

Installation Handbook DeltaV-Seal™ 304L

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Scope

- DeltaV-Seal ASTM A240 Gr. 304L Standard Products
- ASME B16.5 ASTM A182 Gr. F304L Flanges
- NPS ½" - 24" Class 150
- NPS ½" - 20" Class 300

Installation Procedure

Gasket installation shall always be conducted by qualified personnel, according to EN 1591-4 or equivalent.

1. Check that the flanges are made of UNS S30403 ASTM A182 F304L stainless steel and marked with correct size and pressure class. Ensure that the pipe schedule matches the flange neck outside diameter and wall thickness.
2. Check the flanges for damage and ensure that no defects are outside of the tolerances as defined for 'Hard-Faced Gaskets' in ASME PCC-01–2022 Appendix D. Repair or replace if necessary.
3. Clean all contact surfaces and clear for impurities and debris. Use a wire brush and a rag with solvent.
4. Check to verify that the bolts are the correct quality made of material grade A2-80, in accordance with ISO 3506-1, unless otherwise specified, refer to Table 3-8.
5. Grease bolts sufficiently with Molykote® G-Rapid Plus so that all threads and contact surfaces between bolt head, nuts and flanges are covered with lubricant, as shown in Figure 1.

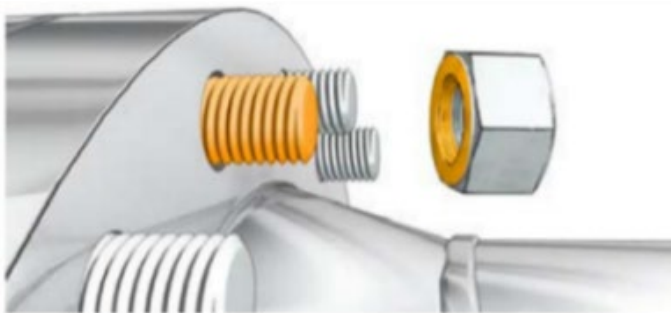


Figure 1: Lubrication (also refer to Note 4)

6. Before installation of the DeltaV-Seal, the flange joint alignment shall be verified. The following four verification methods and tolerances shall be applied:
 - Centreline (CL) tolerance shall be measured at four locations, each approximately 90° apart on the flange. Hold a straight edge parallel to the axis of one flange and flush with the outside diameter (O.D.). Extend the straight edge to the adjoining flange and measure the distance from the straight edge surface to the same surface on the adjoining flange, see Figure 2.
 - Gap (GP) tolerance is a measurement of the spacing between the seating surfaces, see Figure 3.

- Parallelism (PRL) tolerance is a measurement defining the uniformity of distance between the sealing surfaces of two flange faces. PRL tolerance shall be calculated as the difference between the largest and smallest distance between the two sealing surfaces at the sealing surface O.D., see Figure 4.
- Rotational two-hole (RTH) ensures that the flange holes are rotationally aligned to one another such that the fasteners can be installed perpendicular to both flanges. Measure RTH by confirming that the hole centres are aligned, see Figure 5.

Figure E-2-1
Centerline High/Low

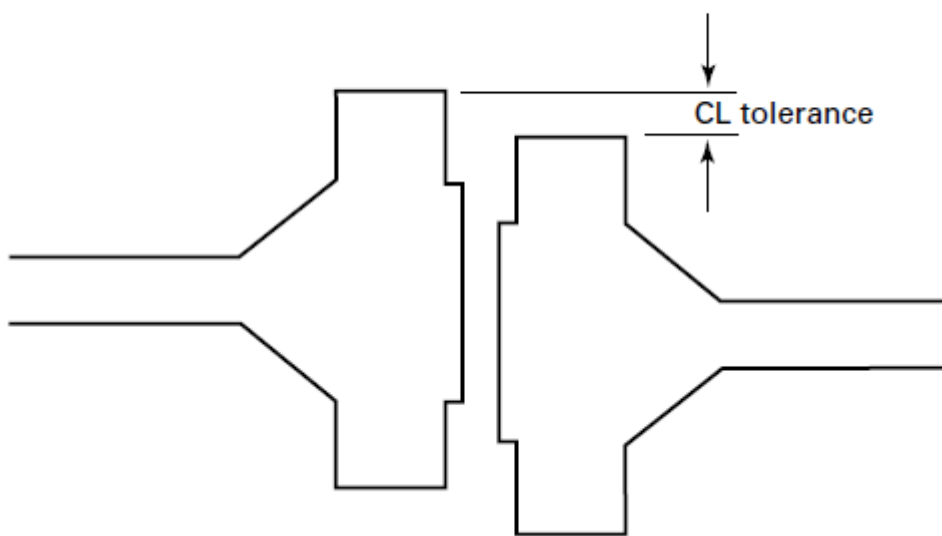


Figure 2

Figure E-2-2
Excessive Spacing Gap

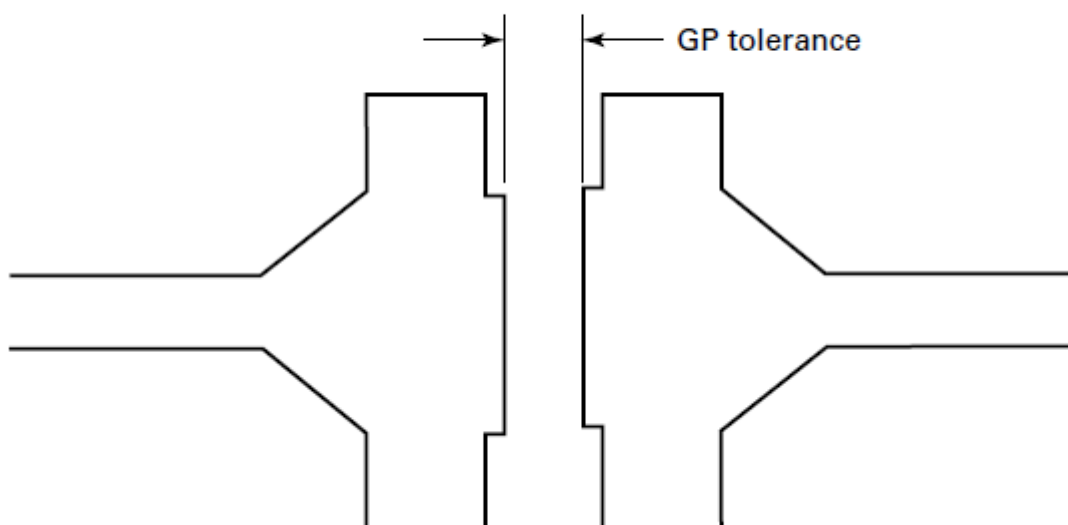


Figure 3

Figure E-2-3
Parallelism

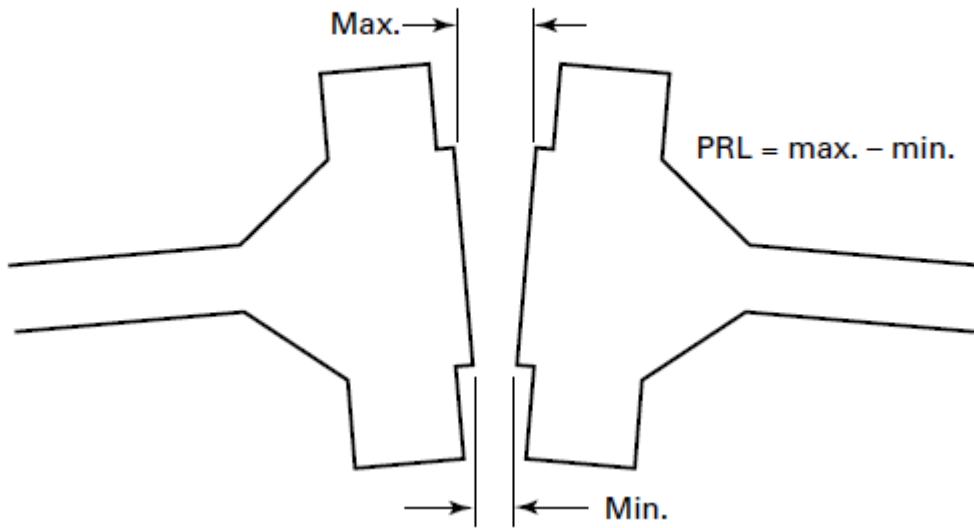


Figure 4

Figure E-2-4
Rotational Two-Hole

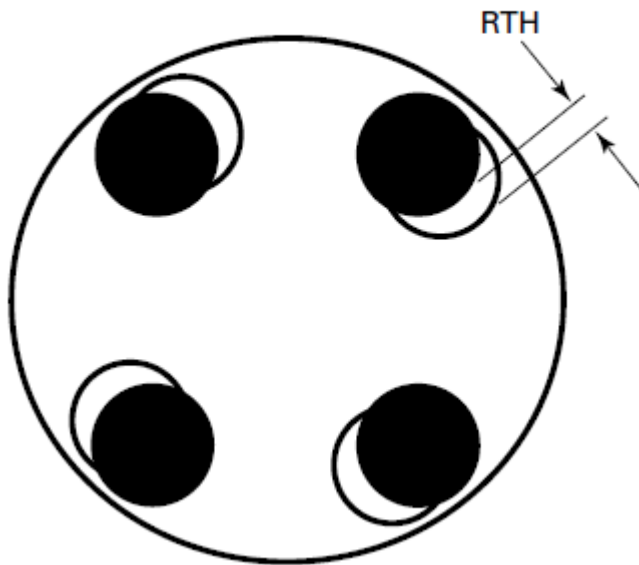


Figure 5

The alignment tolerances shall comply with Table 1.

Table E-2-1	
Flange Alignment Tolerances	
Property	Maximum Tolerance, mm (in.)
CL	1.5 (1/16)
GP	7.6 (1/4)
PRL	0.8 (1/32)
RTH	3 (1/8)

Table 1

Proper tools and methods for correcting misaligned flanges shall be applied, e.g. Equalizer™ FA4TM and FA9TE Flange Alignment Tools or similar.

When external alignment devices are used, flanges should be brought into uniform contact with the uncompressed gasket face using a maximum of 10% of the total target assembly bolt load, refer to Table 4, 6 and 8. No single bolt should be tightened above 20% of the single target bolt load.

When no external alignment devices are used, flanges should meet the alignment tolerances for PRL and GP using a maximum of 20% of the total target assembly bolt load.

7. For horizontal pipework, insert the two bottom bolts and attach nuts, so that the DeltaV-Seal™ can be centred.
8. Insert the DeltaV-Seal™ between the flanges and then insert all bolts and attach nuts.
9. Hand-tighten all bolts evenly making sure the flange faces are parallel.
10. Select a star tightening pattern in accordance with the sequence as given in Table 2 for the applicable number of bolts for any given flange. Always start the bolt-numbering on the bolt where it is widest between the flange faces (12 o'clock position). Always use a calibrated torque wrench, or another form of calibrated torque control.

**ASME PCC-1 - 2022, APPENDIX 7: TABLE F-6.1.1.1-1
STAR PATTERN SEQUENCING**

NO. OF BOLTS	Bolt-Numbering Sequence to Be Marked Clockwise on the Flange
4	1, 3, 2, 4
8	1, 5, 3, 7, 2, 6, 4, 8
12	1, 9, 5, 3, 11, 7, 2, 10, 6, 4, 12, 8
16	1, 9, 5, 13, 3, 11, 7, 15, 2, 10, 6, 14, 4, 12, 8, 16
20	1, 17, 9, 5, 13, 3, 19, 11, 7, 15, 2, 18, 10, 6, 14, 4, 20, 12, 8, 16
24	1, 17, 9, 5, 13, 21, 3, 19, 11, 7, 15, 23, 2, 18, 10, 6, 14, 22, 4, 20, 12, 8, 16, 24

Table 2

Following the sequence numbers as marked per Table 2, tighten each bolt as described in Table 3-8. These incremental loading and tightening steps lead to the assembly target bolt load and torque as stated in Table 3-8, see also Figure 6.

Star Pattern; 24-Bolt Basic Example: (Steps 1-9): (outer numbers indicate the tightening sequence)

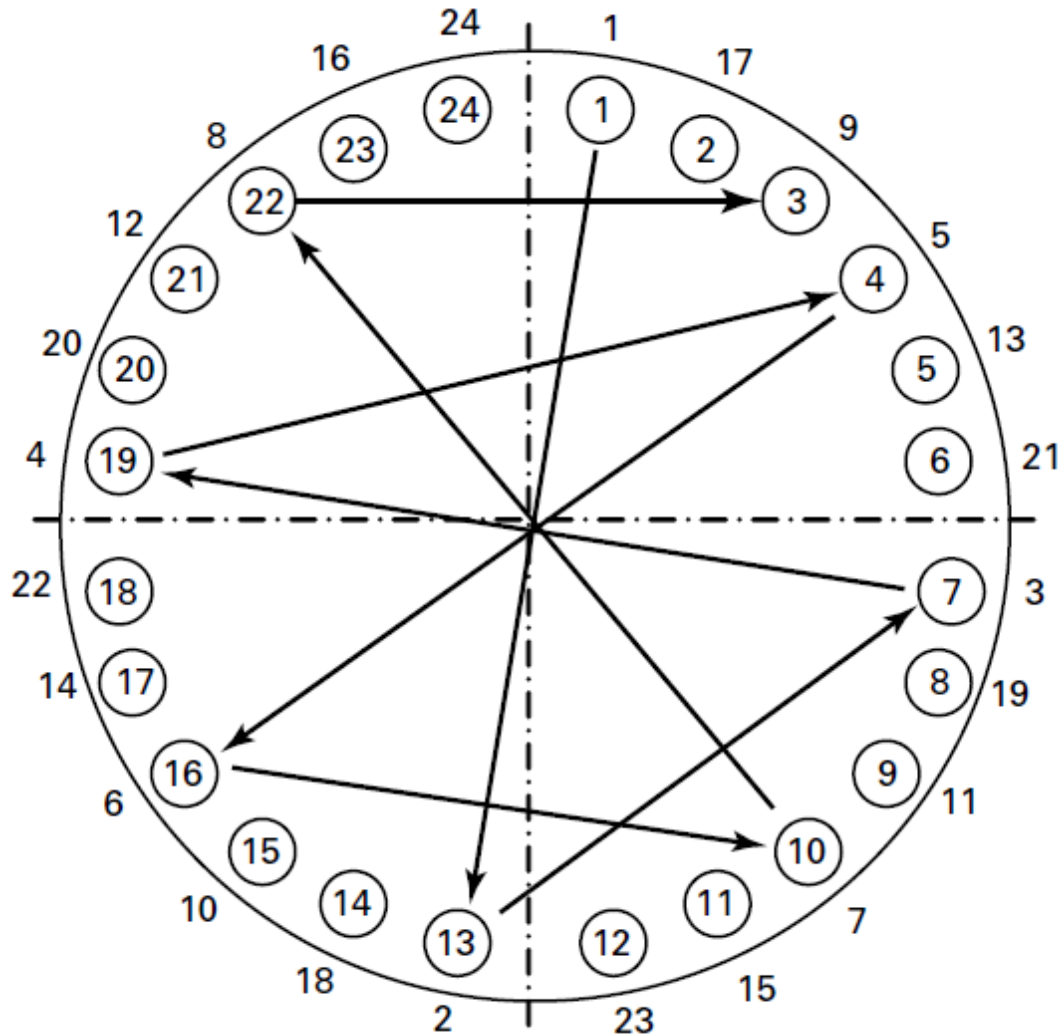


Figure 6

11. Make one last round with 100% torque going clockwise, or counter-clockwise, from bolt to bolt around the entire flange (circular tightening).

Should another form of assembly method be applied e.g., hydraulic tensioner, ensure that the listed values for total installation force ($F_{B0,Nom}$) are reached, as shown in Table 4, 6 and 8.

Table 3 – ASME Class 150 Torque Table

ASME Class 150 – Maximum operating temperature 200°C									
Nominal Pipe Size (NPS)	No. of Bolts	Size of bolts [inch]	Torque [Nm]					Notes	
			Initial Step	10%	20%	40%	80%		100%
½	4	½	Hand tighten	3	5	11	22	27	
¾	4	½		4	8	16	33	41	
1	4	½		6	12	23	46	58	
1 ¼	4	½		6	12	24	49	61	
1 ½	4	½		6	12	24	48	60	
2	4	¾		12	23	46	93	116	
2 ½	4	¾		12	23	46	92	115	
3	4	¾		11	23	46	91	114	
3 ½	8	¾		11	21	42	85	106	
4	8	¾		11	23	45	90	113	
5	8	¾		17	34	69	138	172	
6	8	¾		19	38	76	153	191	
8	8	¾		20	41	81	162	203	
10	12	1		26	52	104	208	260	
12	12	1		28	57	114	227	284	
14	12	1		38	76	153	306	382	
16	16	1		32	64	128	256	320	
18	16	1 ⅛		46	93	185	370	463	
20	20	1 ⅛		29	57	114	229	286	
22	20	1 ⅛		50	99	199	398	497	
24	20	1 ⅛	55	110	220	439	549		

Table 4 – ASME Class 150 Installation Forces (corresponding to Table 3)

ASME #150 – Maximum operating temperature 200°C									
Nominal Pipe Size (NPS)	No. of Bolts	Size of bolts [inch]	Force [kN]					Total inst. force FBO,Nom (kN) (100% x No. bolts)	
			Initial Step	10%	20%	40%	80%		100%
½	4	½	Hand tighten	2	4	7	14	18	70
¾	4	½		3	5	11	21	27	106
1	4	½		4	8	15	30	38	151
1 ¼	4	½		4	8	16	31	39	157
1 ½	4	½		4	8	16	31	39	155
2	4	⅝		6	12	24	49	61	244
2 ½	4	⅝		6	12	24	48	61	242
3	4	⅝		6	12	24	48	60	240
3 ½	8	⅝		6	11	22	45	56	446
4	8	⅝		6	12	24	48	59	475
5	8	¾		8	15	31	62	77	618
6	8	¾		9	17	34	69	86	689
8	8	¾		9	18	37	73	92	732
10	12	⅞		10	20	41	81	101	1215
12	12	⅞		11	22	44	89	111	1329
14	12	1		13	26	52	105	131	1574
16	16	1		11	22	44	88	110	1758
18	16	1 ⅛		14	29	58	115	144	2307
20	20	1 ⅛		9	18	36	71	89	1778
22	20	1 ⅛		14	28	57	113	141	2826
24	20	1 ⅛	16	31	62	125	156	3119	

Table 5 – ASME Class 300 - 600 Torque Table

ASME #300 - #600 – Maximum operating temperature 200°C									
Nominal Pipe Size (NPS)	No. of Bolts	Size of bolts [inch]	Torque [Nm]					Notes	
			Initial Step	10%	20%	40%	80%		100%
½	4	½	Hand tighten	4	8	16	33	41	
¾	4	½		7	13	26	52	65	
1	4	½		8	17	34	67	84	
1 ¼	4	½		10	20	40	81	101	
1 ½	4	½		14	28	57	114	142	
2	4	⅝		7	14	29	58	72	
2 ½	4	⅝		10	21	41	82	103	
3	4	⅝		20	40	80	161	201	

Table 6 – ASME Class 300 - 600 Installation Forces (corresponding to Table 5)

ASME #300 - #600 – Maximum operating temperature 200°C									
Nominal Pipe Size (NPS)	No. of Bolts	Size of bolts [inch]	Force [kN]					Total inst. force FBO,Nom (kN) (100% x No. bolts)	
			Initial Step	10%	20%	40%	80%		100%
½	4	½	Hand tighten	3	5	11	21	27	106
¾	4	½		3	7	14	27	34	137
1	4	½		4	9	18	35	44	177
1 ¼	4	½		5	11	21	43	53	213
1 ½	4	½		6	13	25	51	64	254
2	4	⅝		8	15	30	60	76	302
2 ½	4	⅝		9	19	37	74	93	370
3	4	⅝		9	18	36	72	91	362

Table 7 – ASME Class 300 Torque Table

ASME #300 – Maximum operating temperature 200°C									
Nominal Pipe Size (NPS)	No. of Bolts	Size of bolts [inch]	Torque [Nm]					Notes	
			Initial Step	10%	20%	40%	80%		100%
3 ½	8	¾	Hand tighten	11	23	46	91	114	
4	8	¾		16	32	64	129	161	
5	8	¾		17	35	70	139	174	
6	12	¾		16	32	63	126	158	
8	12	7/8		23	46	93	186	232	
10	16	1		25	50	99	198	248	
12	16	1 1/8		34	68	136	271	339	
14	20	1 1/8		30	61	121	242	303	
16	20	1 1/4		34	67	134	269	336	
18	24	1 1/4		32	64	128	257	321	
20	24	1 1/4		50	101	202	403	504	

Table 8 – ASME Class 300 Installation Forces (corresponding to Table 7)

ASME Class 300 Maximum operating temperature 200°C									
Nominal Pipe Size (NPS)	No. of Bolts	Size of bolts [inch]	Initial Step	Force [kN]					Total inst. force FBO,Nom (kN) (100% x No. bolts)
				10%	20%	40%	80%	100%	
3 ½	8	¾	Hand tighten	5	10	21	41	51	410
4	8	¾		7	14	29	58	72	579
5	8	¾		8	16	31	62	78	623
6	12	¾		7	14	29	57	71	856
8	12	7/8		9	19	37	75	93	1118
10	16	1		9	17	34	68	85	1365
12	16	1 1/8		11	21	42	84	105	1687
14	20	1 1/8		9	19	38	76	94	1888
16	20	1 1/4		10	19	38	76	95	1907
18	24	1 1/4		9	18	37	73	91	2190
20	24	1 1/4		14	29	57	115	143	3439

Notes to Installation Procedure

1. Stated torque values are only applicable for A2-80 bolting. For other bolting, contact Pipeotech for custom-made torque values.
2. Torque values are only applicable to Molykote® G-Rapid Plus lubricant. For other lubricants, contact Pipeotech for custom-made torque values.
3. All torque values are calculated by $M_{t,nom} = k_B \times \frac{F_{B0nom}}{n_B}$ in accordance with EN 1591-1 equation B.4. k_B is the calculated “nut factor” from the coefficients of friction in the threads and underhead from the bolts/nuts, F_{B0nom} is the total installation force whilst n_B is the number of bolts. The F_{B0nom} - value is marked on each gasket as given in Table 4, 6 and 8.
4. All torque and force values in Table 3-8 are rounded off to the nearest Nm/kN.