material** A36 plate steel manufacture.
- **Dimensions** Bolt circle is ANSI B16.5 class 150. Mates with ANSI B16.5, B16.47; AWWA C207.
- **Finish** Red oxide primer, hot dipped galvanized.

Pipe Diameter	Product Codes Flanges	Blinds	Outside Dia. O.D.	Flange Thick. T	Inside Dia. I.D.	Bolt Count N	Bolt Hole B.D.	Bolt Circle B.C.	Weights Flange	Blind	HDPE[1] Operating Pressure	PS-BURP BPS
1 1/2"*	**PS-BUPP 0150**	**BPS 0150 1-D**	5.00	0.63	1.97	4	0.63	3.88	2.5	3.5	275	275
2"*	**PS-BUPP 0200**	**BPS 0200 1-D**	6.00	0.63	2.44	4	0.75	4.75	4.5	5.5	275	275
2 1/2"*	**PS-BUPP 0250**	**BPS 0250 1-D**	7.00	0.63	3.25	4	0.75	5.50	5.0	7.5	275	275
3"*	**PS-BUPP 0300**	**BPS 0300 1-D**	7.50	0.63	3.57	4	0.75	6.00	6.5	8.5	275	275
4"	**PS-BUPP 0400**	**BPS 0400 1-D**	9.00	0.63	4.57	8	0.75	7.50	8.5	12.0	239	275
5"	**PS-BUPP 0500**	**BPS 0500 1-D**	10.00	0.63	5.66	8	0.88	8.50	10.0	15.0	247	275
6"	**PS-BUPP 0600**	**BPS 0600 1-D**	11.00	0.69	6.72	8	0.88	9.50	11.0	18.0	227	275
8"	**PS-BUPP 0800**	**BPS 0800 1-D**	13.50	0.69	8.72	8	0.88	11.75	16.0	27.5	117	188
10"	**PS-BUPP 1000**	**BPS 1000 1-D**	16.00	0.69	10.88	12	1.00	14.25	20.0	38.5	68	126
12"	**PS-BUPP 1200**	**BPS 1200 1-D**	19.00	0.81	12.88	12	1.00	17.00	33.0	63.5	60	117
14"	**PS-BUPP 1400**	**BPS 1400 1-D**	21.00	0.94	14.19	12	1.13	18.75	47.0	89.0	77	140
16"	**PS-BUPP 1600**	**BPS 1600 1-D**	23.50	1.00	16.19	16	1.13	21.25	60.0	110.5	63	123
18"	**PS-BUPP 1800**	**BPS 1800 1-D**	25.00	1.06	18.19	16	1.25	22.75	63.0	141.0	60	117
20"	**PS-BUPP 2000**	**BPS 2000 1-D**	27.50	1.13	20.19	20	1.25	25.00	79.5	181.5	56	111
22"	**PS-BUPP 2200**	**BPS 2200 1-D**	29.50	1.19	22.19	20	1.38	27.25	89.0	213.0	50	104
24"	**PS-BUPP 2400**	**BPS 2400 1-D**	32.00	1.25	24.19	20	1.38	29.50	111.5	275.0	49	99
26”	**PS-BUPP 2600**	**BPS 2600 1-D**	34.25	1.31	26.38	24	1.38	31.75	128.0	334.0	40	90
28"	**PS-BUPP 2800**	**BPS 2800 1-D**	36.50	1.31	28.25	28	1.38	34.00	140.0	370.0	38	83
30"	**PS-BUPP 3000**	**BPS 3000 1-D**	38.75	1.38	30.25	28	1.38	36.00	165.0	445.0	39	80
32"	**PS-BUPP 3200**	**BPS 3200 1-D**	41.75	1.50	32.25	28	1.63	38.50	211.0	588.0	41	83
36"	**PS-BUPP 3600**	**BPS 3600 1-D**	46.00	1.63	36.19	32	1.63	42.75	261.0	735.0	39	80
40"	**PS-BUPP 4000**	**BPS 4000 1-D**	50.75	1.63	40.25	36	1.63	47.25	380.0		31	65
42"	**PS-BUPP 4200**	**BPS 4200 1-D**	53.00	1.75	42.25	36	1.63	49.50	408.0	1085.0	33	68
48"	**PS-BUPP 4800**	**BPS 4800 1-D**	59.50	1.75	48.25	44	1.63	56.00	483.0	1369.0	24	52
54"	**PS-BUPP 5400**	**BPS 5400 1-D**	66.25	2.13	54.25	44	1.88	62.75	702.0		27	62
60"	**PS-BUPP 6000**	**BPS 6000 1-D**	73.00	2.25	60.25	52	1.88	69.25				

*Not in AWWA specification.

1. Operating pressure on an HDPE stub-end with a safety factor of 2.
2. The AWWA C207-94 table 7 blind flange specification differs. Please note that the above blind is to AWWA C207-86. This impacts the pressure rating.

IPP Deltaflex® Flange Bolt Tightening Procedures

IPP recommends the following procedures to ensure a reliable and tight IPP Deltaflex® flange joint.

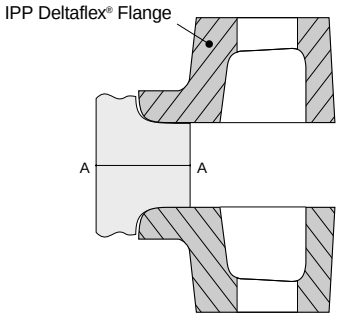


FIGURE 1: HDPE STUB-END

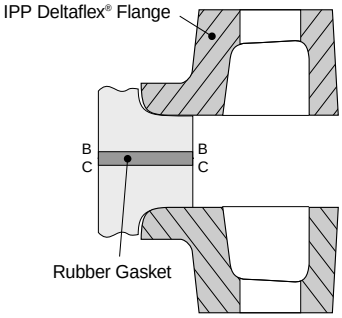


FIGURE 2: STEEL STUB-END

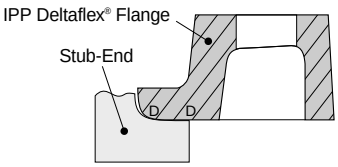


FIGURE 3

Alignment

I. The sealing faces of the two stub-ends in a joint should contact each other or in the case of rubber gasketed joint be parallel to each other all around the circumference and in full contact (see lines A–A, B–B, C–C in Fig. 1 and 2).

II. The IPP Deltaflex® flange face D–D (see Fig. 3). should be in full contact all around the circumference with the upper face of the stub-end to avoid fulcrum effect which will lead to leaking and even breaking of the flange itself while torquing the bolts.

Bolt Tightening

1. Install all the bolts and nuts finger tight, ensuring at all times that the alignment conforms to figures 1, 2, and 3.
2. As the first torquing step, tighten the bolts in a crisscross sequence as shown in Fig. 4. Using a torque wrench with 20% of the final torque listed in the table on the other side of this sheet, taking care that points (I) and (II) are satisfied at all times.
3. In the four remaining steps, repeat step two four times, each time increasing the torque by 20% of the final value.
4. After reaching the final torque, use rotational tightening until all bolts are stable at the final torque value (in general two complete times around is required).

Always use the crisscross pattern!

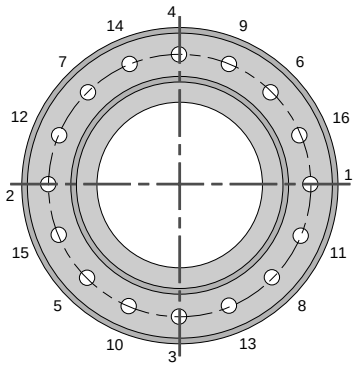


FIG. 4: TIGHTENING SEQUENCE

Caution! Do not use this procedure to align and/or pull the joint together.

IPP Deltaflex® Flange Performance on High Density Polyethylene Stub-ends

Improved Piping Products (IPP) markets a patented-pipe flange under the trade name IPP Deltaflex®. The IPP Deltaflex® flange engineered principles have been incorporated into a unique line of modern high performance flange products. IPP Deltaflex® flanges and back-up rings reduce the cost and weight of a flange without reducing it's pressure performance rating. Three critical factors have influenced the growth and acceptance of the IPP Deltaflex® designed flanges or back-up rings in the piping industry.

- National standards for flanges such as ANSI B16.5 and AWWA C207 were developed many years ago. This was long before the sophisticated computer analytical tools available today, which can be utilized to design flanges. As a result, IPP has shown that the standard flanges called out were either over designed in the case of ANSI or not applicable for modern piping materials such as thermoplastics as is the case for AWWA.
- Historically engineers have been under the impression that the only method to reduce the cost of standard flanges was to make them thinner. As a result flange sealing performance has suffered.
- Standard back-up flanges utilized on high density polyethylene (HDPE) piping stub-end applications were assumed to safely perform at the stated AWWA pressure ratings. IPP research has shown that the AWWA piping industry standards are not applicable to HDPE pipe.

THERE EXIST NO RELIABLE FLANGE STANDARDS FOR THE THERMOPLASTIC PIPING INDUSTRY.

The American Water Works flange standard ratings for class 150 flanges, AWWA C-207 Table 2 Class D (formerly known as the 1-D, are based upon how flanges behave when welded onto steel pipe. When bolted together, the opposing forces neutralize each other via the full faced gasket and there is a marked absence of deflection. This creates a stable joint and assures a safety factor of 2.

On HDPE applications, the free-floating rings are

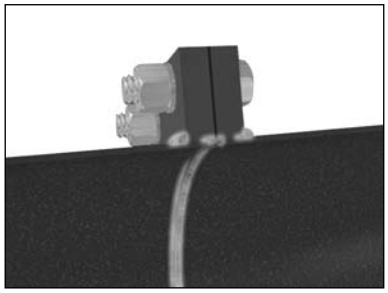


FIGURE 1

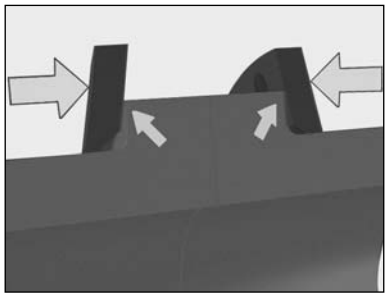


FIGURE 2

able to uplift at the pipe wall. They cantilever and rotate at the edge of the flange adapter, creating a rotational force in an axial direction around the edge of the adapter. This creates stress levels at approximately twice the magnitude of a welded 2-D flange, which exceeds the yield point of the flange material.

Unknowingly, many design engineers have specified the flanges in AWWA C-207 on HDPE piping applications thinking the stated pressure ratings were applicable.

IPP has used Finite Element Analysis to evaluate each and every flange shown on AWWA C-207 Table 2 Class D and Table 4 Class E up to 63" (see page 10), and has concluded that, "C-207 is misused in specifying flanges for HDPE piping applications at the stated pressure ratings, if a traditional safety factor of two is desired, as it is for steel pipe applications. IPP recommends that the pressure ratings in AWWA C-207 not be used for HDPE.

IPP employs sophisticated engineering computer software in order to design its products. Finite Element Analysis (FEA) is used to determine primary levels of

hoop, axial, radial, shear and von Mises stresses. This design tool is recognized for accurate stress analysis and allows for results that are verifiable and reproducible. FEA represents the ultimate in structural analysis for the most sophisticated systems to insure long life and safe operation.

Typically, an engineer strives to design a system that fits the clients needs and is functional, safe and cost effective. As you can see, C-207 flanges will not accomodate all of these criteria. The misapplication of C-207 and the pressure of market forces has caused thinner and thinner flanges to be selected, leading to systems that are held together by strain hardened materials operating at stress levels between yield and tensile break points. The reduced section modulus of these flanges increases the potential for accelerated stress corrosion and ultimate joint failure.

There is a way to reduce the weight and cost of flanges while maintaining safety. Improved Piping Products has patented a unique design trade named DELTAFLEX. It is the modern high performance backing ring for HDPE piping systems because the total mass of the flange, compared to a 2-D flange, is reduced by 30 percent or more and redistributed in a patented configuration that outperforms the 2-D flange.

Note the unique cross sectional design and the manner in which it seats to the HDPE flange adapter and mates with its counterpart. The unit is lightweight, easy to manipulate and install, and incorporates the following important features:

- The I-beam principle for weight reduction.
- Redistribution of mass to the critical load bearing areas for maximum strength and reduction in the joint.
- The Belleville washer principle is utilized for storing energy in the bolts, eliminating the need for retorqueing.
- Better corrosion resistance due to the DELTA FLEX being made of ductile iron as opposed to the 2-D which is made of carbon steel.

In order to make the backing ring selection process less confusing, IPP has designed its products in conjuction with the most commonly used SDR pipes in the industry. Our standard lines include SDR7 in sizes 1/2" through 16" and SDR11 in sizes 2"-54" with many more to choose from, and all are designed with a safety factor of 2.

What if IPP doesn't have a backing ring with the exact SDR rating as that of the pipe being specified? A simple calculation provides the answer. For purpose of illustration, let's assume 12" SDR 9 pipe has been specified, but IPP can only offer SDR11 or SDR7 backing rings in this size. You can choose to use the SDR11 backing ring, however, the safety factor will be less than 2. The calculation for determining the safety factor is simple. Take the pressure rating of the backing ring, in this case 160 psi, and multiply it by its safety factor of 2 (320). Divide 320 by the operating pressure or SDR of the specified pipe, 200 psi, yields a safety factor of 1.6. Using SDR7 backing rings would yield an ample safety factor of 2.67 (267*2/200=2.67). If you were to use the AWWA C207 Class D flange with an actual rating of 60 psi, you would yield a safety factor of 0.6. Now you can make a decision about which safety factor is more appropriate for your application. Choosing the proper safety factor will eliminate joint failure, leakage and the need for bolt retorqueing.

IPP DELTAFLEX backing rings have gained acceptance into a wide segment of the overall piping market and are being used in the following applications:

- Water and Waste Water
- Gas
- Mining
- Landfills
- Shipbuilding (NASSCO Approved for U.S. NavyCoast Guard - Fast Deployment Fleet)
- Factory Mutual
- And many more

One look at the list of customers and projects IPP has

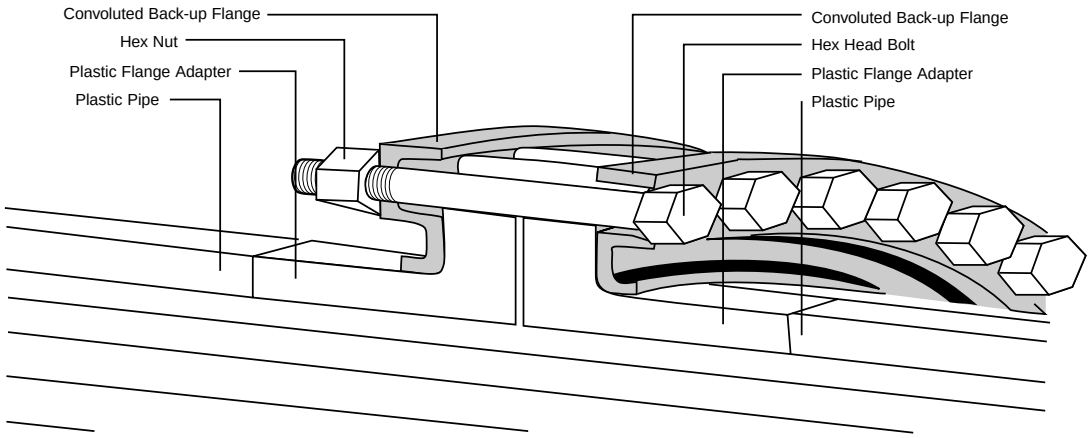


FIGURE 3

supplied will show that DELTAFLEX is recognized worldwide as the preferred backing ring for use on HDPE Pipe (Show list of projects).

Thank you for taking the time to learn about DELTAFLEX and its benefits when used in conjuntion with HDPE piping systems. Millions of our backing rings are in use worldwide. Including DELTAFLEX in your master specification as the preferred backing ring will ensure safety and peace of mind while helping to keep you within budget.

IPP Deltaflex® Flange Performance on Steel Stub-ends

Improved Piping Products (IPP) markets a patented engineered cross section flange for piping under the trade name IPP Deltaflex® flange. The IPP Deltaflex® flange engineered principles have been incorporated into a unique line of modern high performance flange products. IPP Deltaflex® flanges and back-up rings reduce the cost and weight of a flange without reducing it's pressure performance rating. Three critical factors have influenced the growth and acceptance of the IPP Deltaflex® designed flanges in the piping industry.

- National standards for flanges such as ANSI B16.5 and AWWA C207 were developed many years ago. This was long before the sophisticated computer analytical tools available today, which can be utilized to design flanges. As a result IPP has shown that the standard flanges called out were either over designed in the case of ANSI or not applicable for modern piping materials such as thermoplastics as is the case for AWWA.
- Historically engineers have been under the impression that the only method to reduce the cost of standard flanges was to make them thinner and thinner. As a result flange pressure and sealing performance has suffered, especially in the stainless steel industry.

The design problems listed above and their solutions utilizing IPP Deltaflex® flange engineering methods are the basis of the discussion that follows.

The IPP Deltaflex® back-up flange offered by Improved Piping Products, Inc. has been popular with piping system designers and fabricators for several reasons. It is lighter in weight (about 50% of the weight of conventional flanges) and therefore less expensive. In addition, it is easier to handle in the field. The reduced cost of a two piece stub-end back-up ring design instead of the conventional weldneck flange also eliminates the field hassle of flange alignment or "two holing" for about the same cost as the weldneck. Now, a sophisticated engineering analysis has shown that there are also strong structural engineering preferences for this design with its reduced stress level, especially when thermal stresses or corrosive conditions exist that could lead to stress corrosion or cracking, either from within or from ambient environments.

The IPP Deltaflex® pipe flange design is shown in Figure 1. Note the reduced cross section. The unique geometry provides a structure that is lighter in weight and superior in performance than conventional flanges with greater material content. IPP engineers utilize a variation on the I-Beam Principle to create this unique approach to weight reduction. The flange design allows the flange to store energy like a spring and maintain a constant load on the flange faces with changes in system pressure and temperature.

Recognizing that new designs are not immediately integrated into well established engineering practices such as piping system designs, IPP knew that to be successful they would have to provide solid engineering analysis of stress levels in the flanges to piping design engineers. IPP initiated a rigorous stress analysis in addition to performing a series of physical hydrostatic tests. The analysis was

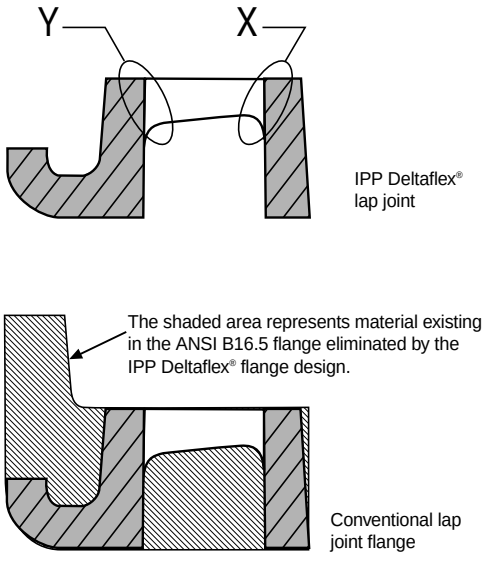
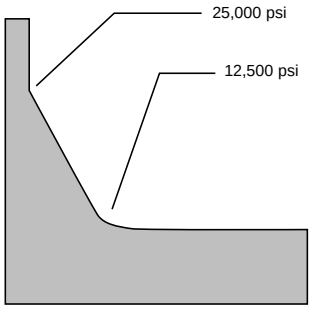
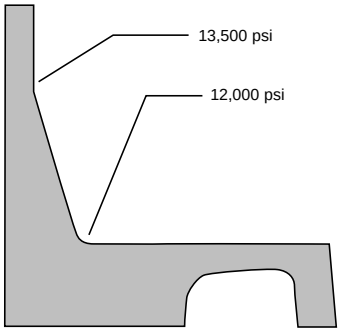


FIGURE 1

Reduces Pipe wall Stress



A. Standard 24"weldneck



B. IPP Deltaflex® Flange 24" weldneck

FIGURE 2

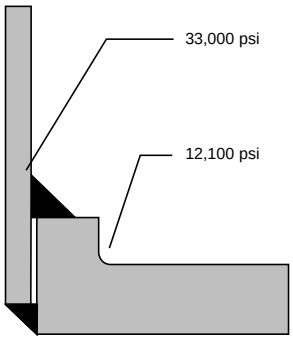
was performed using Auto Design (version 3.1), finite element analysis software that calculates and plots all principal stress levels including the von Mises based on the test pressures and bolt loads on defined elements of the flange and cross sectional elements. Bolt loads were assumed to be uniform in accordance with ASME Section VIII, Appendix 2 and test pressures were used for internal pipe loads.

In the following we will examine the stress level in a series of standard flange designs and compare them to the IPP Deltaflex® flanges at the same physical conditions. The results of these stress analysis were of interest for what they revealed about the stress level in commonly used flanges. They confirm the IPP design stress levels are equal or below that obtained with conventional flanges with major material savings. The examples include comparisons for common flanges such as:

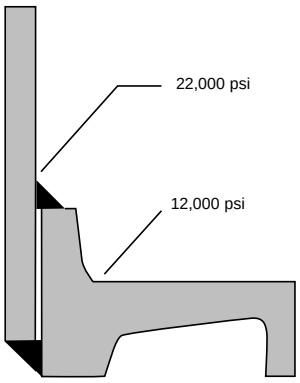
- Weldneck Flanges
- Slip-on Welded flanges
- Lap joint Flanges (with butt-welded and slip-on stub-ends)

Please see Figure 2, which is a finite element analysis of a 24" standard weldneck flange designed for 275psi working pressure (415psi test pressure) and IPP Deltaflex at the same conditions. The results indicated that because of the conservative design, conventional flanges are extraordinarily stiff members as compared to the process pipe they are welded to. **This results in high stress levels (25,00psi) in the thinner and more critical pipe wall just aft of the flange hub-to-pipe weld for the conventional flange (2A) versus 13,000psi in the IPP**

Reduces Pipe wall Stress



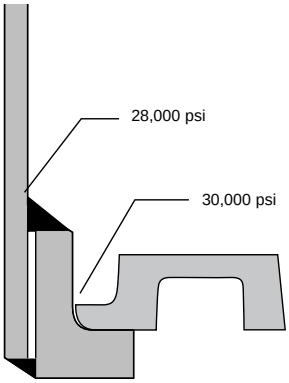
A. Standard 24" slip-on



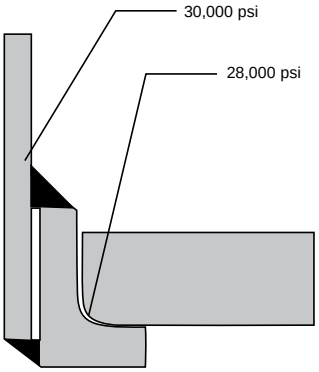
B. IPP Deltaflex 24" slip-on

FIGURE 3

Reduces Pipe wall Stress



4A. IPP Deltaflex with slip-on stub-end



4B Standard Flange with slip-on stub-end

FIGURE 4

IPP Deltaflex flange (2B). The flange body itself is a mass of metal with hardly any stress associated.

Figure 3A shows a conventional slip-on flange with a similar stress pattern. IPP's engineers believe the high stress concentrated just aft of the hub is a result of the high bending loads that are transferred to the pipe from the flange, with little of the energy absorbed by deformation of the flange. Note that the stress at this location for the example shown is approximately 65% higher than the mean pipe stress. While the stress level is still below yield for most materials used, it could be cause for concern in corrosive applications. Corrosive agents such as chlorides or caustics can contribute to stress corrosion, cracking and eventual pipe failure in this location of high stress level in the pipe wall.

Figure 4 shows there is still a high stress level in the pipe aft of the slip-on stub-end with the IPP Deltaflex® back-up ring design, but it is lower than that of the conventional flange design. Thus, a lighter member actually reduces the maximum stress in a pipe flange area for a given process pressure and bolt load.

Another interesting result of the IPP finite element analysis is that pipe and flange stress is virtually independent of bolt loading (except for local compressive stress) because of higher compression of the gasket and bending of the flange. Another advantage of the IPP Deltaflex® flange is that excessive bolt tightening leads to flange flexure rather than bolt elongation. This can help solve a classic problem of flange gasket leaks or crushing of the gasket material when a piping system cools down.

If there is no flexibility in the flange, the bolts can be stressed beyond their yield point during high thermal excursions. When the system cools down, the bolts return to an elongated state, resulting in potential leaks at the flange connection. The IPP Deltaflex®, on the other hand, stores elastic energy like a belleville washer and maintains constant tension on the bolts thereby maintaining the moisture seal and eliminating the need to retighten the bolts.

Results from proof tests conducted by IPP in accordance with the United Pressure Vessel Code ASME Section VIII, Division 1 and ANSI B31.3 confirm the superiority of the IPP Deltaflex® flange design.

Fatigue tests were also performed in which a 4" flange mounted to a 50" pipe section was subjected to 90,000 cycles of 0.6" amplitude without failure.

Conclusions:

- IPP Deltaflex incorporates the I-Beam principle in its

design to reduce weight without reducing performance. Mass is removed and reallocated for greatest efficiency and safety.

- The lighter weight IPP Deltaflex® flange conforms to vital ANSI B16.5 dimensions and offers advantages of corrosion resistance, higher yield resistance and total dimensional interchangeability with forged, plate and cast iron flanges.
- The IPP Deltaflex® flange stores energy like a belleville washer and is better able to tolerate thermal stresses and pipe vibration. This feature maintains the original bolt torque values when flange joints are tightened. Retightening is not necessary and costly spiral-wound gaskets are not required.
- The IPP Deltaflex®/stub-end combination results in a lower pipe wall stress level. Stress is transferred to the more massive forged stub-end. The wide bearing surface and large radius cast in the flange bore minimizes stress risers.

Note: Minor modifications can be made to the inside diameter of the IPP Deltaflex® flange without derating the operating pressure of the design. This feature allows the IPP Deltaflex® inside diameter to be modified to accommodate slip-on welded stub-ends, butt-welded stub-ends and metric pipe sizes with ANSI bolt circles at an additional charge. Major modifications should be referred to the factory prior to ordering.

Industry References

IPP Deltaflex® flange designs have been incorporated by major engineering companies into the world's largest construction projects and has proven its worth in some of the most critical applications. Major organizations and Engineering companies who specify and use IPP Deltaflex® flanges include:

BECHTEL
Radomiro Tomic, La Candalaria project, Silverbell

FLUOR DANIEL
Escondida, Alumbrera Project, Lomas Bayas

KVAERNER METALS, DAVY DIV.
Collohuasi Project, Tonapah, Andacollo

H.A. SIMONS
Zaldivar, Chino Mine, Morenci

U.S. NAVY/COAST GUARD
Fast Deployment Fleet, San Diego

E.I. DU PONT
Company approved specification SP-8, SP8-C

PHILLIPS DRISCOPIPE
Catalog featured flange

KWH PIPE COMPANY
Catalog featured flange

PLEXCO
Catalog featured flange

TEHMCO S.A.
Catalog featured flange

CSR Polypipe
Flange recommended

Canadian registration of fittings
All Provinces

Factory Mutual (FM)
Component of System FOR:
CSR Polypipe
Phillips Driscopipe
KWH Pipe

Company Capabilities

Improved Piping Products (IPP), Inc. has developed a position of leadership in the engineering design, manufacture and distribution of piping flange systems. With over twenty-four years of piping industry experience employed in its patented IPP Deltaflex® convoluted flange design, IPP has been instrumental in bringing reduced costs and increased performance to flanging systems. IPP Deltaflex® flange technology is an innovative, modern high-performance flange design that is adaptable to steel and all thermoplastic piping systems. Our company is committed to further research and to offering its clients cost effective, quality products. IPP strengths are:

- Design of custom flanging systems providing maximum performance at minimum cost
- Manufacture of quality flanges at minimum cost to the client
- Distribution systems to provide on-time delivery to the end-user
- Research results are provided and updated as a service to the industry

With its considerable resources, IPP is indeed the full service flange company with a strong commitment to customer needs.

Design

Clients rely on IPP's professional staff to provide custom design, hard research and answers to difficult flange engineering problems. IPP engineers utilize its patented IPP Deltaflex® flange technology to increase flange performance, reduce weight and save money for clients across a broad spectrum of industries.

Quality Manufacturing

Quality assurance programs are at the heart of IPP's manufacturing expertise. IPP Deltaflex® flange products are produced under an exacting QA/QC program that is administered from its corporate offices by an independent QA/QC manager. The IPP approach to QA assures that each order, large or small, is produced under the same inspection program with the same rigorous acceptance standards. The company employs a very high percentage of inspectors in its manufacturing operations to monitor semi-finished materials as well as finished goods. This program has radically improved productivity, quality and on-time performance, allowing IPP to offer the most cost competitive product lines in the piping industry.

Research Information Systems

IPP regularly publishes the results of its research as a service to the industry. The design staff provides updated reference tables, educational videos and installation instruction manuals for its products. All this information is available to IPP Deltaflex® flange users worldwide, free of charge. IPP is designed to be the full-service flange company with a strong customer connection.

Manufacturing

Raw materials are delivered to the IPP finishing plant in Shanghai, China where they are turned into the final IPP Deltaflex® flange product. Standard flanges are also produced to AWWA and ANSI specifications. It is at this point that critical quality control inspections are finalized and products accepted for shipment to warehouses in the United States.

The raw materials, generally in the form of rough castings, are inspected for quality standards and prepared for finishing work, including:

- Surface finishing
- Drilling of the bolt patterns
- Machining
- Sandblasting
- Coating applications (epoxy, galvanized)

The finished flange is inspected for final acceptance and packaged for shipment.

Distribution

IPP owns and operates an efficient manufacturing and distribution network in North America, South America and Europe. The system supplies finished flanges to the thermoplastic pipe and general metal piping industry. These distribution centers (Oakland, CA; St Louis, MO; Houston, TX) supply flanges to hundreds of independent distributors who serve a cross section of the piping industry.

Customers Utilizing IPP Deltaflex® Flanges

COMPANY	LOCATION	INDUSTRY
Aberdeen 3M	Aberdeen, South Dakota	Chemical
Asarco, Inc.	Tucson, Arizona	Mining
Ashland Petroleum Company	Catlettsburg, Kentucky	Oil/Chemical
Appalachian Power Company	New Haven, West Virginia	Utilities
Barrick Goldstrike Mines	Elko, Nevada	Mining
Bechtel Corporation	San Francisco, California	Mining
Boise-Cascade	Boise, Idaho	Pulp and Paper
Brown & Root, USA	Houston, Texas	Plant Process
Chevron USA, Inc.	Concord, California	Oil
Dow Badishe Company	Freeport, Texas	Chemical
Dow Chemical Company	Midland, Michigan	Chemical
E.I. DuPont	Waynesboro, Virginia	Waste Treatment
Eastman Kodak	East Syracuse, New York	Chemical
Exxon Company USA	Houston, Texas	Oil
Fluor Daniel Wright	British Columbia, Canada	Mining
Georgia Pacific	Brunswick, Georgia	Pulp and Paper
Heochst Celanese Corporation	Narrow, Virginia	Chemical
J.R. Simplot Company	Boise, Idaho	Plant Process
Kennecott Copper Company	Salt Lake City, Utah	Mining
Kvaerner Metals (Davy)	San Ramon, California	Engineering
Magma Copper Company	Miami, Arizona	Mining
Mobile Mining & Minerals	Fort Meade, Florida	Mining
Morrison Knudsen	Boise, Idaho	Mining
Phelps Dodge Mining Company	Phoenix, Arizona	Mining
Phillips 66 Petroleum Company	Sweeney, Texas	Oil/Gas
Placer Dome	British Columbia, Canada	Mining
Port of Oakland	Oakland, California	Dredging
Roberts & Shafer	Salt Lake City, Utah	Mining
Sea World	San Diego, California	Water Service
Southern Peru Copper Corporation	Miami, Florida	Mining
Weyerhaeuser Paper Company	Longview, Washington	Plant Process

IPP Deltaflex® flanges are approved by the following companies and agencies:

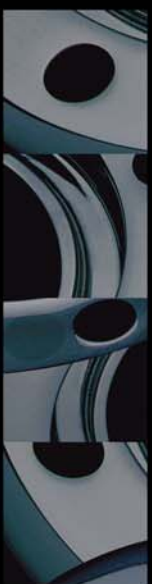
- U.S. Navy/Coast Guard — *Fast Deployment Fleet • San Diego, California*
- Canadian Registration of Fittings
- E.I. Dupont — *Approved specification SP-8 and SP-8C*
- FM Approval (Factory Mutual) — IPP Deltaflex® flanges are a component of the approved combination set (flange adaptor, flange, HDPE pipe) for the following companies: Phillips Driscopipe, CSR Polypipe, KWH Pipe.

IPP Deltaflex is a recommended product and featured catalog item for the following manufacturers:

- Phillips Driscopipe
- KWH Pipe Company
- Plexco
- Tehmco, S.A.
- CSR Polypipe

WARRANTY: IPP warrants each IPP Flange manufactured by it to be free from defects in material and workmanship under normal use and service within limitation recommended by IPP. If any IPP Flange is believed to be defective and on examination IPP finds to its satisfaction that such Flange is in fact defective IPP will at its option repair or replace such Flange without cost. IPP shall not be liable for any consequentiamages resulting from any defect in material or workmanship. THIS GUARANTEE IS EXPRESSLY IN LIEU OF ANY AND ALL OTHER GUARANTEES AND/OR WARRANTIES.

The accuracy or applicability of all information contained herein is intended as a guide and is not guaranteed. Improved Piping Products, Inc. assumes no obligation or liability for this information. All dimensions and tables may be considered as recommendations but not as warranty.



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