

Installation Handbook DeltaV-Seal™ S235

Contents

- Scope..... 2
- Installation Procedure 3
- Table 3 – EN PN10 Torque Table 9
- Table 4 – EN PN10 Installation Forces (corresponding to Table 3) 10
- Table 5 – EN PN16 Torque Table 11
- Table 6 – EN PN16 Installation Forces (corresponding to Table 5) 12
- Table 7 – EN PN25 Torque Table 13
- Table 8 – EN PN25 Installation Forces (corresponding to Table 7) 14
- Table 9 – EN PN40 Torque Table 15
- Table 10 – EN PN40 Installation Forces (corresponding to Table 9) 16
- Table 11 – EN PN10-40 Torque Table 17
- Table 12 – EN PN10-40 Installation Forces (corresponding to Table 11) 18
- Table 13 – EN PN10-16 Torque Table 19
- Table 14 – EN PN10-16 Installation Forces (corresponding to Table 13) 20
- Table 15 – EN PN25-40 Torque Table 21
- Table 16 – EN PN25-40 Installation Forces (corresponding to Table 15) 22
- Notes to Installation Procedure..... 23



Revision No.: 1	Revision date: 27.11.2022
Doc. No: DVS-116-H0-600-01	Page 2

Scope

- DeltaV-Seal EN 10025-2 S235JR/1.0038 Standard Products
- EN 1092-1 EN 10222-2 P245GH/1.0352 Flanges
- DN200-DN600 PN10
- DN200-DN400 PN16
- DN200-DN350 PN25
- DN200-DN250 PN40
- DN10-DN80 PN10-40
- DN100-DN150 PN10-16
- DN100-DN150 PN25-40

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 P245GH/1.0352 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 3-16.
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.

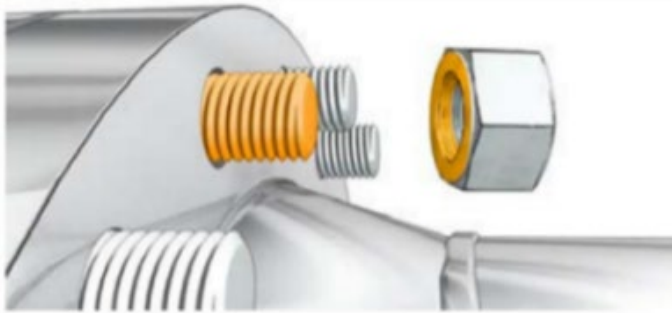


Figure 1: Lubrication (also refer to Note 2)

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

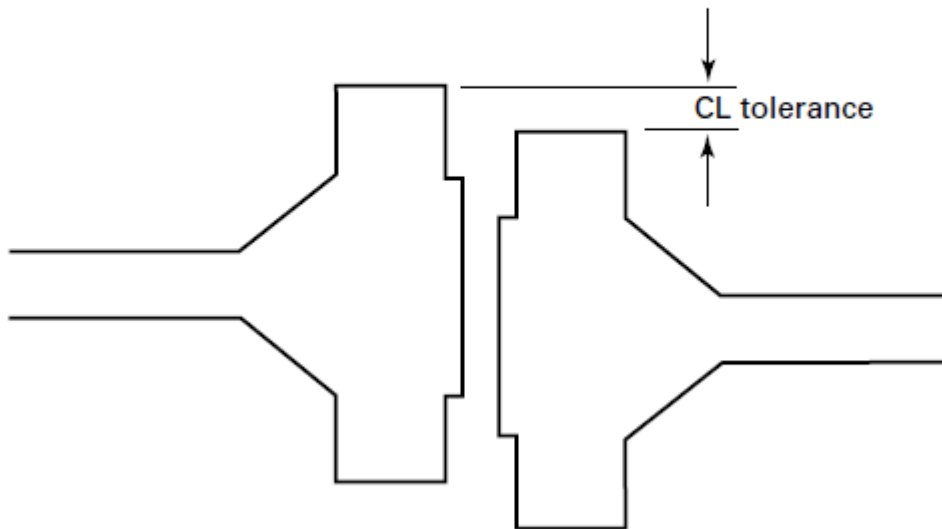


Figure 2

Figure E-2-2
Excessive Spacing Gap

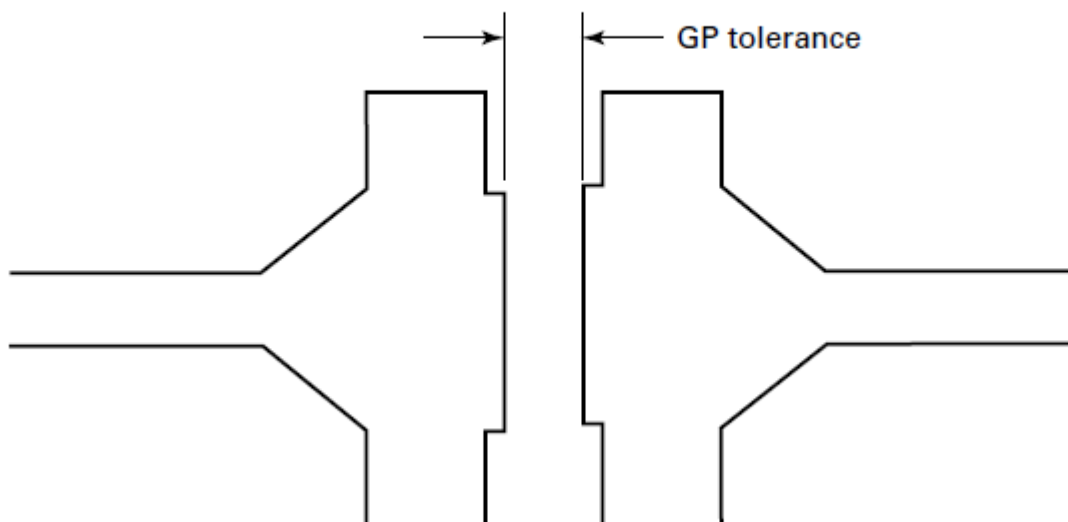


Figure 3

**Figure E-2-3
Parallelism**

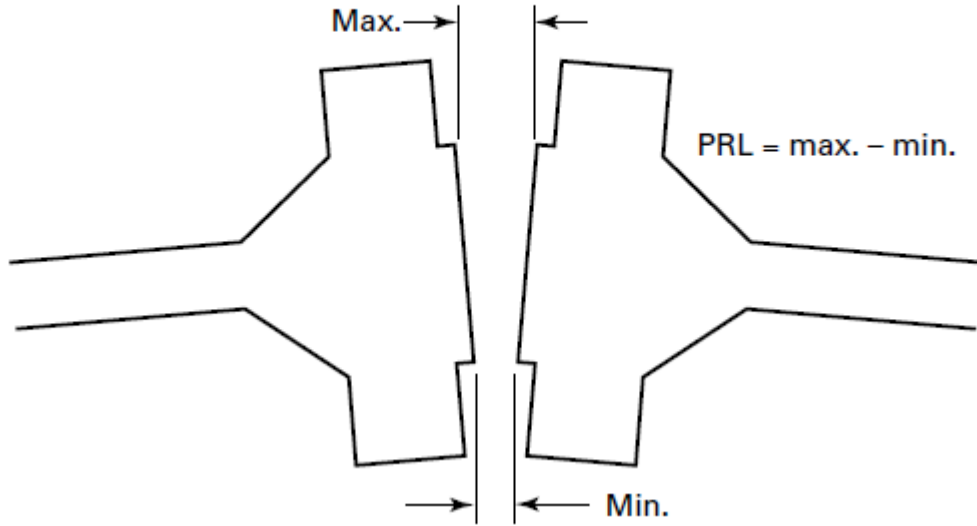


Figure 4

**Figure E-2-4
Rotational Two-Hole**

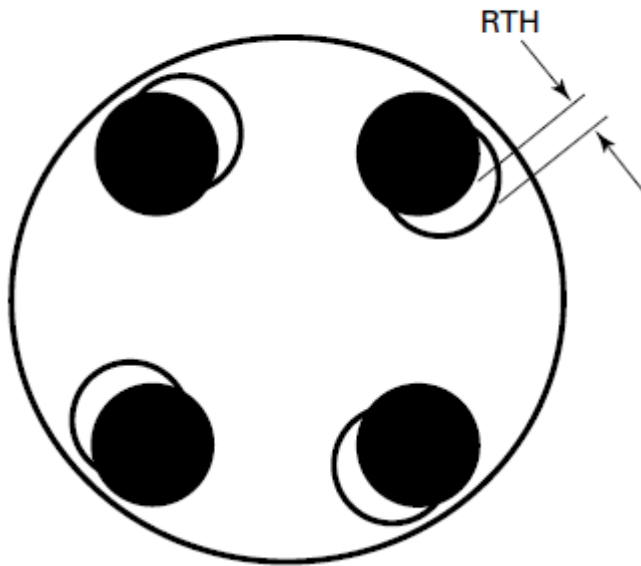


Figure 5

The alignment tolerances shall comply with Table 1.

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

Table 1

Proper tools and methods for correcting misaligned flanges shall be applied, e.g. Equalizer™ FA4™ 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 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 3-8. These incremental loading and tightening steps lead to the assembly target bolt load and torque as stated in Table 3-16, see also Figure 6.

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

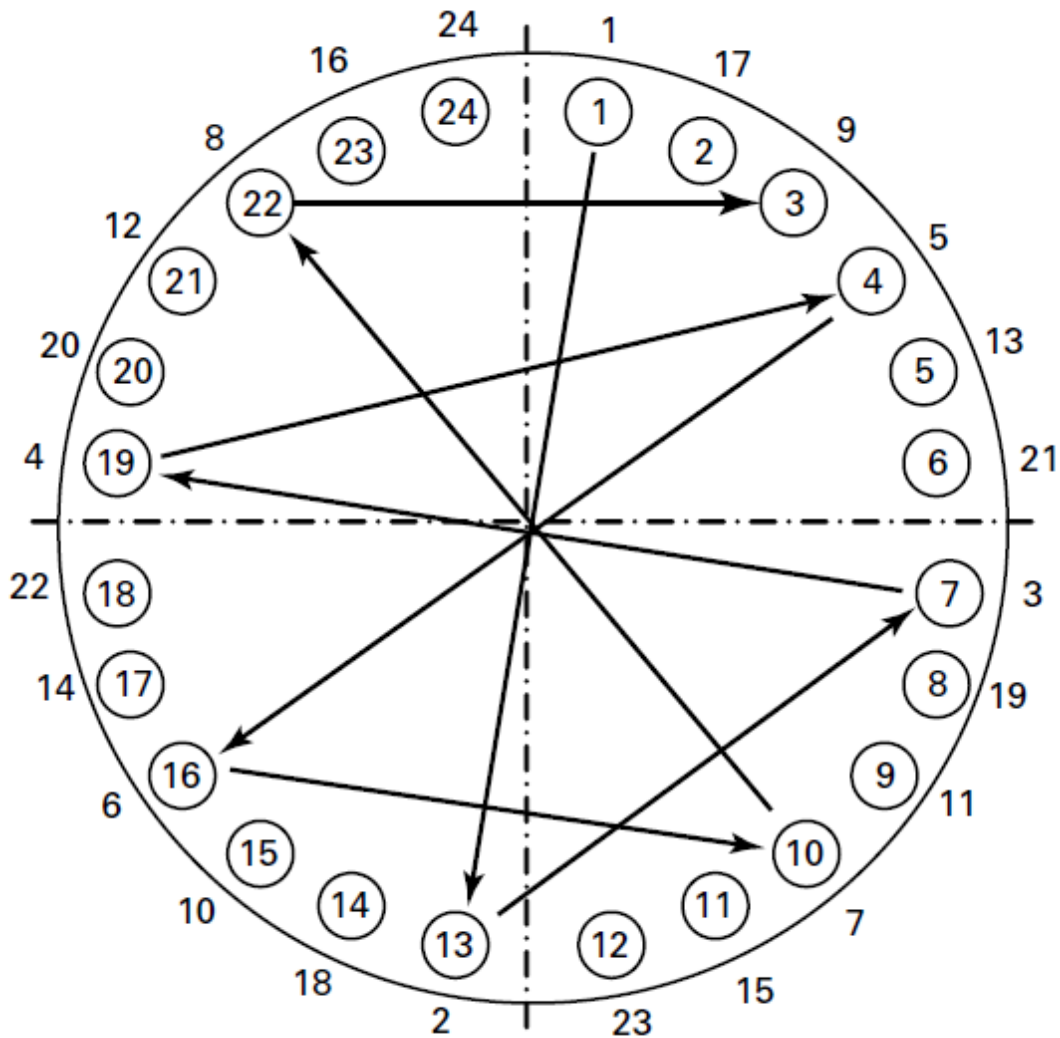


Figure 6

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, 10, 12, 14 and 16.

Table 3 – EN PN10 Torque Table

EN PN10 – Maximum operating temperature 400°C									
Nominal Diameter (mm)	No. of Bolts	Type of Bolt	Torque [Nm]					Notes	
			Initial Step	10%	20%	40%	80%		100%
200	8	M20 x 2.5	Hand Tighten	11	22	44	87	109	Note 1
250	12	M20 x 2.5		10	21	41	82	103	Note 1
300	12	M20 x 2.5		11	22	45	90	112	Note 1
350	16	M20 x 2.5		10	20	40	81	101	Note 1
400	16	M24 x 3		14	27	55	110	137	Note 1
450	20	M24 x 3		12	23	46	92	115	Note 1

Table 4 – EN PN10 Installation Forces (corresponding to Table 3)

EN PN10 – Maximum operating temperature 400°C									
Nominal Diameter (mm)	No. of Bolts	Type of Bolt	Initial Step	Force [kN]					Total inst. force FB0,Nom (kN) (100% x No. bolts)
				10%	20%	40%	80%	100%	
200	8	M20 x 2.5	Hand Tighten	6	12	25	50	62	498
250	12	M20 x 2.5		5	9	19	37	46	555
300	12	M20 x 2.5		5	10	20	40	50	600
350	16	M20 x 2.5		5	9	18	36	45	722
400	16	M24 x 3		5	10	20	41	51	816
450	20	M24 x 3		4	9	17	34	43	861

Table 5 – EN PN16 Torque Table

EN PN16 – Maximum operating temperature 400°C									
Nominal Diameter (mm)	No. of Bolts	Type of Bolt	Torque [Nm]					Notes	
			Initial Step	10%	20%	40%	80%		100%
200	12	M20 x 2.5	Hand Tighten	9	17	35	70	87	Note 1
250	12	M24 x 3		12	23	47	94	117	Note 1
300	12	M30 x 3.5		20	40	81	162	202	
350	16	M24 x 3		19	39	77	154	193	Note 1
400	16	M27 x 3		24	47	95	190	237	Note 1

Table 6 – EN PN16 Installation Forces (corresponding to Table 5)

EN PN16 – Maximum operating temperature 400°C									
Nominal Diameter (mm)	No. of Bolts	Type of Bolt	Force [kN]					Total inst. force FB0,Nom (kN) (100% x No. bolts)	
			Initial Step	10%	20%	40%	80%		100%
200	12	M20 x 2.5	Hand Tighten	4	8	16	31	39	465
250	12	M24 x 3		4	9	18	35	44	526
300	12	M30 x 3.5		8	16	32	64	81	967
350	16	M24 x 3		7	14	29	58	72	1153
400	16	M27 x 3		8	16	32	63	79	1269

Table 7 – EN PN25 Torque Table

EN PN25 – Maximum operating temperature 400°C									
Nominal Diameter (mm)	No. of Bolts	Type of Bolt	Initial Step	Torque [Nm]					Notes
				10%	20%	40%	80%	100%	
200	12	M24 x 3	Hand Tighten	16	31	62	125	156	Note 1
250	12	M27 x 3		22	44	88	175	219	Note 1
300	16	M33 x 3.5		33	66	132	265	331	Note 1
350	16	M30 x 3.5		31	62	124	247	309	Note 1

Table 8 – EN PN25 Installation Forces (corresponding to Table 7)

EN PN25 – Maximum operating temperature 400°C									
Nominal Diameter (mm)	No. of Bolts	Type of Bolt	Initial Step	Force [kN]					Total inst. force FBO,Nom (kN) (100% x No. bolts)
				10%	20%	40%	80%	100%	
200	12	M24 x 3	Hand Tighten	6	12	23	47	58	699
250	12	M27 x 3		7	15	29	59	73	880
300	16	M33 x 3.5		9	19	37	74	93	1483
350	16	M30 x 3.5		9	19	37	74	93	1480

Table 9 – EN PN40 Torque Table

EN PN40 – Maximum operating temperature 400°C									
Nominal Diameter (mm)	No. of Bolts	Type of Bolt	Torque [Nm]					Notes	
			Initial Step	10%	20%	40%	80%		100%
200	12	M27 x 3	Hand Tighten	22	43	86	172	215	Note 1
250	12	M30 x 3.5		35	69	138	277	346	Note 1

Table 10 – EN PN40 Installation Forces (corresponding to Table 9)

EN PN40 – Maximum operating temperature 400°C									
Nominal Diameter (mm)	No. of Bolts	Type of Bolt	Force [kN]					Total inst. force F _{B0,Nom} (kN) (100% x No. bolts)	
			Initial Step	10%	20%	40%	80%		100%
200	12	M27 x 3	Hand	7	14	29	58	72	866
250	12	M30 x 3.5	Tighten	10	21	41	83	104	1243

Table 11 – EN PN10-40 Torque Table

EN PN10-40 – Maximum operating temperature 400°C									
Nominal Diameter (mm)	No. of Bolts	Type of Bolt	Torque [Nm]					Notes	
			Initial Step	10%	20%	40%	80%		100%
10	4	M12 x 1.75	Hand Tighten	4	8	15	30	38	
15	4	M12 x 1.75		5	9	18	36	45	
20	4	M12 x 1.75		5	10	20	39	49	
25	4	M12 x 1.75		5	10	20	41	51	
32	4	M16 x 2		11	22	44	88	110	
40	4	M16 x 2		11	22	44	89	111	
50	4	M16 x 2		11	23	46	91	114	
65	8	M16 x 2		6	13	26	51	64	
65	4	M16 x 2		12	24	48	95	119	
80	8	M16 x 2		8	17	33	66	83	

Table 12 – EN PN10-40 Installation Forces (corresponding to Table 11)

EN PN10-40 – Maximum operating temperature 400°C									
Nominal Diameter (mm)	No. of Bolts	Type of Bolt	Initial Step	Force [kN]					Total inst. force F _{B0,Nom} (kN) (100% x No. bolts)
				10%	20%	40%	80%	100%	
10	4	M12 x 1.75	Hand Tighten	3	6	11	22	28	111
15	4	M12 x 1.75		3	6	13	26	32	129
20	4	M12 x 1.75		4	7	14	29	36	143
25	4	M12 x 1.75		4	7	15	30	37	148
32	4	M16 x 2		6	12	25	49	61	245
40	4	M16 x 2		6	12	25	50	62	248
50	4	M16 x 2		6	13	25	51	63	253
65	8	M16 x 2		4	7	14	29	36	285
65	4	M16 x 2		7	13	27	53	66	265
80	8	M16 x 2		5	9	19	37	46	370

Table 13 – EN PN10-16 Torque Table

EN PN10-16 – Maximum operating temperature 400°C									
Nominal Diameter (mm)	No. of Bolts	Type of Bolt	Torque [Nm]					Notes	
			Initial Step	10%	20%	40%	80%		100%
100	8	M16 x 2	Hand Tighten	7	14	28	55	69	Note 1
125	8	M16 x 2		8	16	31	62	78	Note 1
150	8	M20 x 2.5		10	19	39	78	97	Note 1

Table 14 – EN PN10-16 Installation Forces (corresponding to Table 13)

EN PN10-16 – Maximum operating temperature 400°C									
Nominal Diameter (mm)	No. of Bolts	Type of Bolt	Initial Step	Force [kN]					Total inst. force FB0,Nom (kN) (100% x No. bolts)
				10%	20%	40%	80%	100%	
100	8	M16 x 2	Hand Tighten	4	8	15	31	39	308
125	8	M16 x 2		4	9	17	35	44	349
150	8	M20 x 2.5		4	9	17	35	44	349

Table 15 – EN PN25-40 Torque Table

EN PN25-40 – Maximum operating temperature 400°C									
Nominal Diameter (mm)	No. of Bolts	Type of Bolt	Torque [Nm]					Notes	
			Initial Step	10%	20%	40%	80%		100%
100	8	M20 x 2.5	Hand Tighten	12	24	48	97	121	Note 1
125	8	M24 x 3		16	31	62	124	155	Note 1
150	8	M24 x 3		20	39	79	158	197	Note 1

Table 16 – EN PN25-40 Installation Forces (corresponding to Table 15)

EN PN25-40 – Maximum operating temperature 400°C									
Nominal Diameter (mm)	No. of Bolts	Type of Bolt	Initial Step	Force [kN]					Total inst. force FB0,Nom (kN) (100% x No. bolts)
				10%	20%	40%	80%	100%	
100	8	M20 x 2.5	Hand Tighten	5	11	22	44	54	435
125	8	M24 x 3		6	12	23	46	58	463
150	8	M24 x 3		7	15	29	59	74	588

Notes to Installation Procedure

1. External forces/moments must be controlled, 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, 8, 10, 12, 14 and 16.
4. All torque and force values in Table 3-16 are rounded off to the nearest Nm/kN.