



Belleville Spring Flange Washers



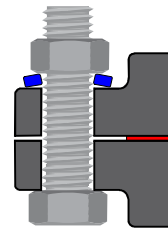
BelleFlex Technologies, LLC Ford City, Pennsylvania

www.BelleFlex.com

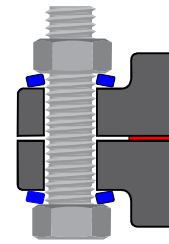
BELLEVILLE SPRING FLANGE WASHER LIVE LOADING DATA SHEET

General Information

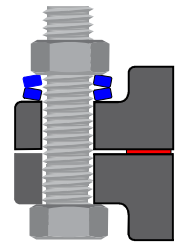
Customer
Unit
System
System Temp
System Pressure
Insulated (Yes / No)
Monitored (Yes / No)
Max Leak Rate (ppm)
Tag No.
Location
Position



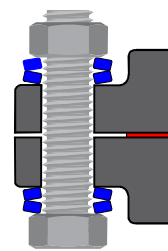
One per Bolt



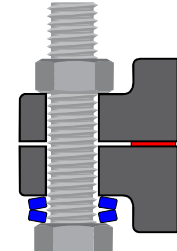
One on
Each Side



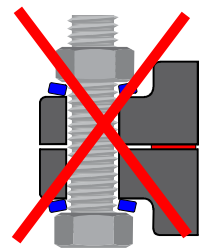
Two in Series



Two in Series
Both Sides



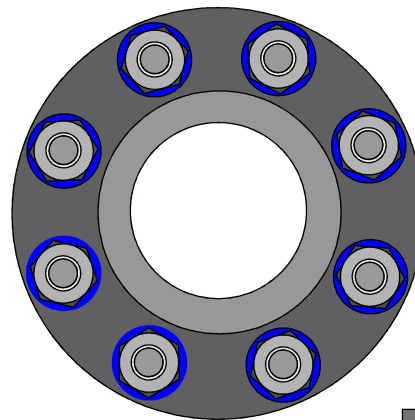
When using hydraulic
tensioners



Springs Installed
Upside Down

Flange Information

Size
Class
No. of Studs
Stud Diameter
Stud Length
Gasket Type
Gasket Style
Gasket Size
Req. Gasket Stress
Req Bolt Torque or Stress
Live Load (Yes / No)



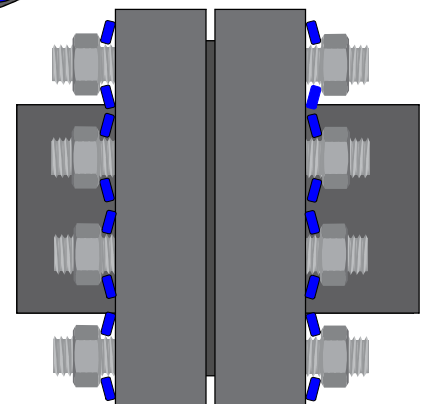
Common
Flange Washer
Stacking Arrangements

Belleville Spring Information

Part Number
Spring Material
Number of Springs
Number of Springs per Stud
Spring Configuration

Contact Information

Contact
Phone
Email



BelleFlex Technologies, LLC - 706 Eljer Way, Ford City, PA 16226

P: 724-540-5053 F: 724-540-5063 www.belleflex.com

24 Hour Emergency Service - 724-816-3648



Belleville Spring Flange Washers

BelleFlex Technologies, Belleville spring flange washers are simply Belleville springs that have been specifically designed to fit on the limited space on a pipe flange. More importantly, they have also been designed to maintain the heavy loads required to keep bolted, gasketed flange joints tight.



The addition of Belleville springs to a bolted gasketed joint is referred to as “Live Loading”. It has been used in the petrochemical and power generation industries for over 40 years. It is a proven method of keeping bolted gasketed joints tight, leak free and reduces fugitive emissions.

Not all flanges, specifically bolted gasketed pipe flanges leak. Often when they do, it is a result of human error. Lack of proper training and/or procedures can be the cause. ASME PCC-1-2013 is attempting to address this.

Flanges that do leak, that are not a result of human error, can leak for a variety of reasons. The number one reason is loss of bolt load over time. A bolt will start to lose bolt load almost immediately after it has been tightened. This can happen due to vibration, creep, differential thermal expansion and elastic interaction or cross talk. This is typically seen on high temperature, cyclic applications that are common in the petrochemical and power generation industries, but it can also occur in cryogenic applications like the ones found in an LNG facility.

Adding Belleville spring flange washers to the bolts or studs of the flange changes the spring rate of the flange joint. They maintain the bolt load at a higher point and allow the joint to relax at a much slower rate, reducing the effects of creep, vibration, differential thermal expansion and elastic interaction.

When Belleville spring flange washers were first developed, they were designed to match the industries standards for bolting using bolt stress. That is why you will see catalogs listing 30,000, 45,000 and 60,000 psi part numbers. Some companies still use bolt stress to determine the final torque or load required. Gasket sealing stress is now used more often than bolt stress. It is, of course, the gasket we are trying to seal, not the bolt.

When selecting which Belleville spring flange washer to use, in most cases, you would select the one closest to the sealing stress of the gasket being used. That information can be obtained from the gasket manufacturer or supplier.

Belleville spring flange washers can and are used on pipe flanges, heat exchangers, manway doors, and many other applications where keeping bolted gasketed joints is a priority. For additional information, design help or engineering assistance please contact BelleFlex Technologies.



Belleville Spring Flange Washers

H13 Tool Steel



Part Number	Bolt Size	OD	ID	Thick	Dish	Height	Flat Load	T / ft-lb
FB1-30-H13	1/2"	1.012	0.530	0.120	0.013	0.133	4360	30
FB1-45-H13	1/2"	1.012	0.530	0.140	0.012	0.152	6391	45
FB1-60-H13	1/2"	1.012	0.530	0.159	0.011	0.170	8582	60
FB2-30-H13	5/8"	1.148	0.641	0.146	0.014	0.160	6895	60
FB2-45-H13	5/8"	1.148	0.641	0.171	0.013	0.184	10286	90
FB2-60-H13	5/8"	1.148	0.641	0.193	0.012	0.205	13652	120
FB3-30-H13	3/4"	1.369	0.761	0.179	0.016	0.195	10174	100
FB3-45-H13	3/4"	1.369	0.761	0.214	0.014	0.228	15212	150
FB3-60-H13	3/4"	1.369	0.761	0.241	0.013	0.254	20175	200
FB4-30-H13	7/8"	1.588	0.892	0.207	0.019	0.226	14008	160
FB4-45-H13	7/8"	1.588	0.892	0.246	0.017	0.263	21036	240
FB4-60-H13	7/8"	1.588	0.892	0.282	0.015	0.297	27960	320
FB5-30-H13	1"	1.808	1.021	0.228	0.024	0.252	18323	245
FB5-45-H13	1"	1.808	1.021	0.277	0.020	0.297	27381	368
FB5-60-H13	1"	1.808	1.021	0.328	0.016	0.344	36369	490
FB6-30-H13	1-1/8"	2.023	1.146	0.264	0.025	0.289	23731	355
FB6-45-H13	1-1/8"	2.023	1.146	0.321	0.021	0.342	35835	533
FB6-60-H13	1-1/8"	2.023	1.146	0.379	0.017	0.396	47746	710
FB7-30-H13	1-1/4"	2.308	1.272	0.296	0.030	0.326	30139	500
FB7-45-H13	1-1/4"	2.308	1.272	0.360	0.025	0.385	45184	750
FB7-60-H13	1-1/4"	2.308	1.272	0.413	0.022	0.435	60036	1000
FB8-30-H13	1-3/8"	2.468	1.401	0.333	0.029	0.362	37187	680
FB8-45-H13	1-3/8"	2.468	1.401	0.395	0.026	0.421	55645	1020
FB8-60-H13	1-3/8"	2.468	1.401	0.453	0.023	0.476	74249	1360
FB9-30-H13	1-1/2"	2.678	1.526	0.366	0.031	0.397	44978	800
FB9-45-H13	1-1/2"	2.678	1.526	0.439	0.027	0.466	67601	1200
FB9-60-H13	1-1/2"	2.678	1.526	0.509	0.023	0.532	89758	1600
FB10-30-H13	1-5/8"	2.951	1.648	0.396	0.036	0.432	53546	1100
FB10-45-H13	1-5/8"	2.951	1.648	0.482	0.030	0.512	80464	1650
FB10-60-H13	1-5/8"	2.951	1.648	0.549	0.027	0.576	107009	2200
FB11-30-H13	1-3/4"	3.168	1.776	0.429	0.038	0.467	62555	1500
FB11-45-H13	1-3/4"	3.168	1.776	0.520	0.032	0.552	93814	2250
FB11-60-H13	1-3/4"	3.168	1.776	0.598	0.028	0.626	124844	3000
FB12-30-H13	1-7/8"	3.391	1.901	0.464	0.040	0.504	72717	2000
FB12-45-H13	1-7/8"	3.391	1.901	0.560	0.034	0.594	108658	3000
FB12-60-H13	1-7/8"	3.391	1.901	0.592	0.032	0.624	120819	4000

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H13 Tool Steel

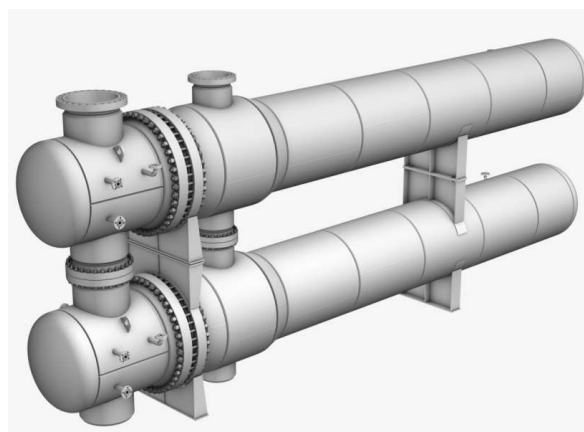
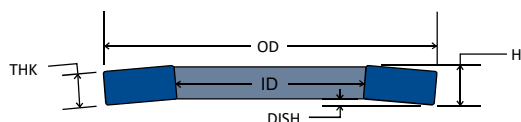


Part Number	Bolt Size	OD	ID	Thick	Dish	Height	Flat Load	T / ft-lb
FB13-30-H13	2"	3.599	2.026	0.501	0.041	0.542	83587	2200
FB13-45-H13	2"	3.599	2.026	0.593	0.037	0.630	125086	3300
FB13-60-H13	2"	3.599	2.026	0.638	0.033	0.671	138937	4400
FB14-30-H13	2-1/4"	4.039	2.282	0.557	0.048	0.605	107109	3180
FB14-45-H13	2-1/4"	4.039	2.282	0.677	0.040	0.717	160268	4770
FB14-60-H13	2-1/4"	4.039	2.282	0.734	0.035	0.769	178721	6360
FB15-30-H13	2-1/2"	4.482	2.529	0.626	0.052	0.678	133617	4400
FB15-45-H13	2-1/2"	4.482	2.529	0.757	0.044	0.801	199929	6600
FB15-60-H13	2-1/2"	4.482	2.529	0.810	0.040	0.850	222665	8800
FB16-30-H13	2-3/4"	4.919	2.777	0.695	0.056	0.751	163554	5920
FB16-45-H13	2-3/4"	4.919	2.777	0.849	0.046	0.895	244906	8880
FB16-60-H13	2-3/4"	4.919	2.777	0.892	0.044	0.936	271685	11840
FB17-30-H13	3"	5.359	3.027	0.755	0.062	0.817	195675	7720
FB17-45-H13	3"	5.359	3.027	0.928	0.050	0.978	293033	11580
FB17-60-H13	3"	5.359	3.027	0.996	0.045	1.041	326056	15440
FB18-60-H13	3-1/4"	5.397	3.293	1.039	0.044	1.083	385062	19990
FB19-60-H13	3-1/2"	6.130	3.525	1.196	0.046	1.242	448145	25090
FB20-60-H13	3-3/4"	6.665	3.818	1.275	0.052	1.327	517376	31020
FB21-60-H13	4"	7.130	4.050	1.500	0.058	1.558	815089	57950

H13 Tool Steel (ASTM A681) Working Temperatures Ambient to 1100°F

Part Numbers

-30 30,000 psi bolt stress
 -45 45,000 psi bolt stress
 -60 60,000 psi bolt stress



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Belleville Spring Flange Washers

Inconel 718

Part Number	Bolt Size	OD	ID	Thick	Dish	Height	Flat Load	T / ft-lb
FB1-30-718	1/2"	1.012	0.528	0.124	0.012	0.136	4273	30
FB1-45-718	1/2"	1.012	0.528	0.146	0.011	0.157	6394	45
FB1-60-718	1/2"	1.012	0.528	0.166	0.010	0.176	8543	60
FB2-30-718	5/8"	1.146	0.642	0.151	0.013	0.164	6876	60
FB2-45-718	5/8"	1.146	0.642	0.182	0.011	0.193	10188	90
FB2-60-718	5/8"	1.146	0.624	0.214	0.009	0.223	13569	120
FB3-30-718	3/4"	1.370	0.762	0.189	0.014	0.203	10100	100
FB3-45-718	3/4"	1.370	0.762	0.222	0.013	0.235	15199	150
FB3-60-718	3/4"	1.370	0.762	0.226	0.015	0.241	20186	200
FB4-30-718	7/8"	1.588	0.891	0.207	0.019	0.226	13871	160
FB4-45-718	7/8"	1.588	0.891	0.265	0.014	0.279	20872	240
FB4-60-718	7/8"	1.588	0.891	0.299	0.013	0.312	27839	320
FB5-30-718	1"	1.807	1.023	0.245	0.020	0.265	18338	245
FB5-45-718	1"	1.807	1.023	0.296	0.017	0.313	27488	368
FB5-60-718	1"	1.807	1.023	0.347	0.014	0.361	36471	490
FB6-30-718	1-1/8"	2.020	1.145	0.279	0.022	0.301	23864	355
FB6-45-718	1-1/8"	2.020	1.145	0.341	0.018	0.359	35649	533
FB6-60-718	1-1/8"	2.020	1.145	0.390	0.016	0.406	47405	710
FB7-30-718	1-1/4"	2.310	1.270	0.311	0.027	0.338	30241	500
FB7-45-718	1-1/4"	2.310	1.270	0.381	0.022	0.403	45306	750
FB7-60-718	1-1/4"	2.310	1.270	0.440	0.019	0.459	60266	1000
FB8-30-718	1-3/8"	2.470	1.401	0.345	0.027	0.372	37059	680
FB8-45-718	1-3/8"	2.470	1.401	0.423	0.022	0.445	55656	1020
FB8-60-718	1-3/8"	2.470	1.401	0.489	0.019	0.508	74259	1360
FB9-30-718	1-1/2"	2.678	1.527	0.378	0.029	0.407	44780	800
FB9-45-718	1-1/2"	2.678	1.527	0.468	0.023	0.491	67349	1200
FB9-60-718	1-1/2"	2.678	1.527	0.540	0.020	0.560	89965	1600
FB10-30-718	1-5/8"	2.948	1.648	0.416	0.032	0.448	53426	1100
FB10-45-718	1-5/8"	2.948	1.648	0.511	0.026	0.537	80398	1650
FB10-60-718	1-5/8"	2.948	1.648	0.586	0.032	0.618	107258	2200
FB11-30-718	1-3/4"	3.168	1.776	0.446	0.035	0.481	62459	1500
FB11-45-718	1-3/4"	3.168	1.776	0.550	0.028	0.578	93706	2250
FB11-60-718	1-3/4"	3.168	1.776	0.637	0.024	0.661	124841	3000
FB12-30-718	1-7/8"	3.392	1.902	0.481	0.037	0.518	72305	2000
FB12-45-718	1-7/8"	3.392	1.902	0.591	0.030	0.621	108679	3000
FB12-60-718	1-7/8"	3.392	1.902	0.626	0.028	0.654	120544	4000

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Belleville Spring Flange Washers

Inconel 718



Part Number	Bolt Size	OD	ID	Thick	Dish	Height	Flat Load	T / ft-lb
FB13-30-718	2"	3.600	2.025	0.501	0.041	0.542	83218	2200
FB13-45-718	2"	3.600	2.025	0.637	0.031	0.668	125173	3300
FB13-60-718	2"	3.600	2.025	0.666	0.030	0.696	138506	4400
FB14-30-718	2-1/4"	4.040	2.282	0.585	0.043	0.628	107168	3180
FB14-45-718	2-1/4"	4.040	2.282	0.757	0.033	0.790	160603	4770
FB14-60-718	2-1/4"	4.040	2.282	0.757	0.033	0.790	178209	6360
FB15-30-718	2-1/2"	4.482	2.530	0.655	0.047	0.702	133512	4400
FB15-45-718	2-1/2"	4.482	2.530	0.805	0.038	0.843	200388	6600
FB15-60-718	2-1/2"	4.482	2.530	0.810	0.040	0.850	222074	8800
FB16-30-718	2-3/4"	4.919	2.777	0.695	0.056	0.751	163181	5920
FB16-45-718	2-3/4"	4.919	2.777	0.849	0.046	0.895	244436	8880
FB16-60-718	2-3/4"	4.919	2.777	0.932	0.040	0.972	271890	11840
FB17-30-718	3"	5.360	3.030	0.790	0.056	0.846	195401	7720
FB17-45-718	3"	5.360	3.030	0.973	0.045	1.018	293365	11580
FB17-60-718	3"	5.360	3.030	1.023	0.043	1.066	325801	15440
FB18-60-718	3-1/4"	5.400	3.290	1.115	0.037	1.152		
FB19-30-718	3-1/2"	6.135	3.530	1.098	0.052	1.150		
FB19-60-718	3-1/2"	6.135	3.530	1.202	0.047	1.249		
FB20-30-718	3-3/4"	6.670	3.825	1.154	0.057	1.211		
FB20-60-718	3-3/4"	6.670	3.825	1.291	0.052	1.343		
FB21-60-718	4"	7.135	4.050	1.618	0.048	1.666		

Inconel 718 (ASTM B637) Working Temperatures -330°F to 1300°F

Part Numbers

-30 30,000 psi bolt stress

-45 45,000 psi bolt stress

-60 60,000 psi bolt stress



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Belleville Spring Flange Washers

Inconel X750



Part Number	Bolt Size	OD	ID	Thick	Dish	Height	Flat Load	T / ft-lb
FB1-30-750	1/2"	1.012	0.528	0.122	0.012	0.134	4260	30
FB1-45-750	1/2"	1.012	0.528	0.144	0.011	0.155	6421	45
FB1-60-750	1/2"	1.012	0.528	0.170	0.009	0.179	8644	60
FB2-30-750	5/8"	1.146	0.641	0.148	0.013	0.161	6791	60
FB2-45-750	5/8"	1.146	0.641	0.185	0.010	0.195	10182	90
FB2-60-750	5/8"	1.146	0.641	0.211	0.009	0.220	13595	120
FB3-30-750	3/4"	1.370	0.762	0.186	0.014	0.200	10077	100
FB3-45-750	3/4"	1.370	0.762	0.224	0.012	0.236	15086	150
FB3-60-750	3/4"	1.370	0.762	0.254	0.011	0.265	20162	200
FB4-30-750	7/8"	1.588	0.891	0.223	0.015	0.238	13949	160
FB4-45-750	7/8"	1.588	0.891	0.261	0.014	0.275	20873	240
FB4-60-750	7/8"	1.588	0.891	0.302	0.012	0.314	27745	320
FB5-30-750	1"	1.807	1.023	0.245	0.019	0.264	18236	245
FB5-45-750	1"	1.807	1.023	0.297	0.016	0.313	27356	368
FB5-60-750	1"	1.807	1.023	0.393	0.015	0.408	36549	490
FB6-30-750	1-1/8"	2.020	1.145	0.279	0.021	0.300	23844	355
FB6-45-750	1-1/8"	2.020	1.145	0.342	0.017	0.359	35553	533
FB6-60-750	1-1/8"	2.020	1.145	0.393	0.015	0.408	47601	710
FB7-30-750	1-1/4"	2.310	1.270	0.310	0.026	0.336	30190	500
FB7-45-750	1-1/4"	2.310	1.270	0.380	0.021	0.401	45019	750
FB7-60-750	1-1/4"	2.310	1.270	0.449	0.017	0.466	60017	1000
FB8-30-750	1-3/8"	2.470	1.401	0.344	0.026	0.370	37030	680
FB8-45-750	1-3/8"	2.470	1.401	0.423	0.021	0.444	55609	1020
FB8-60-750	1-3/8"	2.470	1.401	0.490	0.018	0.508	74092	1360
FB9-30-750	1-1/2"	2.678	1.527	0.382	0.027	0.409	45005	800
FB9-45-750	1-1/2"	2.678	1.527	0.468	0.022	0.490	67432	1200
FB9-60-750	1-1/2"	2.678	1.527	0.541	0.019	0.560	89960	1600
FB10-30-750	1-5/8"	2.948	1.648	0.415	0.031	0.446	53747	1100
FB10-45-750	1-5/8"	2.948	1.648	0.510	0.025	0.535	80445	1650
FB10-60-750	1-5/8"	2.948	1.648	0.585	0.022	0.607	106841	2200
FB11-30-750	1-3/4"	3.168	1.776	0.448	0.033	0.481	62476	1500
FB11-45-750	1-3/4"	3.168	1.776	0.550	0.027	0.577	93606	2250
FB11-60-750	1-3/4"	3.168	1.776	0.637	0.023	0.660	125172	3000
FB12-30-750	1-7/8"	3.392	1.902	0.483	0.035	0.518	72446	2000
FB12-45-750	1-7/8"	3.392	1.902	0.589	0.029	0.618	108855	3000
FB12-60-750	1-7/8"	3.392	1.902	0.624	0.027	0.651	120509	4000

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Belleville Spring Flange Washers

Inconel X750



Part Number	Bolt Size	OD	ID	Thick	Dish	Height	Flat Load	T / ft-lb
FB13-30-750	2"	3.600	2.025	0.516	0.037	0.553	83123	2200
FB13-45-750	2"	3.600	2.025	0.593	0.037	0.630	125014	3300
FB13-60-750	2"	3.600	2.025	0.672	0.028	0.700	138943	4400
FB14-30-750	2-1/4"	4.040	2.282	0.551	0.041	0.592	89373	3180
FB14-45-750	2-1/4"	4.040	2.282	0.720	0.033	0.753	160501	4770
FB14-60-750	2-1/4"	4.040	2.282	0.753	0.032	0.785	178034	6360
FB15-30-750	2-1/2"	4.482	2.530	0.654	0.045	0.699	133255	4400
FB15-45-750	2-1/2"	4.482	2.530	0.800	0.037	0.837	200452	6600
FB15-60-750	2-1/2"	4.482	2.530	0.810	0.040	0.850	222656	8800
FB16-30-750	2-3/4"	4.919	2.777	0.695	0.056	0.751	163432	5920
FB16-45-750	2-3/4"	4.919	2.777	0.849	0.046	0.895	244504	8880
FB16-60-750	2-3/4"	4.919	2.777	0.934	0.038	0.972	272113	11840
FB17-30-750	3"	5.360	3.030	0.793	0.053	0.846	195791	7720
FB17-45-750	3"	5.360	3.030	0.973	0.043	1.016	293430	11580
FB17-60-750	3"	5.360	3.030	1.024	0.041	1.065	326123	15440
FB18-60-750	3-1/4"	5.400	3.290	1.108	0.036	1.144		
FB19-60-750	3-1/2"	6.135	3.530	1.202	0.045	1.247		
FB20-60-750	3-3/4"	6.670	3.825	1.288	0.050	1.338		
FB21-60-750	4"	7.135	4.050	1.617	0.046	1.663		

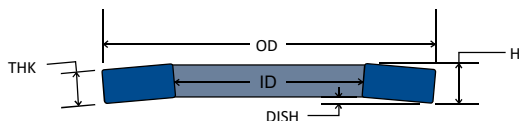
Inconel X750 (A MS 5598) Working Temperatures -400° F to 1200° F

Part Numbers

-30 30,000 psi bolt stress

-45 45,000 psi bolt stress

-60 60,000 pis bolt stress



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Belleville Spring Flange Washers

17-7 PH Stainless Steel



Part Number	Bolt Size	OD	ID	Thick	Dish	Height	Flat Load	T / ft-lb
FB1-30-7	1/2"	1.012	0.528	0.125	0.012	0.137	4314	30
FB1-45-7	1/2"	1.012	0.528	0.147	0.011	0.158	6432	45
FB1-60-7	1/2"	1.012	0.528	0.167	0.010	0.177	8573	60
FB2-30-7	5/8"	1.146	0.642	0.152	0.013	0.165	6912	60
FB2-45-7	5/8"	1.146	0.642	0.178	0.012	0.190	10247	90
FB2-60-7	5/8"	1.146	0.642	0.202	0.011	0.213	13728	120
FB3-30-7	3/4"	1.370	0.762	0.190	0.014	0.204	10113	100
FB3-45-7	3/4"	1.370	0.762	0.223	0.013	0.236	15183	150
FB3-60-7	3/4"	1.370	0.762	0.252	0.012	0.264	20224	200
FB4-30-7	7/8"	1.588	0.891	0.228	0.015	0.243	14037	160
FB4-45-7	7/8"	1.588	0.891	0.266	0.014	0.280	20805	240
FB4-60-7	7/8"	1.588	0.891	0.301	0.013	0.314	27992	320
FB5-30-7	1"	1.807	1.023	0.242	0.021	0.263	18288	245
FB5-45-7	1"	1.807	1.023	0.297	0.017	0.314	27367	368
FB5-60-7	1"	1.807	1.023	0.341	0.015	0.356	36548	490
FB6-30-7	1-1/8"	2.020	1.145	0.276	0.023	0.299	23804	355
FB6-45-7	1-1/8"	2.020	1.145	0.343	0.018	0.361	35756	533
FB6-60-7	1-1/8"	2.020	1.145	0.392	0.016	0.408	47443	710
FB7-30-7	1-1/4"	2.310	1.270	0.312	0.027	0.339	30093	500
FB7-45-7	1-1/4"	2.310	1.270	0.382	0.022	0.404	45004	750
FB7-60-7	1-1/4"	2.310	1.270	0.442	0.019	0.461	60209	1000
FB8-30-7	1-3/8"	2.470	1.401	0.347	0.027	0.374	37162	680
FB8-45-7	1-3/8"	2.470	1.401	0.425	0.022	0.447	55634	1020
FB8-60-7	1-3/8"	2.470	1.401	0.491	0.019	0.510	74088	1360
FB9-30-7	1-1/2"	2.678	1.527	0.380	0.029	0.409	44802	800
FB9-45-7	1-1/2"	2.678	1.527	0.464	0.024	0.488	67501	1200
FB9-60-7	1-1/2"	2.678	1.527	0.542	0.020	0.562	89655	1600
FB10-30-7	1-5/8"	2.948	1.648	0.414	0.033	0.447	83482	1100
FB10-45-7	1-5/8"	2.948	1.648	0.507	0.027	0.534	80367	1650
FB10-60-7	1-5/8"	2.948	1.648	0.589	0.023	0.612	107341	2200
FB11-30-7	1-3/4"	3.168	1.776	0.449	0.035	0.484	62808	1500
FB11-45-7	1-3/4"	3.168	1.776	0.546	0.029	0.575	93631	2250
FB11-60-7	1-3/4"	3.168	1.776	0.632	0.025	0.657	125111	3000
FB12-30-7	1-7/8"	3.392	1.902	0.484	0.037	0.521	72558	2000
FB12-45-7	1-7/8"	3.392	1.902	0.594	0.030	0.624	108749	3000
FB12-60-7	1-7/8"	3.392	1.902	0.622	0.029	0.651	120702	4000

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Belleville Spring Flange Washers

17-7 PH Stainless Steel



Part Number	Bolt Size	OD	ID	Thick	Dish	Height	Flat Load	T / ft-lb
FB13-30-7	2"	3.600	2.025	0.500	0.035	0.535	83458	2200
FB13-45-7	2"	3.600	2.025	0.633	0.032	0.665	124961	3300
FB13-60-7	2"	3.600	2.025	0.670	0.030	0.700	138918	4400
FB14-30-7	2-1/4"	4.040	2.282	0.587	0.043	0.630	106816	3180
FB14-45-7	2-1/4"	4.040	2.282	0.720	0.035	0.755	160279	4770
FB14-60-7	2-1/4"	4.040	2.282	0.753	0.034	0.787	178104	6360
FB15-30-7	2-1/2"	4.482	2.530	0.653	0.048	0.701	133218	4400
FB15-45-7	2-1/2"	4.482	2.530	0.802	0.039	0.841	200433	6600
FB15-60-7	2-1/2"	4.482	2.530	0.810	0.040	0.850	222410	8800
FB16-30-7	2-3/4"	4.919	2.777	0.695	0.056	0.751	163300	5920
FB16-45-7	2-3/4"	4.919	2.777	0.849	0.046	0.895	245012	8880
FB16-60-7	2-3/4"	4.919	2.777	0.937	0.040	0.977	272300	11840
FB17-30-7	3"	5.360	3.030	0.789	0.057	0.846	195349	7720
FB17-45-7	3"	5.360	3.030	0.971	0.046	1.017	293735	11580
FB17-60-7	3"	5.360	3.030	1.020	0.044	1.064	325682	15440
FB18-60-7	3-1/4"	5.400	3.290	1.110	0.038	1.148	384594	19,900
FB19-60-7	3-1/2"	6.135	3.530	1.200	0.048	1.248	448650	25,090
FB20-60-7	3-3/4"	6.670	3.825	1.289	0.053	1.342	517230	31,020
FB21-60-7	4"	7.135	4.050	1.615	0.049	1.664	815364	57,950

17-7 PH Stainless Steel (AMS 5643) Working Temperatures -400°F to 500°F

Part Numbers

-30 30,000 psi bolt stress

-45 45,000 psi bolt stress

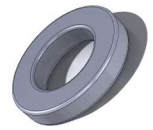
-60 60,000 psi bolt stress



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Belleville Spring Flange Washers

17-4 PH Stainless Steel

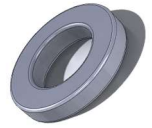


Part Num.	Bolt Size	OD	ID	Thick	Dish	Height	Flat Load	T / ft-lb
FB1-30-4	1/2"	1.012	0.528	0.122	0.013	0.135	4270	30
FB1-45-4	1/2"	1.012	0.528	0.144	0.012	0.156	6482	45
FB1-60-4	1/2"	1.012	0.528	0.168	0.010	0.178	8578	60
FB2-30-4	5/8"	1.146	0.642	0.152	0.013	0.165	6793	60
FB2-45-4	5/8"	1.146	0.642	0.184	0.011	0.195	10196	90
FB2-60-4	5/8"	1.146	0.624	0.209	0.010	0.219	13584	120
FB3-30-4	3/4"	1.370	0.762	0.183	0.016	0.199	10149	100
FB3-45-4	3/4"	1.370	0.762	0.224	0.013	0.237	15122	150
FB3-60-4	3/4"	1.370	0.762	0.253	0.012	0.265	20042	200
FB4-30-4	7/8"	1.588	0.891	0.215	0.018	0.233	13881	160
FB4-45-4	7/8"	1.588	0.891	0.262	0.015	0.277	20933	240
FB4-60-4	7/8"	1.588	0.891	0.302	0.013	0.315	27784	320
FB5-30-4	1"	1.807	1.023	0.243	0.021	0.264	18197	245
FB5-45-4	1"	1.807	1.023	0.299	0.017	0.316	27442	368
FB5-60-4	1"	1.807	1.023	0.343	0.015	0.358	36554	490
FB6-30-4	1-1/8"	2.020	1.145	0.278	0.023	0.301	23906	355
FB6-45-4	1-1/8"	2.020	1.145	0.339	0.019	0.358	35809	533
FB6-60-4	1-1/8"	2.020	1.145	0.395	0.016	0.411	47703	710
FB7-30-4	1-1/4"	2.310	1.270	0.314	0.027	0.341	30147	500
FB7-45-4	1-1/4"	2.310	1.270	0.385	0.022	0.407	45279	750
FB7-60-4	1-1/4"	2.310	1.270	0.445	0.019	0.464	60384	1000
FB8-30-4	1-3/8"	2.470	1.401	0.349	0.027	0.376	37157	680
FB8-45-4	1-3/8"	2.470	1.401	0.427	0.022	0.449	55489	1020
FB8-60-4	1-3/8"	2.470	1.401	0.494	0.019	0.513	74154	1360
FB9-30-4	1-1/2"	2.678	1.527	0.382	0.029	0.411	44763	800
FB9-45-4	1-1/2"	2.678	1.527	0.466	0.024	0.490	67199	1200
FB9-60-4	1-1/2"	2.678	1.527	0.536	0.021	0.557	89526	1600
FB10-30-4	1-5/8"	2.948	1.648	0.417	0.033	0.450	53711	1100
FB10-45-4	1-5/8"	2.948	1.648	0.510	0.027	0.537	80392	1650
FB10-60-4	1-5/8"	2.948	1.648	0.592	0.023	0.615	107110	2200
FB11-30-4	1-3/4"	3.168	1.776	0.451	0.035	0.486	62553	1500
FB11-45-4	1-3/4"	3.168	1.776	0.550	0.029	0.579	94002	2250
FB11-60-4	1-3/4"	3.168	1.776	0.636	0.025	0.661	125304	3000
FB12-30-4	1-7/8"	3.392	1.902	0.487	0.037	0.524	72641	2000
FB12-45-4	1-7/8"	3.392	1.902	0.597	0.030	0.627	108502	3000
FB12-60-4	1-7/8"	3.392	1.902	0.626	0.029	0.029	120924	4000

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Belleville Spring Flange Washers

17-4 PH Stainless Steel



Part Number	Bolt Size	OD	ID	Thick	Dish	Height	Flat Load	T / ft-lb
FB13-30-4	2"	3.600	2.025	0.521	0.039	0.560	83452	2200
FB13-45-4	2"	3.600	2.025	0.637	0.032	0.669	125149	3300
FB13-60-4	2"	3.600	2.025	0.674	0.030	0.704	138983	4400
FB14-30-4	2-1/4"	4.040	2.282	0.591	0.043	0.634	107026	3180
FB14-45-4	2-1/4"	4.040	2.282	0.724	0.035	0.759	160221	4770
FB14-60-4	2-1/4"	4.040	2.282	0.758	0.034	0.792	178543	6360
FB15-30-4	2-1/2"	4.482	2.530	0.657	0.048	0.705	133280	4400
FB15-45-4	2-1/2"	4.482	2.530	0.806	0.039	0.845	199940	6600
FB15-60-4	2-1/2"	4.482	2.530	0.850	0.037	0.887	222478	8800
FB16-30-4	2-3/4"	4.919	2.777	0.728	0.052	0.780	163160	5920
FB16-45-4	2-3/4"	4.919	2.777	0.895	0.042	0.937	244869	8880
FB16-60-4	2-3/4"	4.919	2.777	0.942	0.040	0.982	271912	11840
FB17-30-4	3"	5.360	3.030	0.794	0.057	0.851	195580	7720
FB17-45-4	3"	5.360	3.030	0.976	0.046	1.022	293153	11580
FB17-60-4	3"	5.360	3.030	1.026	0.044	1.070	325748	15440
FB18-60-4	3-1/4"	5.400	3.290	1.117	0.038	1.155		
FB19-60-4	3-1/2"	6.135	3.530	1.207	0.048	1.255		
FB20-60-4	3-3/4"	6.670	3.825	1.296	0.053	1.349		
FB21-60-4	4"	7.135	4.050	1.625	0.049	1.674		

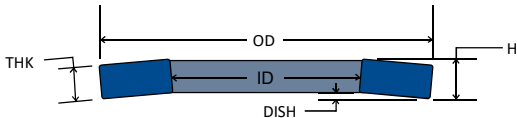
17-4 PH Stainless Steel (ASTM A693) Working Temperatures -330°F to 600°F

Part Numbers

-30 30,000 psi bolt stress

-45 45,000 psi bolt stress

-60 60,000 psi bolt stress



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Belleville Spring Flange Washers Installation

Installation:

There are several factors to keep in mind when ordering and installing BelleFlex Technologies Belleville spring flange washers.

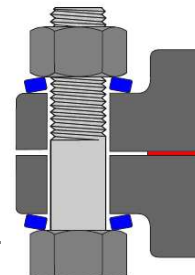
Typically, the operating temperature is the first thing to consider. This usually determines the material of the flange washer. The temperatures listed are the temperatures that the Belleville spring will operate, not the process temperature. As a rule of thumb, the Belleville spring will see about 50% of the process temperature, unless the flange is insulated.

Belleville spring flange washers are available in several different materials. Selecting the right one is based on the applications environment. H13 tool steel is the most commonly used material and has an operating temperature of up to 1100°F. Inconel X750 and Inconel 718, can be used for both cryogenic and high temperature applications as well as corrosive environments. 17-7PH Stainless Steel can also be used in cryogenic applications, but can be susceptible to chloride and fluoride stress corrosion cracking. Additional information on each material can be found on the parts pages or you can contact BelleFlex Technologies Engineering Dept.

H13 Tool Steel	Ambient to 1100°F
Inconel 718	-330°F to 1300°F
Inconel X750	-400°F to 1200°F
17-7PH Stainless	-400°F to 500°F
17-4PH Stainless	-330°F to 600°F

When installing Belleville spring flange washers for the first time, the bolt or stud length must be considered. Many existing applications do not have bolts or studs that are long enough to accommodate the added thickness of the Belleville springs being added. When possible, new studs, nuts and Belleville springs should be used. Lubrication and/or anti-seize should also be considered.

In most cases, it is recommended to use one Belleville spring flange washer on each end of the stud or bolt. This may not always be possible. Two springs on the same side have the same affect on the joint as one spring on each side of the joint. Examples of other stacking arrangements can be found on the next page.



Tightening procedures do not change when installing Belleville spring flange washers. Typically the bolts are tightened in multiple passes following your companies procedure. They can be tightened by hand, impact or hydraulic tensioner. There are various methods to get to a final torque or bolt load, but by using Belleville spring flange washers, you can maintain that load above the sealing stress of the gasket to keep the joint leak free and reduce fugitive emissions.

For additional information, engineering assistance or design help, please contact BelleFlex Technologies.

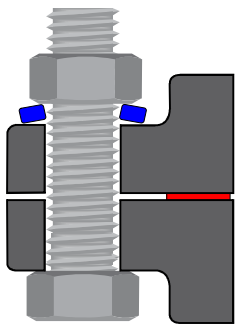


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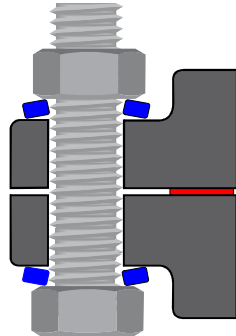
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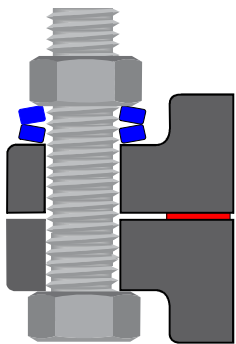
Common Flange Washer Stacking Arrangements



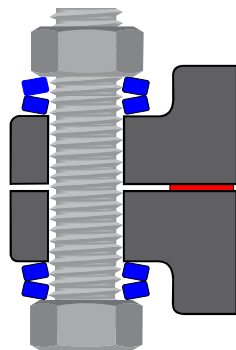
One per Bolt



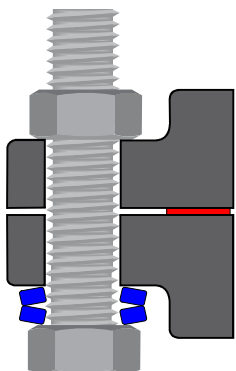
One on
Each Side



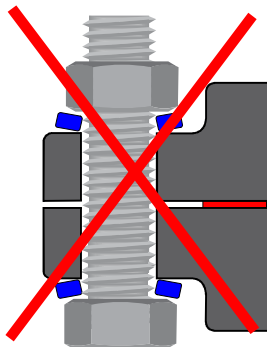
Two in Series



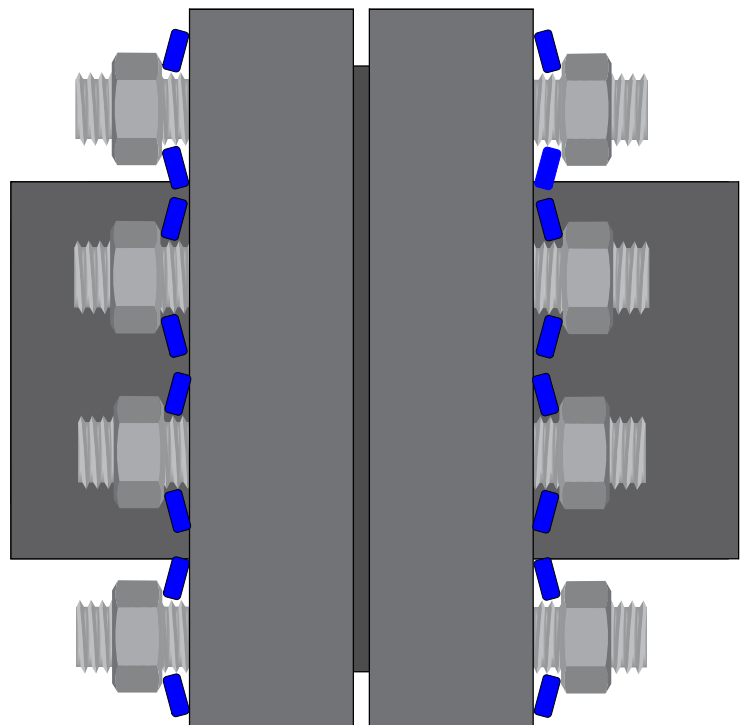
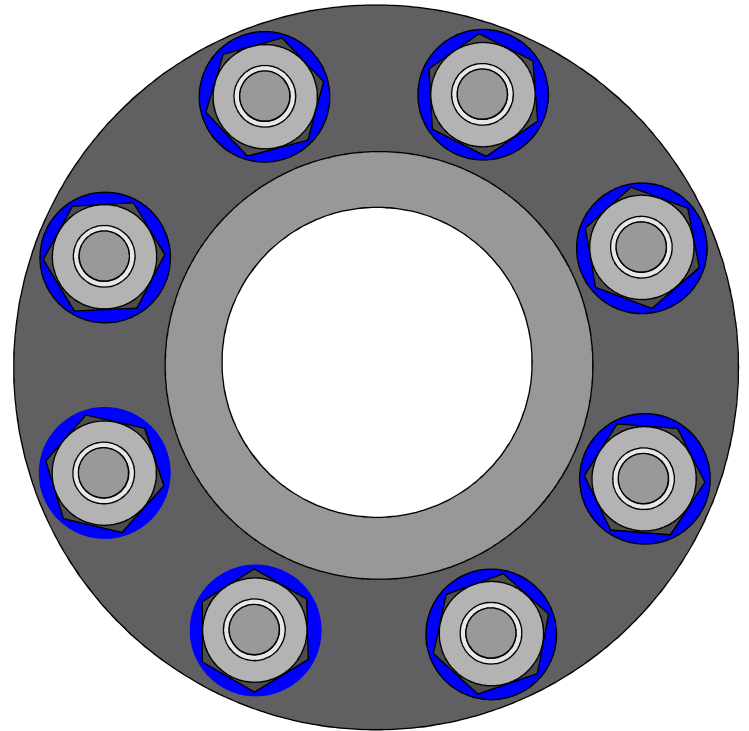
Two in Series
Both Sides



When using hydraulic
tensioners



Springs Installed
Upside Down



Belleville Spring Flange Washers Shown Uncompressed

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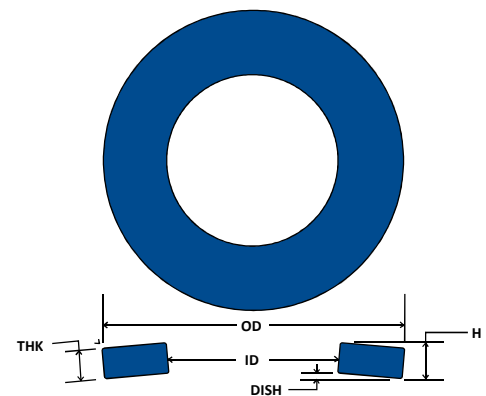
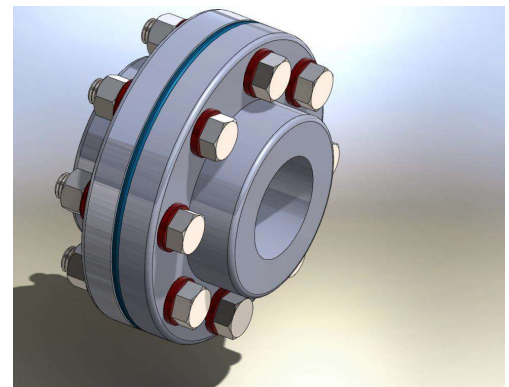
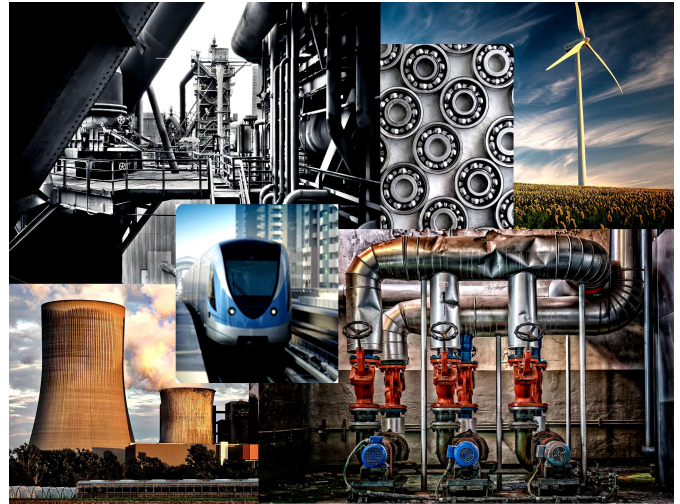


Beyond Belleville Springs



Our PulFlex division is developing ultra-high strength composites and a wide range of corrosion-resistant materials to face challenges from the deepest mines and ocean floors to the unique requirements of deep space.

A keystone element of the BelleFlex / PulFlex business model is our ability to explore, create and produce engineered solutions for our customers and for the industries and regions we serve around the world.



BelleFlex Technologies, LLC - 706 Eljer Way, Ford City, PA 16226

P: 724-540-5053 F: 724-540-5063 www.belleflex.com

724-816-3648 - 24 Hour Emergency Service - 724-681-3234