

## DESIGN-FLOW®

U.S. Patent # 7,401,821

### **Convolutd Ductile Iron & Stainless Steel Bolt Rings**

**Designed Specifically for use  
with HDPE Flange Adapters\***

**ASME / ANSI B16.5, B16.47<sup>Ser.A</sup> CL150  
B16.1 CL125 AWWA C207 B,D & E**

### **Design Information**

Van Stone Style Flanges have been used for decades in the USA. The typical polyethylene flange adapter has a Van-Stone style flange with slip-on bolt-ring. Our Design-Flow® Bolt Ring is engineered specifically for Polyethylene Flange Adapters. Design-Flow® Bolt Rings meet the standard bolt circle dimensional specifications of ASME / ANSI B16.5 CL 150, B16.47 Ser. A - CL 150, B16.1- CL 125; AWWA C207 - CL 150 / B, D & E. Design-Flow Bolt Rings are produced in ductile iron and stainless steel (Ductile Iron A536 65/45/12, 316 Stainless Steel A351-CF8M). Our ductile iron Bolt Rings are stocked with an oil based enamel painted surface (IPS sizes stocked in bright red, DIPS sizes stocked in aqua blue). Many more coating choices are available that provide superior cathodic protection depending on the specific needs of the project. Additional surface coating choices include epoxy based paints; fusion bonded epoxies; hot dip galvanizing and other electrostatically applied surface treatments.

Our Design-Flow® Bolt Ring is so unique in its novel design that it has earned U.S. Patent # 7,401,821 status based, in principle, on its strong, tough, ductile and constant sealing design. Its contoured cross-section enables ring deformation which provides a constant sealing force. Our Design-Flow® Bolt Ring is stronger; being able to accept more bolt torque (sealing load) than other previous designs. At these higher bolt torques, rubber gaskets are not required, which results in more secure sealing and reduced assembly costs. Our Design-Flow® Bolt Ring has a beveled bolt surface which is drawn into parallel with the flange face when the proper bolt torque is applied. This bolt ring deflection is more effective in placing the sealing force closer to the pipe OD and more uniformly distributing that higher force across the flange face. Unlike previous industry designs, Design-Flow® Bolt Rings “seal from the inside out” !

Our Design-Flow® Bolt Ring design places more metal in optimized locations to make the bolt ring stronger resulting in a shorter outer perimeter plane. Design-Flow® Bolt Rings are designed for working pressure ratings ranging from 50 psi up to 275 psi in many sizes. Please consult this catalog sectional 1.3.B1 or our Customer Service Department for more information regarding our Design-Flow® Bolt Rings.



## DESIGN-FLOW® Convuluted - Ductile Iron IPS Bolt Rings

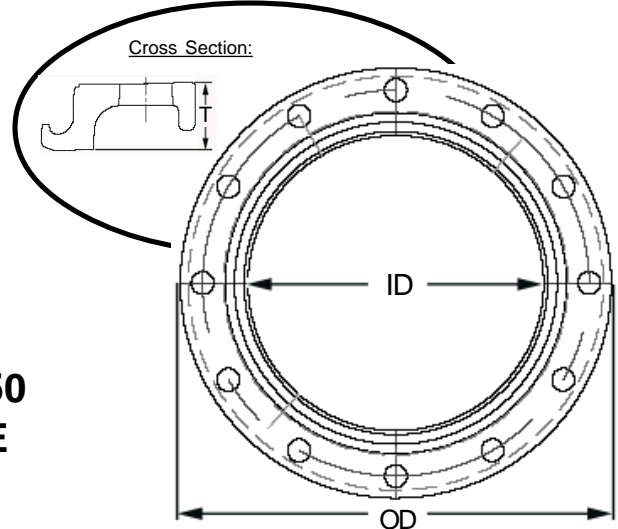
Designed Specifically for use  
with HDPE Flange Adapters\*

**ASME / ANSI B16.5, B16.47<sup>Ser.A</sup> CL150**

**B16.1 CL125 AWWA C207 B,D & E**

(Dimensions in Inches)

U.S. Patent # 7,401,821



IPS Nominal Size	T (Thickness)	OD	ID	Bolt Hole Circle	Number Of Bolt Holes	Diameter Of Bolt Holes	WPR (psi)	Weight (lbs)
3/4"	.53	3.88	1.11	2.75	4	5/8"	275	1.0
1"	.53	4.25	1.38	3.13	4	5/8"	275	1.2
1-1/4"	.63	4.63	1.72	3.50	4	5/8"	275	1.5
1-1/2"	.69	5.00	1.97	3.88	4	5/8"	275	1.6
2"	.75	6.00	2.50	4.69	4	3/4"	275	2.7
3"	.94	7.50	3.63	6.00	4	3/4"	275	4.5
4"	.94	9.00	4.63	7.50	8	3/4"	275	5.5
5"	.94	10.00	5.69	8.50	8	7/8"	275	5.9
6"	1.00	11.00	6.75	9.50	8	7/8"	275	7.5
8"	1.13	13.50	8.75	11.75	8	7/8"	275	12
10"	1.19	16.00	10.94	14.25	12	1"	275	15
12"	1.25 1.50	19.00	13.00	17.00	12	1"	160 275	24 25
14"	1.38 1.63	21.00	14.38	18.75	12	1-1/8"	160 275	29 35

WPR (working pressure rating) is for free-floating rings on HDPE flange adapters and includes a 2:1 safety factor. These are cast convuluted ductile iron metal bolt rings with 150# bolt-hole pattern; the material is in compliance with ASTM A536 GR 65/45/12 and surfaced in Bright Red oil based enamel paint.



## DESIGN-FLOW® Convuluted - Ductile Iron IPS Bolt Rings (cont.)

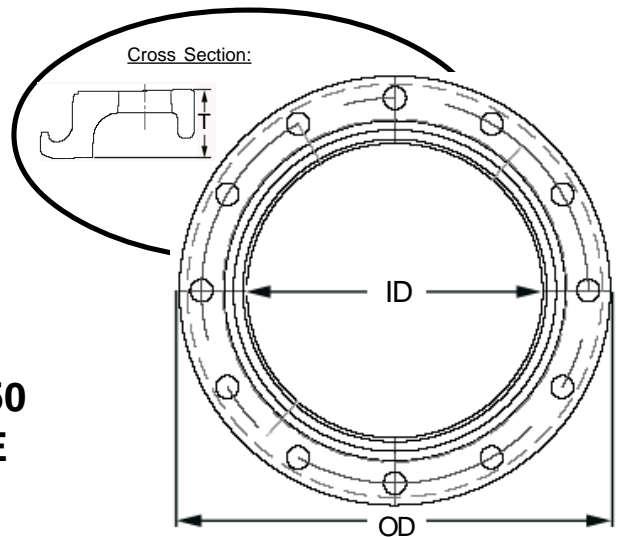
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**ASME / ANSI B16.5, B16.47<sup>ser.A</sup> CL150**

**B16.1 CL125 AWWA C207 B,D & E**

(Dimensions in Inches)

U.S. Patent # 7,401,821



IPS Nominal Size	T (Thickness)	OD	ID	Bolt Hole Circle	Number Of Bolt Holes	Diameter Of Bolt Holes	WPR (psi)	Weight (lbs)
16"	1.63 1.84	23.50	16.19	21.25	16	1-1/8"	160 275	39 48
18"	1.70 2.00	25.00	18.38	22.75	16	1-1/4"	160 275	42 53
20"	1.84 2.23	27.50	20.38	25.00	20	1-1/4"	160 275	57 70
22"	2.41	29.50	22.38	27.25	20	1-3/8"	275	80
24"	2.16 2.56	32.00	24.38	29.50	20	1-3/8"	160 275	80 103
26"	2.50	34.25	26.38	31.75	24	1-3/8"	200	109
28"	2.59	36.50	28.38	34.00	28	1-3/8"	200	130
30"	2.28 2.47	38.75	30.38	36.00	28	1-3/8"	100 160	118 139
32"	2.56	41.75	32.38	38.50	28	1-5/8"	160	165
34"	2.88	43.75	34.38	40.50	32	1-5/8"	160	191
36"	2.75 3.00	46.00	36.38	42.75	32	1-5/8"	100 160	193 214
42"	3.25	53.00	42.38	49.50	36	1-5/8"	100	265
48"	3.63	59.50	48.50	56.00	44	1-5/8"	80	354
54"	4.03	66.25	54.62	62.75	44	1-7/8"	80	519

WPR (working pressure rating) is for free-floating rings on HDPE flange adapters and includes a 2:1 safety factor. These are cast convuluted ductile iron metal bolt rings with 150# bolt-hole pattern; the material is in compliance with ASTM A536 GR 65/45/12 and surfaced in Bright Red oil based enamel paint.



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## Convuluted - Ductile Iron DIPS Bolt Rings

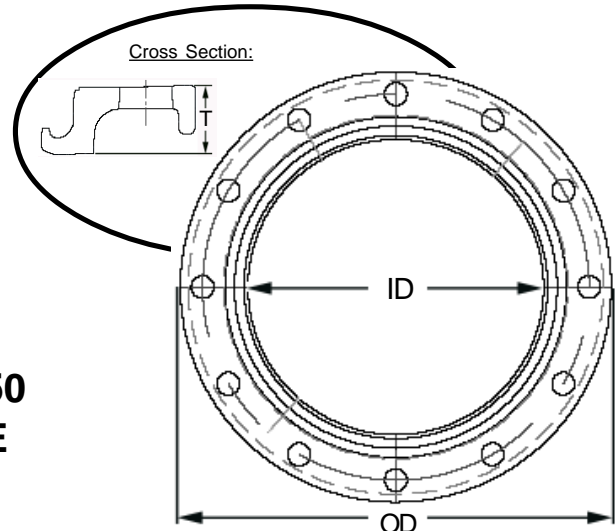
Designed Specifically for use  
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**ASME / ANSI B16.5, B16.47<sup>ser.A</sup> CL150**

**B16.1 CL125 AWWA C207 B,D & E**

(Dimensions in Inches)

U.S. Patent # 7,401,821



DIPS Nominal Size	T (Thickness)	OD	ID	Bolt Hole Circle	Number Of Bolt Holes	Diameter Of Bolt Holes	WPR (psi)	Weight (lbs)
4"	.94	9.00	4.90	7.50	8	3/4	275	5
6"	1.00	11.00	7.00	9.50	8	7/8	275	8
8"	1.13	13.50	9.19	11.75	8	7/8	275	11
10"	1.19	16.00	11.25	14.25	12	1	275	16
12"	1.50	19.00	13.38	17.00	12	1	275	26
14"	1.63	21.00	15.49	18.75	12	1-1/8	275	31
16"	1.84	23.50	17.59	21.25	16	1-1/8	275	42
18"	2.00	25.00	19.70	22.75	16	1-1/4	275	51
20"	2.23	27.50	21.85	25.00	20	1-1/4	275	61
24"	2.56	32.00	26.05	29.50	20	1-3/8	275	94
30"	2.88	38.75	32.25	36.00	28	1-3/8	200	142

WPR (working pressure rating) is for free-floating rings on HDPE flange adapters and includes a 2:1 safety factor. These are cast convoluted ductile iron metal bolt rings with 150# bolt-hole pattern; the material is in compliance with ASTM A536 GR 65/45/12 and surfaced in Aqua Blue oil based enamel paint.



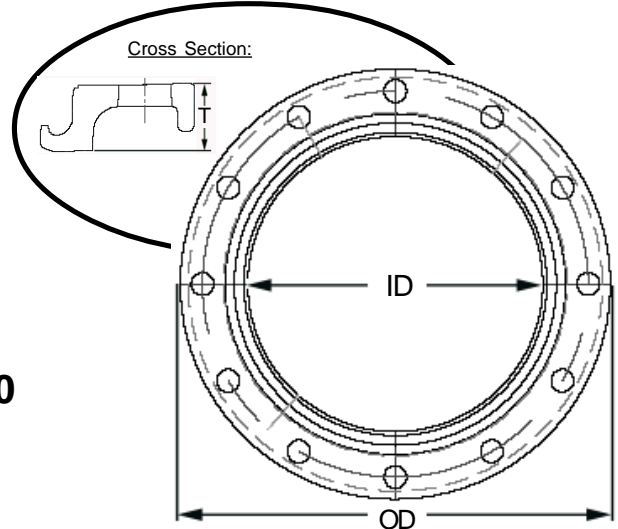
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## Convuluted - Stainless Steel IPS Bolt Rings

Designed Specifically for use  
with HDPE Flange Adapters\*

**ASME / ANSI B16.5, B16.47<sup>ser.A</sup> CL150**  
**B16.1 CL125 AWWA C207 B,D & E**  
(Dimensions in Inches)

U.S. Patent # 7,401,821



IPS Nominal Size	T (Thickness)	OD	ID	Bolt Hole Circle	Number Of Bolt Holes	Diameter Of Bolt Holes	WPR (psi)	Weight (lbs)
2"	.75	6.00	2.50	4.69	4	3/4"	275	2.6
3"	.94	7.50	3.63	6.00	4	3/4"	275	4.8
4"	.94	9.00	4.63	7.50	8	3/4"	275	5.9
6"	1.00	11.00	6.75	9.50	8	7/8"	275	8
8"	1.13	13.50	8.75	11.75	8	7/8"	275	13
10"	1.19	16.00	10.94	14.25	12	1"	275	16
12"	1.50	19.00	13.00	17.00	12	1"	275	27
14"	1.38	21.00	14.38	18.75	12	1-1/8"	160	31
16"	1.63	23.50	16.38	21.25	16	1-1/8"	160	42
18"	1.70	25.00	18.38	22.75	16	1-1/4"	160	46

WPR (working pressure rating) is for free-floating rings on HDPE flange adapters and includes a 2:1 safety factor. These are cast convuluted stainless steel bolt rings with 150# bolt-hole pattern; the material is stainless steel 316 A351-CF8M.



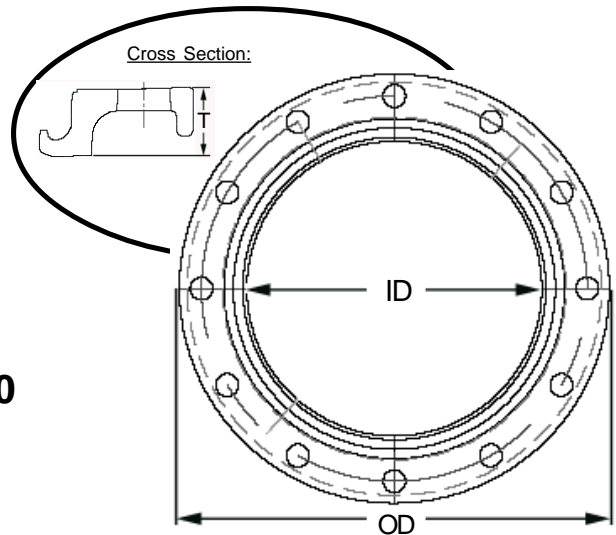
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## Convolute - Stainless Steel IPS Bolt Rings (cont.)

Designed Specifically for use  
with HDPE Flange Adapters\*

**ASME / ANSI B16.5, B16.47<sup>ser.A</sup> CL150**  
**B16.1 CL125 AWWA C207 B,D & E**  
(Dimensions in Inches)

U.S. Patent # 7,401,821



IPS Nominal Size	T (Thickness)	OD	ID	Bolt Hole Circle	Number Of Bolt Holes	Diameter Of Bolt Holes	WPR (psi)	Weight (lbs)
20"	1.84	27.50	20.38	25.00	20	1-1/4"	160	58
22"	2.41	29.50	22.38	27.25	20	1-3/8"	275	69
24"	2.16	32.00	24.38	29.50	20	1-3/8"	160	87
26"	2.50	34.25	26.38	31.75	24	1-3/8"	200	Coming Soon !
28"	2.59	36.50	28.38	34.00	28	1-3/8"	200	Coming Soon !
30"	2.47	38.75	30.38	36.00	28	1-3/8"	160	0
32"	2.56	41.75	32.38	38.50	28	1-5/8"	160	Coming Soon !
34"	2.88	43.75	34.38	40.50	32	1-5/8"	160	Coming Soon !
36"	2.75	46.00	36.38	42.75	32	1-5/8"	160	0
42"	3.25	53.00	42.38	49.50	36	1-5/8"	100	0
48"	3.63	59.50	48.50	56.00	44	1-5/8"	80	0
54"	4.03	66.25	54.62	62.75	44	1-7/8"	80	0

WPR (working pressure rating) is for free-floating rings on HDPE flange adapters and includes a 2:1 safety factor. These are cast convolute stainless steel back up rings with 150# bolt-hole pattern; the material is stainless steel 316 A351-CF8M.



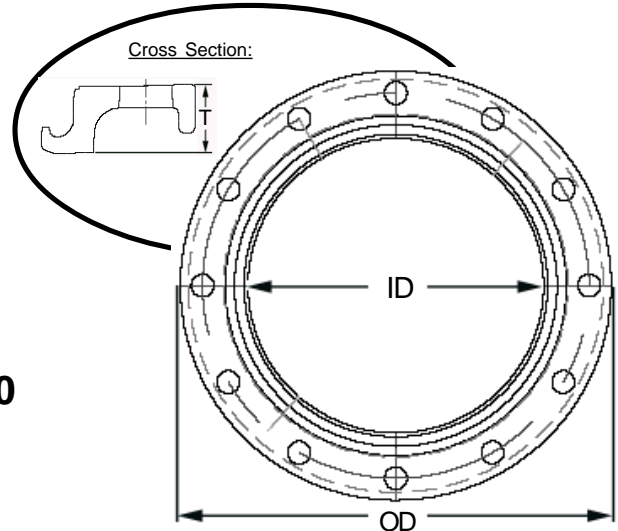
**DESIGN-FLOW®**

## Convuluted - Stainless Steel DIPS Bolt Rings

Designed Specifically for use  
with HDPE Flange Adapters\*

**ASME / ANSI B16.5, B16.47<sup>ser.A</sup> CL150**  
**B16.1 CL125 AWWA C207 B,D & E**  
(Dimensions in Inches)

U.S. Patent # 7,401,821



DIPS Nominal Size	T (Thickness)	OD	ID	Bolt Hole Circle	Number Of Bolt Holes	Diameter Of Bolt Holes	WPR (psi)	Weight (lbs)
4"	.94	9.00	4.90	7.50	8	3/4	275	5.4
6"	1.00	11.00	7.00	9.50	8	7/8	275	7.5
8"	1.13	13.50	9.19	11.75	8	7/8	275	12
10"	1.19	16.00	11.25	14.25	12	1	275	15
12"	1.50	19.00	13.38	17.00	12	1	275	27
14"	1.38	21.00	15.49	18.75	12	1-1/8	160	30
16"	1.63	23.50	17.59	21.25	16	1-1/8	160	41
18"	1.70	25.00	19.70	22.75	16	1-1/4	160	45
20"	1.84	27.50	21.85	25.00	20	1-1/4	160	57
24"	2.16	32.00	26.05	29.50	20	1-3/8	160	86

WPR (working pressure rating) is for free-floating rings on HDPE flange adapters and includes a 2:1 safety factor. These are cast convuluted stainless steel back up rings with 150# bolt-hole pattern; the material is stainless steel 316 A351-CF8M.



## DESIGN-FLOW®

Convuluted - Epoxy Coated & Galvanized DI

### IPS Bolt Rings

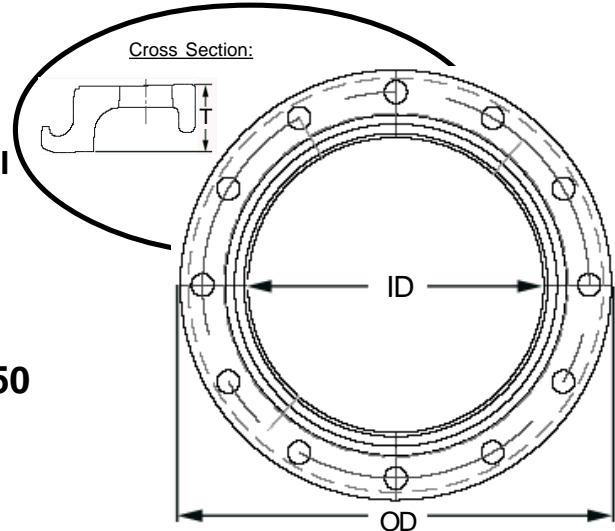
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ASME / ANSI B16.5, B16.47Ser.A CL150

B16.1 CL125 AWWA C207 B,D & E

(Dimensions in Inches)

U.S. Patent # 7,401,821



IPS Nominal Size	T (Thickness)	OD	ID	Bolt Hole Circle	Number Of Bolt Holes	Diameter Of Bolt Holes	WPR (psi)	Weight (lbs)
3/4"	.53	3.88	1.11	2.75	4	5/8"	275	1.0
1"	.53	4.25	1.38	3.13	4	5/8"	275	1.2
1-1/4"	.63	4.63	1.72	3.50	4	5/8"	275	1.5
1-1/2"	.69	5.00	1.97	3.88	4	5/8"	275	1.6
2"	.75	6.00	2.50	4.69	4	3/4"	275	2.7
3"	.94	7.50	3.63	6.00	4	3/4"	275	4.5
4"	.94	9.00	4.63	7.50	8	3/4"	275	5.5
5"	.94	10.00	5.69	8.50	8	7/8"	275	5.9
6"	1.00	11.00	6.75	9.50	8	7/8"	275	7.5
8"	1.13	13.50	8.75	11.75	8	7/8"	275	12
10"	1.19	16.00	10.94	14.25	12	1"	275	15
12"	1.25 1.50	19.00	13.00	17.00	12	1"	160 275	24 25
14"	1.38 1.63	21.00	14.38	18.75	12	1-1/8"	160 275	29 35

WPR (working pressure rating) is for free-floating rings on HDPE flange adapters and includes a 2:1 safety factor. These are cast convuluted ductile-iron metal bolt rings with 150# bolt-hole pattern; primed and surfaced with an epoxy based paint; the material is in compliance with ASTM A536 GR 65/45/12. Rings also available with galvanized coating.

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## DESIGN-FLOW®

Convuluted - Epoxy Coated & Galvanized DI

### IPS Bolt Rings (cont.)

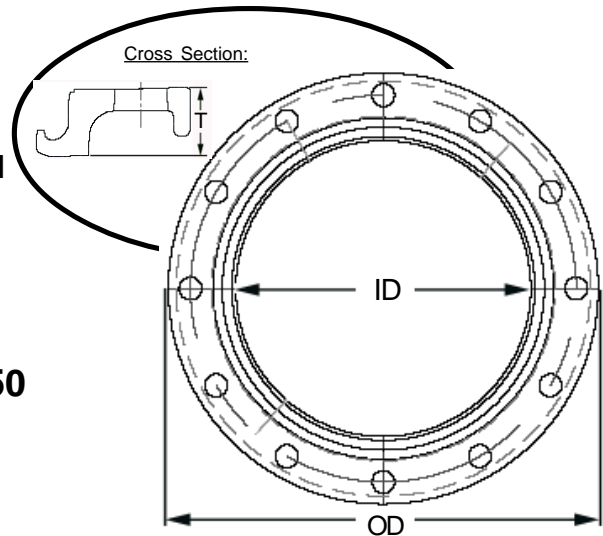
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ASME / ANSI B16.5, B16.47Ser.A CL150

B16.1 CL125 AWWA C207 B,D & E

(Dimensions in Inches)

U.S. Patent # 7,401,821



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16"	1.63 1.84	23.50	16.19	21.25	16	1-1/8"	160 275	39 48
18"	1.70 2.00	25.00	18.38	22.75	16	1-1/4"	160 275	42 53
20"	1.84 2.23	27.50	20.38	25.00	20	1-1/4"	160 275	57 70
22"	2.41	29.50	22.38	27.25	20	1-3/8"	275	80
24"	2.16 2.56	32.00	24.38	29.50	20	1-3/8"	160 275	80 103
26"	2.50	34.25	26.38	31.75	24	1-3/8"	200	109
28"	2.59	36.50	28.38	34.00	28	1-3/8"	200	130
30"	2.28 2.47	38.75	30.38	36.00	28	1-3/8"	100 160	118 139
32"	2.56	41.75	32.38	38.50	28	1-5/8"	160	165
34"	2.88	43.75	34.38	40.50	32	1-5/8"	160	191
36"	2.75 3.00	46.00	36.38	42.75	32	1-5/8"	100 160	193 214
42"	3.25	53.00	42.38	49.50	36	1-5/8"	100	265
48"	3.63	59.50	48.50	56.00	44	1-5/8"	80	354
54"	4.03	66.25	54.62	62.75	44	1-7/8"	80	519

WPR (working pressure rating) is for free-floating rings on HDPE flange adapters and includes a 2:1 safety factor. These are cast convuluted ductile-iron metal bolt rings with 150# bolt-hole pattern; primed and surfaced with an epoxy based paint; the material is in compliance with ASTM A536 GR 65/45/12. Rings also available with galvanized coating.

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Convuluted - Epoxy Coated & Galvanized DI

## DIPS Bolt Rings

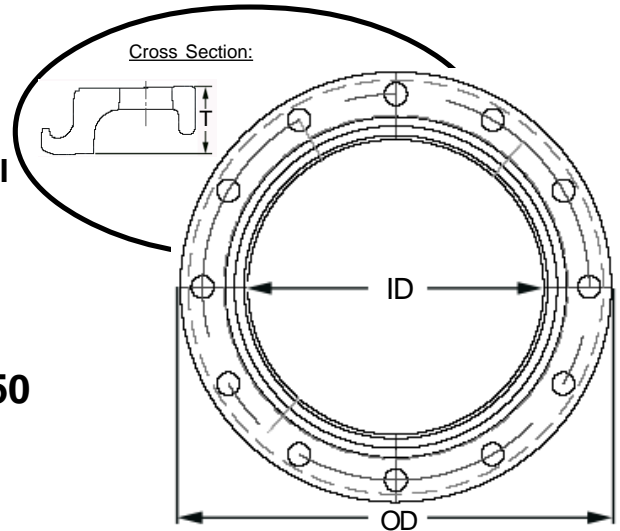
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**ASME / ANSI B16.05, B16.47<sup>ser.A</sup> CL150**

**B16.1 CL125 AWWA C207 B,D & E**

(Dimensions in Inches)

U.S. Patent # 7,401,821



DIPS Nominal Size	T (Thickness)	OD	ID	Bolt Hole Circle	Number Of Bolt Holes	Diameter Of Bolt Holes	WPR (psi)	Weight (lbs)
4"	.94	9.00	4.90	7.50	8	3/4	275	5
6"	1.00	11.00	7.00	9.50	8	7/8	275	8
8"	1.13	13.50	9.19	11.75	8	7/8	275	11
10"	1.19	16.00	11.25	14.25	12	1	275	16
12"	1.50	19.00	13.38	17.00	12	1	275	26
14"	1.63	21.00	15.49	18.75	12	1-1/8	275	31
16"	1.84	23.50	17.59	21.25	16	1-1/8	275	42
18"	2.00	25.00	19.70	22.75	16	1-1/4	275	51
20"	2.23	27.50	21.85	25.00	20	1-1/4	275	61
24"	2.56	32.00	26.05	29.50	20	1-3/8	275	94
30"	2.88	38.75	32.25	36.00	28	1-3/8	200	142

WPR (working pressure rating) is for free-floating rings on HDPE flange adapters and includes a 2:1 safety factor. These are cast convuluted ductile-iron metal bolt rings with 150# bolt-hole pattern; primed and surfaced with an epoxy based paint; the material is in compliance with ASTM A536 GR 65/45/12. Rings also available with galvanized coating.

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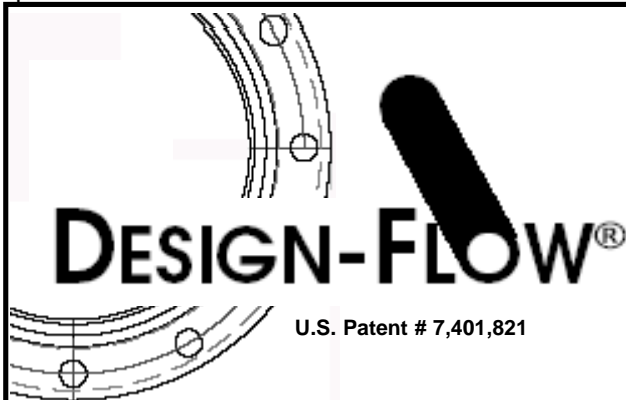
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# INDEPENDENT PIPE PRODUCTS, INC.



“BETTER BY DESIGN”®

Specification Sheet #B1



## Design-Flow® Convoluted Ductile Iron & Stainless Steel Bolt Rings Metals & Coatings Physical Properties

METALS & ALLOYS		
Type of Material	ASTM Standard	Comments
Ductile Iron	ASTM A536	Grade 65-45-12
Stainless Steel 316	ASTM A531	Grade CF8M
PAINTS & SURFACE TREATMENTS		
Type of Material	ASTM Standard	Comments
Oil Based Enamel Paint	ASTM B117 Salt Spray	100+ Hours
Epxoy Based Paint	ASTM B117 Salt Spray	500+ Hours
E-Coat	ASTM B117 Salt Spray	1000+ Hours
Hot Dip Galvanizing	ASTM A153	5 mils
	ASTM G-85 Salt Fog	2000 Hours
Aqua-Armor Metal Jacket®	ASTM B117 Salt Spray	2500+ Hours
Fusion Bonded Epoxy Coating	ASTM A775 FBE	10 MILS to 26 MILS
	ASTM A972 FBE	10 MILS to 26 MILS
	ASTM B117 Salt Spray	3000+ Hours

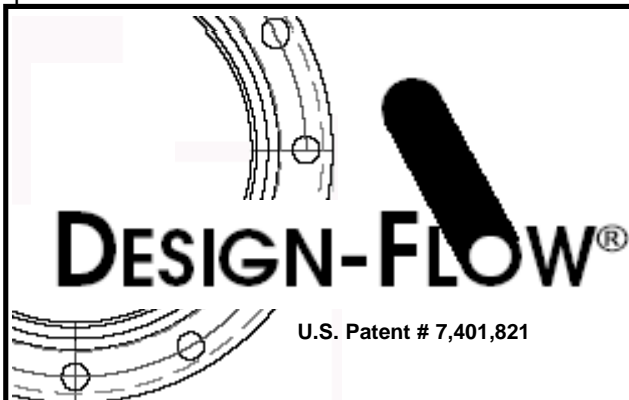
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Issued January 1, 2009

Version 1.4.1



## Design-Flow® Convoluted Ductile Iron & Stainless Steel Bolt Rings Installation and Bolt Tightening Information

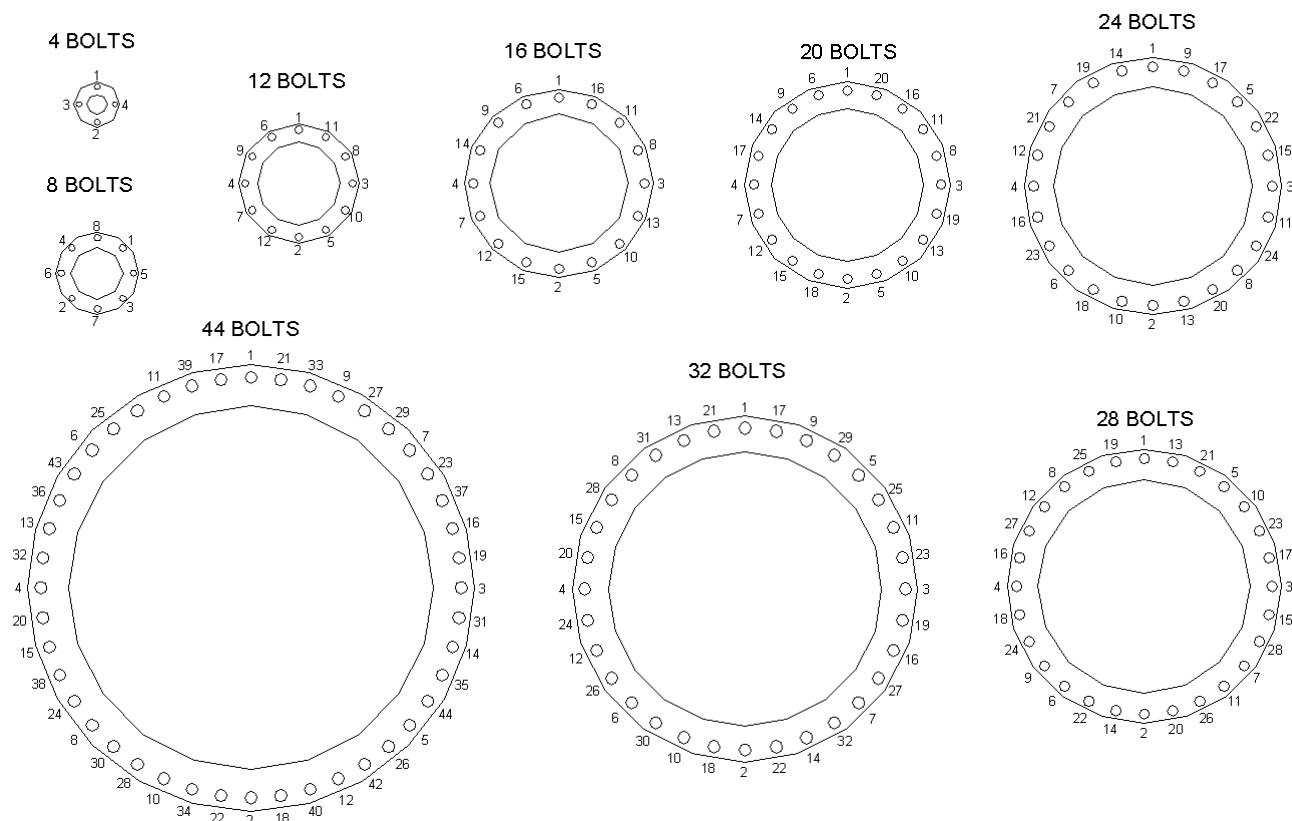
Flange assembly should be square, perpendicular, concentric and axially in contact with the mating flange, prior to applying sealing torque.

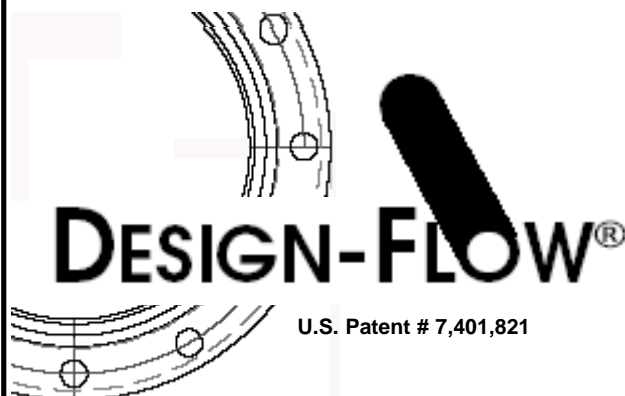
Tighten bolts in an alternating “star pattern” in numerical order as shown in illustration below.

Tighten bolts uniformly in even increments, raising the torque intensity in “steps”, uniform “steps” or “levels” are generally 20% increments of total torque value.

Torque all bolts uniformly to the first level before progressing to the next higher level of uniform bolt torque.

Hydro-test to insure no leaks exist, retighten as needed.





## Technical Report : Bolt Torque Test On Design-Flow® Bolt Rings & HDPE Flange Adapters

### Technical Report: Bolt-Torque Tests on IPPI Bolt-Rings & HDPE Flange Adapters

The compressive sealing stress applied by the IPPI bolt rings onto the HDPE flange face through bolt torque, is targeted at 1100 psi initial interfacial pressure, before viscoelastic stress relaxation occurs. The bolt ring and HDPE flange assembly have been tested to evaluate effective sealing across a wide range of operational pressure with surge allowance, and over a wide range of thermal conditions. The threaded carbon steel or stainless steel bolts (or all-thread studs) are expected to be of SAE Grade 2 to SAE Grade 5 tensile strength. The bolts tested were reasonably clean, oiled and not rusted. Every flange assembly should be installed square, perpendicular, concentric and axially in contact with the mating flange, prior to applying sealing torque. The bolts were tightened in an alternating “star pattern”. The bolts were tightened uniformly in even increments, raising the torque intensity in “steps”, with all bolts torqued uniformly to the first level before progressing to the next higher level of uniform bolt torque. The IPPI thick face flanges and bolt rings were hydro-tested at the torque listed below, and proven to seal effectively. The 4 x WPR hydro-tests were conducted successfully on flat face, and serrated face, HDPE flange adapters without gaskets. The IPPI bolt rings have also been tested to a 25% higher maximum bolt torque than listed without bolt ring fracture; tested maximum torque was well above the useful sealing bolt torque.

Nominal Pipe Size	Bolt Diameter for Bolt Ring	Number of Bolts	Tested Uniform Bolt Torque (Ft-lbs)
2"	0.625	4	*
3"	0.625	4	*
4"	0.625	8	
5"	0.750	8	
6"	0.750		
8"	0.750		
10"	0.875		
12"			
14"			

**HDPE FLANGE BOLT TORQUE GUIDELINES ARE NOW AVAILABLE.**  
**PLEASE REFER TO PLASTICS PIPE INSTITUTE, INC.**  
**TECHNICAL NOTE #38 - BOLT TORQUE FOR PE FLANGED JOINTS**  
**Please contact our Customer Service Department for more information.**

		28	*
		28	*
		28	*
		32	*
	1.500	32	*
	1.500	36	*
40"	1.500	36	*
42"	1.500	44	*
48"	1.500	44	*
54"	1.875	44	*

**PLEASE NOTE:** Torque is an indirect indicator of tensile load in the bolt itself. With several variables involved in the assembly, bolting and flange sealing process; the bolt torque test values presented above were considered as a guideline only. For example, compare the compressive differences of a plastic to plastic connection verses a plastic to steel connection. It is the responsibility of the project “engineer of record” to establish the bolt torque and assembly requirements for each specific flange assembly design. A large torque wrench is specified.