Installation Handbook DeltaV-Seal™ S235

Contents

Scope

- DeltaV-Seal EN 10025-2 S235JR/1.0038 Standard Products
- ASME B16.5 ASTM A105 Flanges
- NPS ½'' - 24'' Class 150
- NPS ½'' - 12'' Class 300
- NPS 3½'' - 16'' Class 600

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 ASTM A105 carbon steel and marked with correct size and pressure class. Ensure that the pipe schedule is SCH 40.
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 42CrMo4 - 1.7225 +QT, in accordance with EN 10269, unless otherwise specified, refer to Table 3-10.
5. Grease bolts sufficiently with Molykote® G-Rapid Plus so that all threads and contact surfaces between nuts and flanges are covered with lubricant as shown in Figure 1.

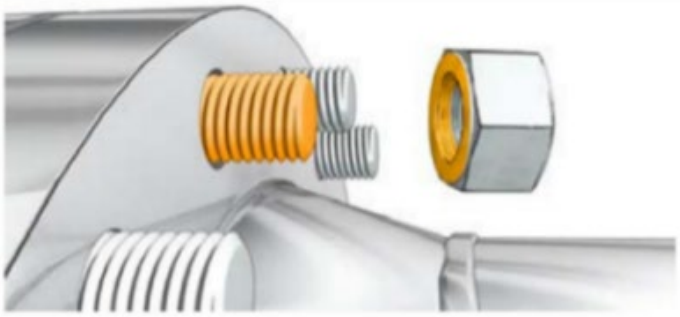

Figure 1: Lubrication (also refer to Note 2)

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

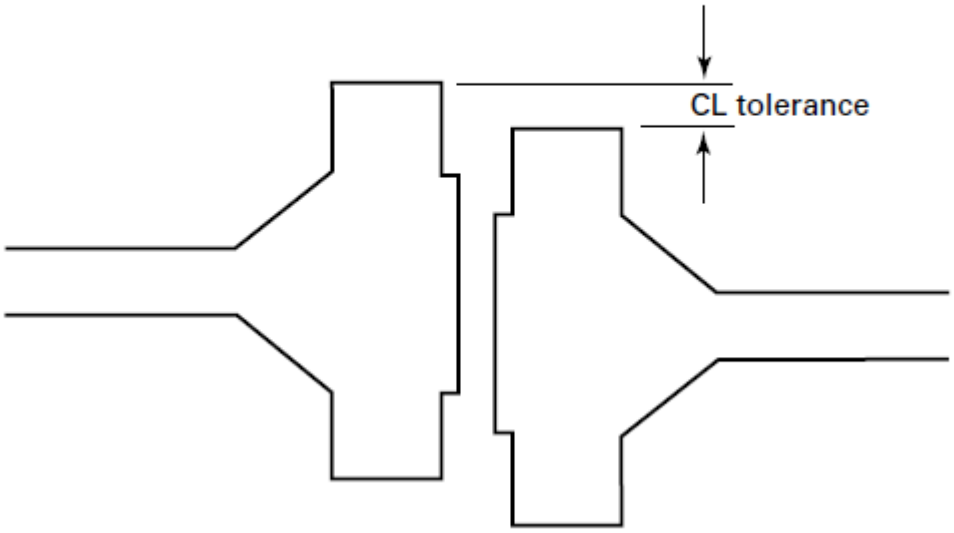

Figure 2

Figure E-2-2
Excessive Spacing Gap

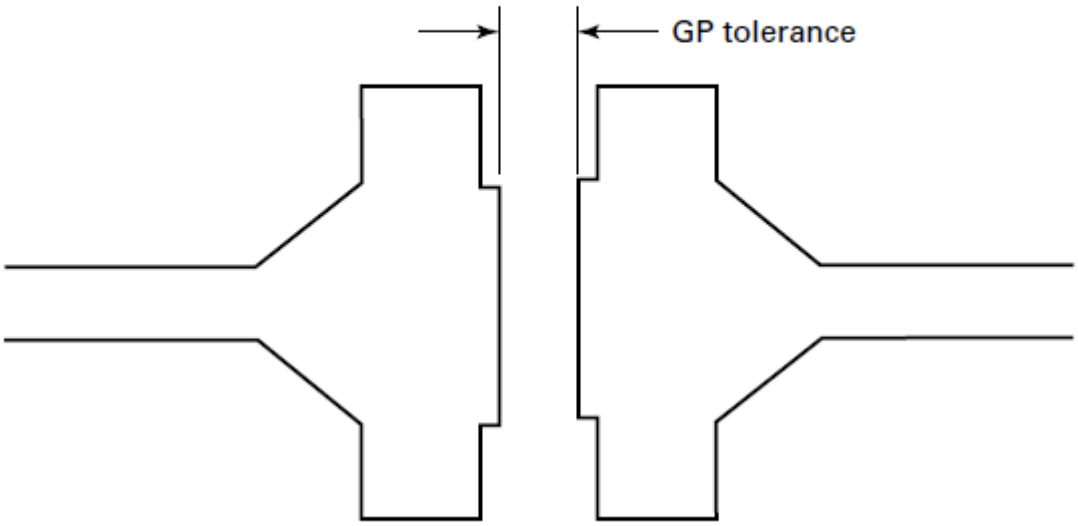

Figure 3

Figure E-2-3
Parallelism

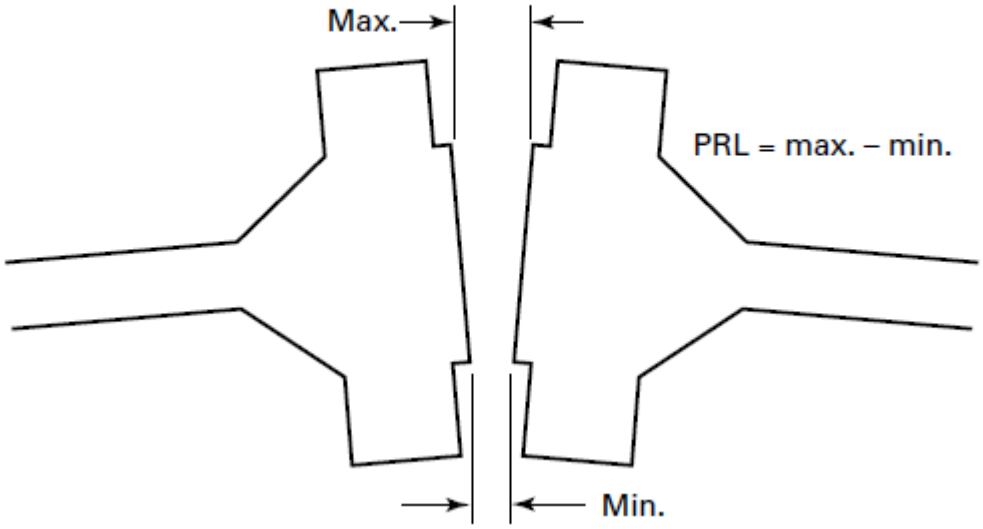

Figure 4

Figure E-2-4
Rotational Two-Hole

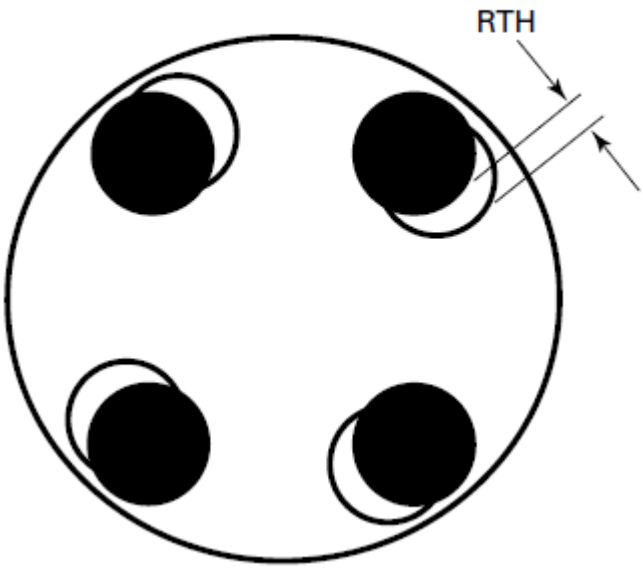

Figure 5

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, 8 and 10. 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 3 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 3-10. These incremental loading and tightening steps lead to the assembly target bolt load and torque as stated in Table 3-10, see also Figure 6.

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

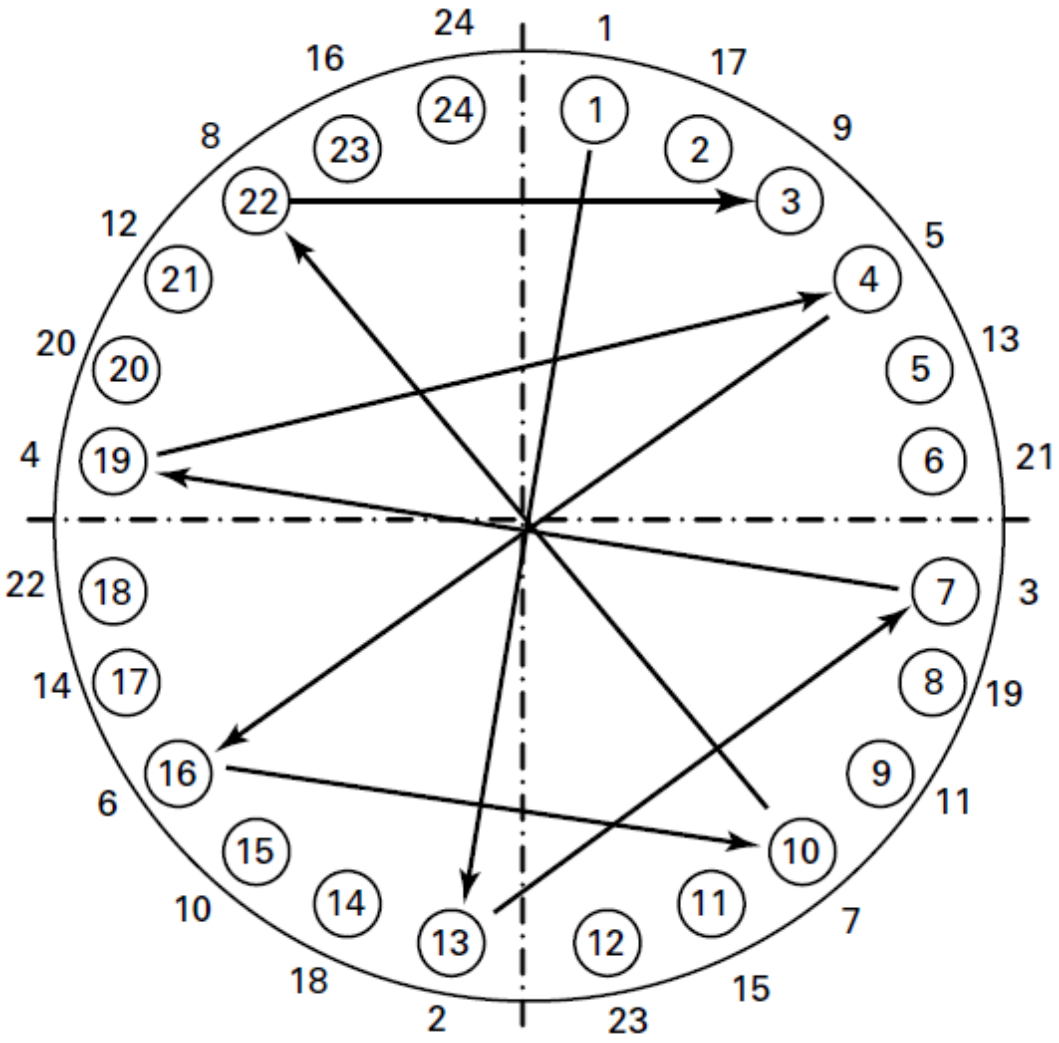

Figure 6

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, 8 and 10.

Table 3 – ASME Class 150 Torque Table

ASME Class 150 Maximum operating temperature 400°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	6	11	22	28	
¾	4	½		6	12	24	49	61	
1	4	½		7	15	30	59	74	
1 ¼	4	½		6	12	25	50	62	
1 ½	4	½		5	11	21	42	53	
2	4	⅝		11	22	44	88	110	
2 ½	4	⅝		10	20	39	78	98	
3	4	⅝		12	24	48	96	120	Note 1
3 ½	8	⅝		10	19	39	78	97	
4	8	⅝		10	20	41	82	102	
5	8	¾		16	32	64	127	159	
6	8	¾		20	40	81	162	202	
8	8	¾		21	41	82	165	206	
10	12	⅞		28	56	111	222	278	
12	12	⅞		30	60	119	238	298	
14	12	1		38	76	152	304	380	
16	16	1		33	66	132	264	330	
18	16	1 ⅛		49	99	198	395	494	
20	20	1 ⅛		44	88	175	350	438	
22	20	1 1/4		55	111	222	443	554	
24	20	1 1/4		58	116	233	466	582	

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

ASME Class 150 Maximum operating temperature 400°C									
Nominal Pipe Size (NPS)	No. of Bolts	Size of bolts [inch]	Force [kN]						Total inst. force FB0,Nom (kN) (100% x No. bolts)
			Initial Step	10%	20%	40%	80%	100%	
½	4	½	Hand Tighten	2	4	7	15	18	73
¾	4	½		3	6	13	26	32	129
1	4	½		4	8	16	31	39	156
1 ¼	4	½		4	8	16	32	40	161
1 ½	4	½		3	7	14	27	34	137
2	4	⅝		6	12	23	46	58	231
2 ½	4	⅝		5	10	21	41	52	206
3	4	⅝		6	13	25	51	64	254
3 ½	8	⅝		5	10	21	41	51	410
4	8	⅝		5	11	21	43	54	428
5	8	¾		7	14	29	57	71	570
6	8	¾		9	18	36	72	90	723
8	8	¾		9	18	37	74	92	739
10	12	⅞		11	22	43	87	108	1299
12	12	⅞		12	23	46	93	116	1392
14	12	1		13	26	52	104	131	1567
16	16	1		11	23	45	91	113	1815
18	16	1 ⅛		15	31	62	123	154	2460
20	20	1 ⅛		14	27	55	109	136	2725
22	20	1 1/4		16	31	63	126	157	3149
24	20	1 1/4		17	33	66	132	166	3310

Table 5 – ASME Class 300 - 600 Torque Table

ASME Class 300 – 600 Maximum operating temperature 400°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	7	13	26	33	
¾	4	⅝		6	13	25	50	63	
1	4	⅝		8	15	31	62	77	
1 ¼	4	⅝		11	21	43	86	107	
1 ½	4	3/4		15	30	61	122	152	
2	8	⅝		6	11	22	45	56	
2 ½	8	3/4		11	22	45	90	112	
3	8	3/4		14	27	55	110	137	

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

ASME Class 300 – 600 Maximum operating temperature 400°C									
Nominal Pipe Size (NPS)	**No. of Bolts**	**Size of bolts [inch]**	**Force [kN]**						**Total inst. force FB0,Nom (kN) (100% x No. bolts)**
			Initial Step	**10%**	**20%**	**40%**	**80%**	**100%**	
½	4	½	Hand Tighten	3	6	12	24	30	120
¾	4	½		3	7	13	26	33	132
1	4	½		4	8	16	32	41	162
1 ¼	4	½		6	11	23	45	56	225
1 ½	4	½		7	14	27	54	68	272
2	4	⅝		6	12	24	47	59	236
2 ½	4	⅝		10	20	40	80	101	402
3	4	⅝		12	25	49	99	123	493

Table 7 – ASME Class 300 Torque Table

ASME Class 300 Maximum operating temperature 400°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	14	28	56	113	141	
4	8	¾		17	35	69	138	173	
5	8	¾		11	22	44	88	110	
6	12	¾		16	32	64	128	160	
8	12	⅞		17	34	68	135	169	
10	16	1		14	28	56	112	140	
12	16	1 1/8		31	63	125	250	313	

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

ASME Class 300 Maximum operating temperature 400°C									
Nominal Pipe Size (NPS)	**No. of Bolts**	**Size of bolts [inch]**	**Force [kN]**						**Total inst. force FB0,Nom (kN) (100% x No. bolts)**
			Initial Step	**10%**	**20%**	**40%**	**80%**	**100%**	
3 ½	8	¾	Hand Tighten	6	13	25	51	63	507
4	8	¾		8	16	31	62	78	620
5	8	¾		5	10	20	40	50	396
6	12	¾		11	22	43	86	108	860
8	12	⅞		10	21	41	83	103	826
10	16	1		9	18	36	72	90	1074
12	16	1 1/8		14	27	54	109	136	1632

Table 9 – ASME Class 600 Installation Torque Table

ASME #600 – Maximum operating temperature 400°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	⅞	Hand Tighten	18	35	70	141	176	
4	8	⅞		21	41	83	166	207	
5	8	1		34	68	136	271	339	
6	12	1		33	66	133	266	332	
8	12	1 1/8		49	99	197	394	493	
10	16	1 1/4		52	104	208	416	520	
12	20	1 1/4		55	110	220	439	549	
14	20	1 3/8		60	120	240	481	601	
16	20	1 1/2		81	161	323	646	807	

Table 10 – ASME Class 600 Installation Forces (corresponding to Table 9)

ASME Class 600 Maximum operating temperature 400°C									
Nominal Pipe Size (NPS)	**No. of Bolts**	**Size of bolts [inch]**	**Force [kN]**						**Total inst. force FB0,Nom (kN) (100% x No. bolts)**
			Initial Step	**10%**	**20%**	**40%**	**80%**	**100%**	
3 ½	8	⅞	Hand Tighten	7	14	28	55	69	550
4	8	⅞		8	16	32	65	81	646
5	8	1		12	23	47	93	117	933
6	12	1		11	23	46	91	114	1367
8	12	1 1/8		15	31	61	123	153	1840
10	16	1 1/4		15	30	59	118	148	2363
12	20	1 1/4		16	31	62	125	156	3118
14	20	1 3/8		16	31	63	126	157	3147
16	20	1 1/2		20	39	78	157	196	3919

Notes to Installation Procedure

1. Under-bolted flange design.
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, 8 and 10.
4. All torque and force values in Table 3-10 are rounded off to the nearest Nm/kN.