Tata Steel Technical Directive

R1 81 01 01 Flange assembly procedure and torque tables

Author: L. van der Meulen / D. Jonker / M. Picavet
Date: 19-5-2021
Version: 2.0

The latest version of this document is available via https://www.tatasteeleurope.com/ts/nl/gezondheid-en-veiligheid/toegang-en-veiligheid-ijmuiden/voorschriften

Information and changes

Document content:	PTC MCE HPM	+31 (0)251-496821
Standardisation:	ptc-adm@tatasteeleurope.com	+31 (0)251-494443

Table of Contents

INTRODUCTION

The relevant DIN and EN standards do not provide information on the force that may be applied in making a flange joint between carbon steel flanges.

This Technical Directive therefore provides additional data and conditions that must be met to produce a good flange joint.

This includes:

- Assembly procedure;
- Tightening of the bolts;
- Torque tables.

For the flanges named in this Technical Directive, this implies a flange rotation of about 0.5 degrees. For further information, see below.

1 APPLICABLE CODES AND STANDARDS

EN-standard

EN 1092-1 Flanges and their joints; Circular flanges for pipes, valves, fittings and accessories, PN designed; Part 1: Steel flanges

EN 1591-1 Flanges and their joints; Design rules for gasketed circular flange connections; Part 1: Calculation

EN 1591-4 Flanges and their joints; Part 4: Qualification of personnel competency in the assembly of the bolted connections of critical service pressurized systems

Tatasteel-standards

- Tata Steel Standaard S1768101 The marking of medium carriers
- Tata Steel Richtlijn R1850001 Gaskets
- Tata Steel Richtlijn R1420102 part 2 Design of hydraulic- & pneumatic flange connections
- VCA-certificaat WF (Working on flange connections, Werken aan flensverbindingen)
- VCA-certificaat WFpr (Working on flange connections according to protocol, Werken aan flensverbindingen volgens protocol)

2 STARTING POINTS FOR TORQUE CALCULATION

- the calculation has been performed based on EN 1591-1 (version 2014);
- calculation has been performed with leak tightness L0,01; means a specific leakage rate should be equal or less than 0.01 mgs-1m-1;
- coefficient of friction applied in the calculation is 0.15;
- as the basis for the calculation of the torque values, the flange-, gasket- and bolting materials are used;
- special materials as nickel, titanium, etc. are not included in the torque calculation, this needs to be performed case to case;
- gasket strength parameters based on http://www.gasketdata.org;
- tolerance and corrosion allowance are not taken into account for the torque calculation;
- additional loads according to EN 1092-1 have been taken into account for the calculation for EN flanges;
- The values of the torque tables are based on acceptable stress values;
- The torque values for FRP are based on manufacturer' standard.

3 ASSEMBLY PROCEDURE

Depending on the flange category determined in QHSE 5.30 a “flange protocol” shall be filled in during the flange assembly. For an example see chapter 7.

3.1 Surface condition of flange faces

In case flange facings have been temporarily covered e.g. with an anti-corrosion coating, the coating has to be removed before the assembly.
When gaskets are replaced, attention must be paid to fully remove the old gasket from the flange facing without damaging the facing.

3.2 Visual inspection before assembly

Attention should be paid to having the flange faces clean, intact and flat. In particular, no surface damage in the form of radial oriented grooves or impact scars may occur. In case of doubt the damage must be examined on the spot by an expert, and the flanges have to be replaced or modified as mentioned below:

- Bolts, nuts and washers must be clean and intact. Special attention should be given to screw threading and bearing surfaces;
- Bolts, nuts and washers disassembled during mounting operations should be replaced by new ones, or the bolts, washers and nuts have to be in very good condition to make reuse possible;
- Check bolt and nut materials before installing (bolt and nut identification symbols can be found on the bolt top and nu top);
- Before installation the mechanic shall verify the right gasket;
- The gasket must be clean, intact and dry. The application of the adhesives and or assembling pastes is not allowed;
- Used gaskets may not be reused;
- All gaskets which are to be installed must be free of faults and defects. Fiber and elastomer gaskets may not be exposed to UV radiation (sunlight) or heat for long periods during storage. The manufacturer’s instruction must be followed.

3.3 Lubrication and lubricants

To minimize frictional forces, the contact surfaces of the bolts, nuts and washers must be pre-treated with suitable lubricants before tightening. Optimum lubrication is achieved when all contact surfaces, including the threading and landing area nut are lubricated. Only in this way the required pre-clamping force of the bolts can be achieved.
As a principle all lubricants should be applied in a thin but fully covering film. Over-greasing bring no advantage in respect of friction reduction or otherwise.

If the bolt connections are exposed to operating temperatures > 250°C, heat-resistant lubricant must be applied.

Ensure that the lubricant is chemically compatible with bolt, nut, washer and process medium. This will avoid lubricant that could contribute to stress corrosion cracking, galvanic corrosion, oxygen auto ignition etc.

3.4 Inserting an aligning the gasket

Gaskets to be used have to be mounted according to the gasket list of the pipe system specification, cross indexes, key lists, isometrics, job description of the apparatus.

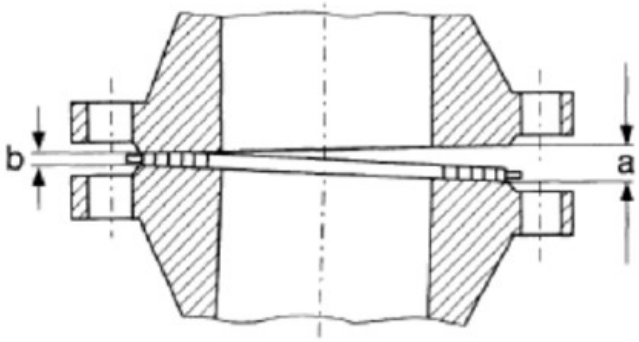
Synthetic fiber gaskets may not be greased. Greasing will have a negative effect on the compressive strength and the gas tightness of the gasket. The gasket is delivered with a non-sticking layer. The reinforced graphite gasket needs to be installed in dry condition for the above reason.

For correct mounting of the flange joints it is essential that the flanges are aligned in parallel, without deviations in the middle, allowing positioned insertion of the gasket without damaging. In particular in case of reduced-shaft bolts an assembly aid should be applied in the form centring bolts.

The sealing faces should be pushed apart to the extent that the gasket can be inserted without applying force and without damaging.

Proper alignment of all joint members is essential to ensure maximum sealing surface contact, maximum opportunity for uniform and designed sealing pressure and reduced friction between the nut and the flange.

The gaping (the non-parallelism of the sealing faces) before the bolts are tightened, shall be considered.
The maximum allowable gap shall be as followed
The gap should be eliminated from the side where it is widest (a)



DN	**a – b (mm)**
10-150	± 0,5
> **150**	± 1,0

As per NEN EN 13480-4 Annex B

4 TIGHTENING OF THE BOLTS

4.1 General

The sequence in which the bolts and nuts are tightened has an essential effect on the distribution of forces acting on the gasket (plane pressure). Inappropriate tightening leads to a wide dispersion of sealing pressure and can result in a shortfall from the required minimum sealing pressure, causing leakage.

After the nuts have been tightened, at least three and at most six thread turns of a bolt should protrude. Hexagon screws and threaded rods should be mounted in such a way that the protrusion is about the same on both ends. Bolt heads, nut and washers must be in plane. The bolts should be pre-positioned by hand, observing the following:

- All bolts, nuts and washers shall be new and free of damage;
- All bolts, nuts and washers shall be hot dip galvanised (according to NEN EN ISO 10684). This shall be reconsidered in case of “special” environmental conditions.
- Under the nuts washers according to ISO 7089 or ISO 7090 shall be used. The hardness of the washers shall be at least class 200HV by using bolts up to grade 8.8;
- Install the bolts in such a manner that all bolt heads are on one side of the flange;
- In case of screw joints where the screw head is rotated (blind tapped hole), place the washer under the screw head;
- With horizontally arranged flanges, stich the bolts through from above;
- Replace difficulty moving bolts by smooth-moving ones.

It is possible to deploy several tightening devices at the same time, combining them in sensible fashion.

4.2 Tools

To prevent overtightening of bolt connections and applying the required torque values, the use of calibrated adjustable torque wrenches are required. The torque wrenches shall only be used on the nuts. The use of electrical- or pneumatic hand drills are forbidden. For critical connections, e.g. chlorine, etc. the use of electronic torque wrenches with torque indicator are recommended. Hydraulic tightening tools may only be used after consulting department PTC MCE HPM.

4.3 Additional requirement for PTFE gaskets

PTFE gaskets need re-torque to compensate for their stress relaxation behaviour. Consult the gaskets supplier for detailed and specific information for the type of gasket used or the PTC MCE HPM department. The common practice is to torque again after 24 hours at process temperature, with 70% of the torque value.

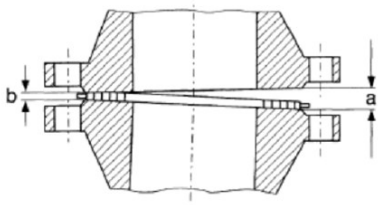
4.4 Additional requirement for reinforced graphite gaskets

When using reinforced graphite gaskets, the bolted connection needs to be tightened in one tightening procedure in depressurized condition. When this isn’t done correctly the gasket can suck up medium and the mechanical properties of the gasket are lost.

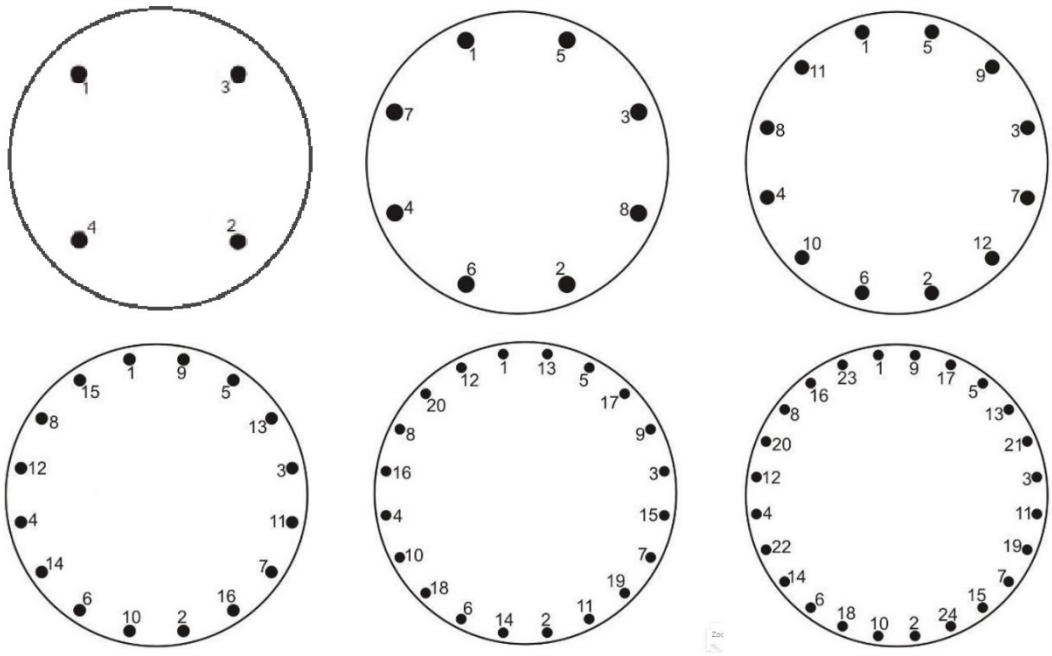
4.5 Tightening procedure

The bolts should be tightened in the following sequence:

1. All bolt/studs/washers and nuts shall be hand tight mounted,
2. Determine the biggest gap (A) as bolt 1 (see image below)
3. Crosswise as depicted in figures on next pages, to 30% of the nominal torque,
4. As 1, to 60% of the nominal torque,
5. As 1, to 100% of the nominal torque, and
6. Once more to the full nominal torque, going around clockwise.
7. Sequence 6. should be repeated until the nuts will turn no further under application of the full torque.



In individual cases the “setting” of the gasket (its adaptation to the flange face) requires re-tightening of bolts. In such cases the bolts, after a few hours or after the first heat exposure, must be re-tightened at room temperature under non pressurized condition of the flange joint. The individual risk assessment is required, if the re-tightening required while in operation at an elevated temperature.



5 DISASSEMBLING

It must be ensured that the installation is non- pressurized and has been flushed.

- Built-in or built-on parts that are not held separate must be secured before the flange joint is dismantled;
- Loosening the bolts and/or nuts has to start from the side turned away from the body;
- The bolts and/or nuts are to be loosened in crosswise sequence. If the tubing is under mechanical stress, the possibility of its sudden deflection must be taken into account;
- When gaskets are exchanged, it must be ensured that the old gasket is completely removed from the flange face without damaging the gasket contact facing of the flange.

6 REQUIREMENTS

QHSE 5.30 Flange management

6.1 Assembling personnel

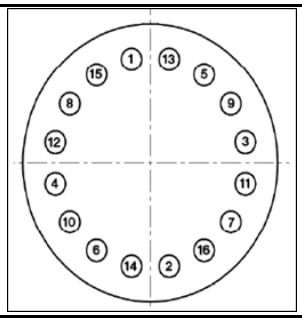
The assembling of the flange joints may only be performed by qualified (certified) personnel.

See QHSE 5.30 Flange Management.
Qualifying the personnel for assembling flange joints can e.g. be done on the basis of EN 1591-4.

6.2 Quality assurance

From the ‘flange category’ it follows what quality assurance measures, including the relevant documentation, are required. See QHSE 5.30

7 FLANGE PROTOCOL (example/ template)

Factory:			
Location:			
Tag number:			
Flange:	Size		DN350 PN10
Gasket:	Type		Novaphit
	Quantity		2
Bolt connection	Bolt size		Bout M20 x 150
	Quantity of bolts		32
	Quantity of nuts		32
	Quantity of washers		64
	Grease type:	Oil	0.15
Mounting procedure:			
Step 1:	85Nm	Crosswise 30%	
Step 2:	170Nm	Crosswise 60%	
Step 3:	250Nm	Crosswise 100%	
Step 4:	250Nm	Clockwise 100%	
Step 5:	250Nm	Clockwise 100%	
Mounting			**Comments:**
Piping aligned?	Yes / No		
Bolts thread clean?	Yes / No		
Bolts greased?	Yes / No		
Washers used?	Yes / No		
Torque wrench used?	Yes / No		
Valve/instrument renewed	Yes / No		
Final inspection			
Name mechanic:			
Name company:			
Name inspector:			

8 TORQUE TABLES

8.1 Table 1: Pipe class: A060, A120, A061, A010, I011, I010 / PN10 – Graphite Gasket

Pipe class			A060, A120, A061, A010, I011, I010						**Table 1**						
Pipe system			PN10												
Flange Material			P250GH												
Bolt Material			25CrMo4 / 8.8												
Gasket Material			Novaphit SSTC TA-L / novaphit SSTC TA-L with XP-Technology 2mm												
Gasket Manufacture			Frenzelit												
Gasket type			IBC												
Leak tighness			L0.01												
Friction			0,15												
Design pressure			According to the pipe class												
Design Temperature			200ºC considered in the calculation												
External force and moments			DN15 - DN350: according to EN1092 -1 (reduced)												
			DN400 - DN500: 1,35 times of internal pressure												
			DN600 & above: 1 times of internal pressure												
Remarks															
- Depending on lubrication, state of bolt and external forces the actual required torque may differ from the below advised calculated torque															
- Afhankelijk van de smering, staat van de bouten en externe krachten kan het werkelijk benodigde aanhaalmoment afwijken van het hieronder berekende aanhaalmoment															

Flange size (DN)	Bolt size	Number	External axial force (KN)	Bolt Force KN			Torque Nm								
							Oil 0,15			Molycoat 0,08			No Lubrication 0,25		
				Min	Max	Used	Min	Max	**Used**	Min	Max	**Used**	Min	Max	**Used**
15	M12	4	13,6	21	104	84	12	62	**50**	6	33	**27**	20	103	**83**
20	M12	4	18,1	17	104	85	17	61	**50**	9	33	**27**	28	102	**83**
25	M12	4	22,6	38	103	85	22	60	**50**	12	32	**27**	37	100	**83**
32	M16	4	29	47	202	131	36	155	**100**	19	83	**53**	60	258	**167**
40	M16	4	36,2	62	201	131	47	154	**100**	25	82	**53**	78	257	**167**
50	M16	4	50	83	204	131	64	156	**100**	34	83	**53**	107	260	**167**
65	M16	8	58,8	123	336	261	47	129	**100**	25	69	**53**	78	215	**167**
80	M16	8	72,4	149	443	261	57	170	**100**	30	91	**53**	95	283	**167**
100	M16	8	100	180	468	261	69	179	**100**	37	95	**53**	115	298	**167**
125	M16	8	101,2	221	462	261	85	177	**100**	45	94	**53**	142	295	**167**
150	M20	8	122,5	247	609	515	120	296	**250**	64	158	**133**	200	493	**417**
200	M20	8	128	326	685	515	158	333	**250**	84	178	**133**	263	555	**417**
250	M20	12	158,1	387	999	772	125	324	**250**	67	173	**133**	208	540	**417**
300	M20	12	173,2	460	1051	772	149	340	**250**	79	181	**133**	248	567	**417**
350	M20	16	187,1	696	1236	1029	169	300	**250**	90	160	**133**	282	500	**417**
400	M24	16	143,5	747	1429	1042	215	412	**300**	115	220	**160**	358	687	**500**
450	M24	20	182,9	1020	1452	1302	235	335	**300**	125	179	**160**	392	558	**500**
500	M24	20	227,5	1329	1514	1389	306	349	**320**	163	186	**171**	510	582	**533**
600	M27	20	243,9	1590	1817	1652	414	473	**430**	221	252	**229**	690	788	**717**
700	M27	24	226,6	1632	2368	1983	354	514	**430**	189	274	**229**	590	857	**717**
800	M30	24	298,1	2133	2808	2454	521	686	**600**	278	366	**320**	868	1143	**1000**
900	M30	28	372,4	2535	3656	2863	531	766	**600**	283	409	**320**	885	1277	**1000**
1000	M33	28	416,5	3074	4082	3506	701	931	**800**	374	497	**427**	1168	1552	**1333**

8.2 Table 2: Pipe class A210, A211, A241, I200 / PN16 – Graphite Gasket

Pipe class	A210, A211, A241, I200
Pipe system	PN16
Flange Material	P250GH
Bolt Material	25CrMo4 / 8.8
Gasket Material	Novaphit SSTC TA-L / novaphit SSTC TA-L with XP-Technology 2mm
Gasket Manufacture	Frenzelit
Gasket type	IBC
Leak tighness	L0.01
Friction	0,15
Design pressure	According to the pipe class
Design Temperature	200°C considered in the calculation
External force and moments	DN15 - DN1000: according EN1092 -1 (reduced)

Table 2

Remarks

- Depending on lubrication, state of bolt and external forces the actual required torque may differ from the below advised calculated torque
- Afhankelijk van de smering, staat van de bouten en externe krachten kan het werkelijk benodigde aanhaalmoment afwijken van het hieronder berekende aanhaalmoment

Flange size (DN)	Bolt size	Number	External axial force (KN)	Bolt Force KN			Torque Nm								
							Oil 0,15			Molycoat 0,08			No Lubrication 0,25		
				Min	Max	Used	Min	Max	**Used**	Min	Max	**Used**	Min	Max	**Used**
15	M12	4	13,6	27	98	67	16	59	**40**	9	31	**21**	27	98	**67**
20	M12	4	18,1	43	93	67	26	56	**40**	14	30	**21**	43	93	**67**
25	M12	4	22,6	57	94	67	34	56	**40**	18	30	**21**	57	93	**67**
32	M16	4	29	70	188	128	54	146	**100**	29	78	**53**	90	243	**167**
40	M16	4	36,2	92	185	128	72	144	**100**	38	77	**53**	120	240	**167**
50	M16	4	45,3	115	190	154	90	148	**120**	48	79	**64**	150	247	**200**
65	M16	8	58,8	155	329	257	60	128	**100**	32	68	**53**	100	213	**167**
80	M16	8	72,4	191	431	257	74	168	**100**	39	90	**53**	123	280	**167**
100	M16	8	88,1	219	445	308	85	173	**120**	45	92	**64**	142	288	**200**
125	M16	8	101,2	272	432	308	106	168	**120**	57	90	**64**	177	280	**200**
150	M20	8	110,8	299	589	412	145	286	**200**	77	153	**107**	242	477	**333**
200	M20	12	128	394	774	618	128	251	**200**	68	134	**107**	213	418	**333**
250	M24	12	143,1	479	919	651	184	353	**250**	98	188	**133**	307	588	**417**
300	M24	12	173,2	615	1395	1042	236	536	**400**	126	286	**213**	393	893	**667**
350	M24	16	164,8	830	1736	1389	239	500	**400**	127	267	**213**	398	833	**667**
400	M27	16	176,1	954	1929	1537	310	628	**500**	165	335	**267**	517	1047	**833**
450	M27	20	186,8	1350	2029	1537	351	528	**400**	187	282	**213**	585	880	**667**
500	M30	20	196,9	1624	2175	1875	276	638	**550**	147	340	**293**	460	1063	**917**
600	M33	20	310,5	2309	3117	2504	738	996	**800**	394	531	**427**	1230	1660	**1333**
700	M33	24	319,6	2386	3272	2629	635	871	**700**	339	465	**373**	1058	1452	**1167**
800	M36	24	415,3	3128	3582	3281	906	1037	**950**	483	553	**507**	1510	1728	**1583**
900	M36	28	467,7	3692	4335	3828	916	1076	**950**	489	574	**507**	1527	1793	**1583**
1000	M39	28	520,6	4056	5670	4475	1088	1521	**1200**	580	811	**640**	1813	2535	**2000**

8.3 Table 3: Pipe class A270, I250 / PN25 – Graphite Gasket

Pipe class	A270, I250
Pipe system	PN25
Flange Material	P250GH
Bolt Material	25CrMo4
Gasket Material	Novaphit SSTC TA-L / novaphit SSTC TA-L with XP-Technology 2mm
Gasket Manufacture	Frenzelit
Gasket type	IBC
Leak tighness	L0.01
Friction	0,15
Design pressure	According to the pipe class
Design Temperature	200°c considered in the calculation
External force and moments	DN15 - DN600: according EN1092 -1 (reduced)

Table 3

Remarks

- Depending on lubrication, state of bolt and external forces the actual required torque may differ from the below advised calculated torque
- Afhankelijk van de smering, staat van de bouten en externe krachten kan het werkelijk benodigde aanhaalmoment afwijken van het hieronder berekende aanhaalmoment

Flange size (DN)	Bolt size	Number	External axial force (KN)	Bolt Force KN			Torque Nm								
							Oil 0,15			Molycoat 0,08			No Lubrication 0,25		
				Min	Max	Used	Min	Max	**Used**	Min	Max	**Used**	Min	Max	**Used**
15	M12	4	13,6	27	98	67	16	59	**40**	9	31	**21**	27	98	**67**
20	M12	4	18,1	44	92	67	26	55	**40**	14	29	**21**	43	92	**67**
25	M12	4	25	59	93	67	35	56	**40**	19	30	**21**	58	93	**67**
32	M16	4	29	72	188	128	56	146	**100**	30	78	**53**	93	243	**167**
40	M16	4	36,2	92	185	128	72	144	**100**	38	77	**53**	120	240	**167**
50	M16	4	45,3	115	185	128	90	144	**100**	48	77	**53**	150	240	**167**
65	M16	8	58,8	156	415	257	61	162	**100**	33	86	**53**	102	270	**167**
80	M16	8	72,4	194	404	257	76	157	**100**	41	84	**53**	127	262	**167**
100	M20	8	88,1	251	601	412	122	292	**200**	65	156	**107**	203	487	**333**
125	M24	8	101,2	295	751	521	170	433	**300**	91	231	**160**	283	722	**500**
150	M24	8	110,8	382	997	694	220	574	**400**	117	306	**213**	367	957	**667**
200	M24	12	128	527	1282	1042	202	492	**400**	108	262	**213**	337	820	**667**
250	M27	12	143,1	645	1489	1153	280	646	**500**	149	345	**267**	467	1077	**833**
300	M27	16	152,5	838	1752	1230	273	570	**400**	146	304	**213**	455	950	**667**
350	M30	16	164,8	945	2325	1636	347	853	**600**	185	455	**320**	578	1422	**1000**
400	M33	16	176,1	1087	2810	2003	434	1122	**800**	231	598	**427**	723	1870	**1333**
450	M33	20	186,8	1056	3090	2504	337	987	**800**	180	526	**427**	562	1645	**1333**
500	M33	20	206,7	1224	4178	2504	391	1335	**800**	209	712	**427**	652	2225	**1333**
600	M36	20	273,5	1415	4367	2878	492	1517	**1000**	262	809	**533**	820	2528	**1667**

8.4 Table 4: Pipe Class A400, A401, A450 / PN40 – Graphite Gasket

Pipe class	A400, A401, A450
Pipe system	PN40
Flange Material	P250GH
Bolt Material	25CrMo4 / 8.8
Gasket Material	Novaphit SSTC TA-L / novaphit SSTC TA-L with XP-Technology 2mm
Gasket Manufacture	Frenzelit
Gasket type	IBC
Leak tighness	L0.01
Friction	0,15
Design pressure	According to the pipe class
Design Temperature	200°C considered in the calculation
External force and moments	DN15 - DN600: according EN1092 -1 (reduced)

Table 4

Remarks

- Depending on lubrication, state of bolt and external forces the actual required torque may differ from the below advised calculated torque
- Afhankelijk van de smering, staat van de bouten en externe krachten kan het werkelijk benodigde aanhaalmoment afwijken van het hieronder berekende aanhaalmoment

Flange size (DN)	Bolt size	Number	External axial force (KN)	Bolt Force KN			Torque Nm								
							Oil 0,15			Molycoat 0,08			No Lubrication 0,25		
				Min	Max	Used	Min	Max	**Used**	Min	Max	**Used**	Min	Max	**Used**
15	M12	4	13,6	37	98	67	22	59	**40**	12	31	**21**	37	98	**67**
20	M12	4	18,1	59	91	67	35	54	**40**	19	29	**21**	58	90	**67**
25	M12	4	22,6	79	92	84	47	55	**50**	25	29	**27**	78	92	**83**
32	M16	4	29	98	188	128	76	146	**100**	41	78	**53**	127	243	**167**
40	M16	4	36,2	125	185	154	97	144	**120**	52	77	**64**	162	240	**200**
50	M16	4	45,3	160	184	167	125	143	**130**	67	76	**69**	208	238	**217**
65	M16	8	58,8	207	421	308	81	164	**120**	43	87	**64**	135	273	**200**
80	M16	8	72,4	256	411	308	100	160	**120**	53	85	**64**	167	267	**200**
100	M20	8	88,1	300	592	412	146	288	**200**	78	154	**107**	243	480	**333**
125	M24	8	101,2	361	740	521	208	426	**300**	111	227	**160**	347	710	**500**
150	M24	8	110,8	441	964	694	254	555	**400**	135	296	**213**	423	925	**667**
200	M27	12	128	629	1394	922	273	605	**400**	146	323	**213**	455	1008	**667**
250	M30	12	143,1	841	2052	1432	411	1003	**700**	219	535	**373**	685	1672	**1167**
300	M30	16	152,5	1026	2627	1909	376	963	**700**	201	514	**373**	627	1605	**1167**
350	M33	16	164,8	1011	2959	2003	404	1182	**800**	215	630	**427**	673	1970	**1333**
400	M36	16	180,5	1458	4294	2993	633	1865	**1300**	338	995	**693**	1055	3108	**2167**
450	M36	20	230,6	1519	4668	3741	528	1622	**1300**	282	865	**693**	880	2703	**2167**
500	M39	20	291	1763	5417	3995	662	2034	**1500**	353	1085	**800**	1103	3390	**2500**
600	M45	20	394,4	2253	7396	5466	989	3248	**2400**	527	1732	**1280**	1648	5413	**4000**

8.5 Table 5: Pipe Class A420 / PN40 – Graphite Gasket

Pipe class	A420
Pipe system	PN40
Flange Material	16Mo3
Bolt Material	21CrMoV5-7
Gasket Material	Novaphit SSTC TA-L / novaphit SSTC TA-L with XP-Technology 2mm
Gasket Manufacture	Frenzelit
Gasket type	IBC
Leak tighness	L0.01
Friction	0,15
Design pressure	According to the pipe class
Design Temperature	200°C considered in the calculation
External force and moments	DN25 - DN600: according EN1092 -1 (reduced)

Table 5

Remarks

- Depending on lubrication, state of bolt and external forces the actual required torque may differ from the below advised calculated torque
- Afhankelijk van de smering, staat van de bouten en externe krachten kan het werkelijk benodigde aanhaalmoment afwijken van het hieronder berekende aanhaalmoment

Flange size (DN)	Bolt size	Number	External axial force (KN)	Bolt Force KN			Torque Nm								
							Oil 0,15			Molycoat 0,08			No Lubrication 0,25		
				Min	Max	Used	Min	Max	**Used**	Min	Max	**Used**	Min	Max	**Used**
15	M12	4													
20	M12	4													
25	M12	4	25	82	109	92	49	65	**55**	26	35	**29**	82	108	**92**
32	M16	4	32	101	220	154	79	171	**120**	42	91	**64**	132	285	**200**
40	M16	4	40	130	223	180	101	174	**140**	54	93	**75**	168	290	**233**
50	M16	4	50	166	218	180	129	170	**140**	69	91	**75**	215	283	**233**
65	M16	8	58,8	209	419	308	81	163	**120**	43	87	**64**	135	272	**200**
80	M16	8	80	261	491	360	102	191	**140**	54	102	**75**	170	318	**233**
100	M20	8	100	309	726	515	150	353	**250**	80	188	**133**	250	588	**417**
125	M24	8	111,8	367	885	694	211	510	**400**	113	272	**213**	352	850	**667**
150	M24	8	122,5	447	1069	781	257	616	**450**	137	329	**240**	428	1027	**750**
200	M27	12	141,4	661	1535	1153	287	666	**500**	153	355	**267**	478	1110	**833**
250	M30	12	158,1	868	2254	1636	424	1102	**800**	226	588	**427**	707	1837	**1333**
300	M30	16	164,9	1282	2811	2182	470	1031	**800**	251	550	**427**	783	1718	**1333**
350	M33	16	178,1	1409	3133	2003	563	1251	**800**	300	667	**427**	938	2085	**1333**
400	M36	16	195,2	2534	4728	3454	1101	2053	**1500**	587	1095	**800**	1835	3422	**2500**
450	M36	20	249,3	2656	4902	4029	923	1703	**1400**	492	908	**747**	1538	2838	**2333**
500	M39	20	314,6	2969	5760	4262	1115	2163	**1600**	595	1154	**853**	1858	3605	**2667**
600	M45	20	426,4	4381	7718	5693	1924	3389	**2500**	1026	1807	**1333**	3207	5648	**4167**

8.6 Table 6: Pipe Class F02, F022, H130 / PN10 – Graphite Gasket

		Table 6
Pipe class	F020, F022, H130	
Pipe system	PN10	
Flange Material	1.4404 / 1.4539 / 1.4571	
Bolt Material	A4-70	
Gasket Material	Novaphit SSTC TA-L / novaphit SSTC TA-L with XP-Technology 2mm	
Gasket Manufacture	Frenzelit	
Gasket type	IBC	
Leak tighness	L0.01	
Friction	0,15	
Design pressure	According to the pipe class	
Design Temperature	200°C considered in the calculation	
External force and moments	DN15 - DN600: according EN1092 -1 (reduced)	

Remarks

- Depending on lubrication, state of bolt and external forces the actual required torque may differ from the below advised calculated torque
- Afhankelijk van de smering, staat van de bouten en externe krachten kan het werkelijk benodigde aanhaalmoment afwijken van het hieronder berekende aanhaalmoment

Flange size (DN)	Bolt size	Number	External axial force (KN)	Bolt Force KN			Torque Nm								
							Oil 0,15			Molycoat 0,08			No Lubrication 0,25		
				Min	Max	Used	Min	Max	**Used**	Min	Max	**Used**	Min	Max	**Used**
15	M12	4	11,8	22	115	67	13	69	**40**	7	37	**21**	22	115	**67**
20	M12	4	15,7	31	102	67	19	61	**40**	10	33	**21**	32	102	**67**
25	M12	4	19,6	40	102	67	24	61	**40**	13	33	**21**	40	102	**67**
32	M16	4	25,1	48	203	128	37	158	**100**	20	84	**53**	62	263	**167**
40	M16	4	31,4	63	193	128	49	150	**100**	26	80	**53**	82	250	**167**
50	M16	4	39,3	83	199	128	65	155	**100**	35	83	**53**	108	258	**167**
65	M16	8	51,1	123	271	180	48	105	**70**	26	56	**37**	80	175	**117**
80	M16	8	62,9	151	402	257	59	156	**100**	31	83	**53**	98	260	**167**
100	M16	8	78,6	181	437	257	70	170	**100**	37	91	**53**	117	283	**167**
125	M16	8	87,8	222	454	257	86	177	**100**	46	94	**53**	143	295	**167**
150	M20	8	96,2	250	548	412	121	266	**200**	65	142	**107**	202	443	**333**
200	M20	8	111,1	329	711	515	160	345	**250**	85	184	**133**	267	575	**417**
250	M20	12	124,2	390	894	618	126	290	**200**	67	155	**107**	210	483	**333**
300	M20	12	136,1	471	975	772	153	316	**250**	82	169	**133**	255	527	**417**
350	M20	16	147	706	1096	823	171	266	**200**	91	142	**107**	285	443	**333**
400	M24	16	157,1	838	1244	1042	241	358	**300**	129	191	**160**	402	597	**500**
450	M24	20	166,7	910	1295	1085	210	298	**250**	112	159	**133**	350	497	**417**
500	M24	20	175,7	1032	1389	1085	238	320	**250**	127	171	**133**	397	533	**417**
600	M27	20	192,5	1236	1612	1345	322	420	**350**	172	224	**187**	537	700	**583**

8.7 Table 7: Pipe Class F210, F212 / PN16 – Graphite Gasket

Pipe class	F210, F212
Pipe system	PN16
Flange Material	1.4307 / 1.4571
Bolt Material	A4-70
Gasket Material	Novaphit SSTC TA-L / novaphit SSTC TA-L with XP-Technology 2mm
Gasket Manufacture	Frenzelit
Gasket type	IBC
Leak tighness	L0.01
Friction	0,15
Design pressure	According to the pipe class
Design Temperature	200°C considered in the calculation
External force and moments	DN15 - DN600: according EN1092 -1 (reduced)

Table 7

Remarks

- Depending on lubrication, state of bolt and external forces the actual required torque may differ from the below advised calculated torque
- Afhankelijk van de smering, staat van de bouten en externe krachten kan het werkelijk benodigde aanhaalmoment afwijken van het hieronder berekende aanhaalmoment

Flange size			External axial force	Bolt Force KN			Torque Nm								
							Oil 0,15			Molycoat 0,08			No Lubrication 0,25		
(DN)	Bolt size	Number	(KN)	Min	Max	Used	Min	Max	**Used**	Min	Max	**Used**	Min	Max	**Used**
15	M12	4	11,8	27	115	67	16	69	**40**	9	37	**21**	27	115	**67**
20	M12	4	15,7	46	102	67	28	61	**40**	15	33	**21**	47	102	**67**
25	M12	4	19,6	60	102	84	36	61	**50**	19	33	**27**	60	102	**83**
32	M16	4	25,1	73	203	128	57	158	**100**	30	84	**53**	95	263	**167**
40	M16	4	31,4	92	193	128	72	150	**100**	38	80	**53**	120	250	**167**
50	M16	4	39,3	115	199	167	90	155	**130**	48	83	**69**	150	258	**217**
65	M16	8	51,1	154	265	206	60	103	**80**	32	55	**43**	100	172	**133**
80	M16	8	62,9	189	396	257	74	154	**100**	39	82	**53**	123	257	**167**
100	M16	8	78,6	226	424	257	88	165	**100**	47	88	**53**	147	275	**167**
125	M16	8	87,8	280	462	334	109	180	**130**	58	96	**69**	182	300	**217**
150	M20	8	96,2	311	538	412	151	261	**200**	81	139	**107**	252	435	**333**
200	M20	12	111,1	413	704	463	134	228	**150**	71	122	**80**	223	380	**250**
250	M24	12	124,2	483	839	651	185	322	**250**	99	172	**133**	308	537	**417**
300	M24	12	136,1	600	1179	781	230	453	**300**	123	242	**160**	383	755	**500**
350	M24	16	147	739	1662	1042	213	479	**300**	114	255	**160**	355	798	**500**
400	M27	16	157,1	831	1861	1230	270	605	**400**	144	323	**213**	450	1008	**667**
450	M27	20	166,7	934	1969	1537	243	512	**400**	130	273	**213**	405	853	**667**
500	M30	20	175,7	1090	2108	1534	320	618	**450**	171	330	**240**	533	1030	**750**
600	M33	20	244	1543	2701	1878	493	863	**600**	263	460	**320**	822	1438	**1000**

8.8 Table 8: Pipe Class F250 / PN25 – Graphite Gasket

Pipe class	F250
Pipe system	PN25
Flange Material	1,4404
Bolt Material	A4-70
Gasket Material	Novaphit SSTC TA-L / novaphit SSTC TA-L with XP-Technology 2mm (Rev. 2)
Gasket Manufacture	Frenzelit
Gasket type	IBC
Leak tighness	L0.01
Friction	0,15
Design pressure	According to the pipe class
Design Temperature	200°C considered in the calculation
External force and moments	DN15 - DN600: according EN1092 -1 (reduced)

Table 8

Remarks

- Depending on lubrication, state of bolt and external forces the actual required torque may differ from the below advised calculated torque
- Afhankelijk van de smering, staat van de bouten en externe krachten kan het werkelijk benodigde aanhaalmoment afwijken van het hieronder berekende aanhaalmoment

Flange size			External axial force	Bolt Force KN			Torque Nm								
							Oil 0,15			Molycoat 0,08			No Lubrication 0,25		
(DN)	Bolt size	Number	(KN)	Min	Max	Used	Min	Max	**Used**	Min	Max	**Used**	Min	Max	**Used**
15	M12	4	11,8	27	115	67	16	69	**40**	9	37	**21**	27	115	**67**
20	M12	4	15,7	46	102	67	28	61	**40**	15	33	**21**	47	102	**67**
25	M12	4	19,6	60	102	84	36	61	**50**	19	33	**27**	60	102	**83**
32	M16	4	25,1	73	203	128	57	158	**100**	30	84	**53**	95	263	**167**
40	M16	4	31,4	92	193	128	72	150	**100**	38	80	**53**	120	250	**167**
50	M16	4	39,3	115	197	167	90	153	**130**	48	82	**69**	150	255	**217**
65	M16	8	51,1	162	397	257	63	155	**100**	34	83	**53**	105	258	**167**
80	M16	8	62,9	195	440	257	76	171	**100**	41	91	**53**	127	285	**167**
100	M20	8	78,6	244	573	412	119	278	**200**	63	148	**107**	198	463	**333**
125	M24	8	87,8	289	696	521	166	401	**300**	89	214	**160**	277	668	**500**
150	M24	8	96,2	320	918	694	184	529	**400**	98	282	**213**	307	882	**667**
200	M24	12	111,1	414	1150	781	159	442	**300**	85	236	**160**	265	737	**500**
250	M27	12	124,2	497	1412	1037	216	612	**450**	115	326	**240**	360	1020	**750**
300	M27	16	136,1	607	1710	1230	197	556	**400**	105	297	**213**	328	927	**667**
350	M30	16	147	756	2247	1636	277	824	**600**	148	439	**320**	462	1373	**1000**
400	M33	16	157,1	868	2699	2003	347	1078	**800**	185	575	**427**	578	1797	**1333**
450	M33	20	166,7	961	2928	2191	307	935	**700**	164	499	**373**	512	1558	**1167**
500	M33	20	184,4	1135	3955	2817	363	1264	**900**	194	674	**480**	605	2107	**1500**
600	M36	20	244	1393	4101	2878	484	1426	**1000**	258	761	**533**	807	2377	**1667**

8.9 Table 9: Pipe class F400, F401 / PN40 – Graphite Gasket

Pipe class	F400, F401
Pipe system	PN40
Flange Material	1.4404 / 1.4571
Bolt Material	21CrMo5-7 / A4-70
Gasket Material	Novaphit SSTC TA-L / novaphit SSTC TA-L with XP-Technology 2mm
Gasket Manufacture	Frenzelit
Gasket type	IBC
Leak tighness	L0.01
Friction	0,15
Design pressure	According to the pipe class
Design Temperature	200°C considered in the calculation
External force and moments	DN15 - DN400: according EN1092 -1 (reduced)

Table 9

Remarks

- Depending on lubrication, state of bolt and external forces the actual required torque may differ from the below advised calculated torque
- Afhankelijk van de smering, staat van de bouten en externe krachten kan het werkelijk benodigde aanhaalmoment afwijken van het hieronder berekende aanhaalmoment

Flange size			External	Bolt Force KN			Torque Nm								
							Oil 0,15			Molycoat 0,08			No Lubrication 0,25		
(DN)	Bolt size	Number	axial force (KN)	Min	Max	Used	Min	Max	**Used**	Min	Max	**Used**	Min	Max	**Used**
15	M12	4	11,8	34	113	67	20	68	**40**	11	36	**21**	33	113	**67**
20	M12	4	15,7	56	91	67	33	54	**40**	18	29	**21**	55	90	**67**
25	M12	4	19,6	75	98	84	45	59	**50**	24	31	**27**	75	98	**83**
32	M16	4	25,1	93	205	128	72	160	**100**	38	85	**53**	120	267	**167**
40	M16	4	31,4	124	197	154	97	153	**120**	52	82	**64**	162	255	**200**
50	M16	4	39,3	157	196	167	122	153	**130**	65	82	**69**	203	255	**217**
65	M16	8	19,7	184	318	257	72	124	**100**	38	66	**53**	120	207	**167**
80	M16	8	62,9	249	364	283	97	142	**110**	52	76	**59**	162	237	**183**
100	M20	8	78,6	294	416	329	143	202	**160**	76	108	**85**	238	337	**267**
125	M24	8	87,8	342	538	434	197	310	**250**	105	165	**133**	328	517	**417**
150	M24	8	96,2	418	749	521	241	431	**300**	129	230	**160**	402	718	**500**
200	M27	12	111,1	598	1059	807	259	459	**350**	138	245	**187**	432	765	**583**
250	M30	12	124,2	784	1571	1227	383	768	**600**	204	410	**320**	638	1280	**1000**
300	M30	16	136,1	965	2053	1636	354	753	**600**	189	402	**320**	590	1255	**1000**
350	M33	16	160,4	1239	2721	2003	495	1087	**800**	264	580	**427**	825	1812	**1333**
400	M36	16	161	1591	3498	2302	691	1519	**1000**	369	810	**533**	1152	2532	**1667**

8.10 Table 10: Pipe class M120, M170, M190 / PN10 – PTFE + insert gasket

Pipe class	M120, M170, M190
Pipe system	PN10
Flange Material	PVDF/FRP, PP/FRP, PVC-U/FRP
Bolt Material	4.6 HDG
Gasket Material	VSP Pita gasket
Gasket Manufacture	VSP/ Klinger
Gasket type	IBC
Leak tighness	L0.01
Friction	0,14
Design pressure	7 barg
Design Temperature	95ºC considered in the calculation
External force and moments	DN15 - DN600: according EN1092 -1 (reduced)

Table 10

Remarks

- Depending on lubrication, state of bolt and external forces the actual required torque may differ from the below advised calculated torque
- Afhankelijk van de smering, staat van de bouten en externe krachten kan het werkelijk benodigde aanhaalmoment afwijken van het hieronder berekende moment
- Maximum torque is based on flange material, if you feel or hear cracking of the flange stop and consult the TATA contact person
- If more than 2 gaskets are used in one bolt assembly retorquing is required; to be advised by supplier/ PTC-HPM

Flange size (DN)	Bolt size	Number	External axial force	Bolt Force KN			Torque Nm								
							Copper grease 0,14			Molycoat 0,08			No Lubrication 0,25		
				Min	Max	Used	Min	Max	**Used**	Min	Max	**Used**	Min	Max	**Used**
15	M12	4								Do not use			Do not use		
20	M12	4													
25	M12	4				39			**20**						
32	M16	4													
40	M16	4				59			**40**						
50	M16	4				59			**40**						
65	M16	8				66			**45**						
80	M16	8				132			**45**						
100	M16	8				132			**45**						
125	M16	8				147			**50**						
150	M20	8				141			**60**						
200	M20	8				141			**60**						
250	M20	12				247			**70**						
300	M20	12				265			**75**						
350	M20	16				353			**75**						
400	M24	16				412			**105**						
450	M24	20													
500	M24	20				515			**105**						

8.11 Table 11: Pipe class M120, M170, M190 / PN10 – Top-chem gasket

Table not yet available. For details contact the gasket supplier.

8.12 Table 12: Pipe class A060, A120, A061, A010, I011, I010 / PN10 – Fiber gasket

Pipe class	A060, A120, A061, A010, I011, I010
Pipe system	PN10
Flange Material	P250GH
Bolt Material	25CrMo4 / 8.8
Gasket Material	KLINGERSIL C-4400 2mm
Gasket Manufacture	KLINGER® GmbH & Co. KG
Gasket type	IBC
Leak tighness	L0.01
Friction	0,15
Design pressure	According to the pipe class
Design Temperature	200ºC considered in the calculation
External force and moments	DN15 -- DN350 = according EN1092 -1 (reduced)
	DN400 -DN500 - 1.35 times of internal pressure
	DN600 & above - 1 times of internal pressure

Table 12

Remarks

- Depending on lubrication, state of bolt and external forces the actual required torque may differ from the below advised calculated torque
- Afhankelijk van de smering, staat van de bouten en externe krachten kan het werkelijk benodigde aanhaalmoment afwijken van het hieronder berekende aanhaalmoment

Flange size			External axial force	Bolt Force KN			Torque Nm								
							Oil 0,15			Molycoat 0,08			No Lubrication 0,25		
(DN)	Bolt size	Number	(KN)	Min	Max	Used	Min	Max	**Used**	Min	Max	**Used**	Min	Max	**Used**
15	M12	4	13,6	68	121	84	40	72	**50**	21	38	**27**	67	120	**83**
20	M12	4	18,1	74	124	85	43	73	**50**	23	39	**27**	72	122	**83**
25	M12	4	22,6	92	119	103	54	70	**60**	29	37	**32**	90	117	**100**
32	M16	4	29	108	229	196	83	175	**150**	44	93	**80**	138	292	**250**
40	M16	4	36,2	135	230	196	103	176	**150**	55	94	**80**	172	293	**250**
50	M16	4	45,3	160	236	196	123	181	**150**	66	97	**80**	205	302	**250**
65	M16	8	58,8	172	420	313	66	161	**120**	35	86	**64**	110	268	**200**
80	M16	8	72,4	208	482	392	80	185	**150**	43	99	**80**	133	308	**250**
100	M16	8	90,5	255	488	392	98	187	**150**	52	100	**80**	163	312	**250**
125	M16	8	101,2	280	488	392	107	187	**150**	57	100	**80**	178	312	**250**
150	M20	8	122,5	345	695	515	168	338	**250**	90	180	**133**	280	563	**417**
200	M20	8	128	398	695	515	193	338	**250**	103	180	**133**	322	563	**417**
250	M20	12	143,1	461	1040	772	149	337	**250**	79	180	**133**	248	562	**417**
300	M20	12	156,8	544	1051	772	176	340	**250**	94	181	**133**	293	567	**417**
350	M20	16	169,3	814	1328	1029	198	323	**250**	106	172	**133**	330	538	**417**
400	M24	16	135,4	868	1525	1042	250	439	**300**	133	234	**160**	417	732	**500**
450	M24	20	182,9	1111	1545	1302	256	356	**300**	137	190	**160**	427	593	**500**
500	M24	20	227,5	1356	1603	1389	312	369	**320**	166	197	**171**	520	615	**533**
600	M27	20	196,8	1614	1908	1652	420	497	**430**	224	265	**229**	700	828	**717**
700	M27	24	203,9	1713	2458	1983	372	533	**430**	198	284	**229**	620	888	**717**
800	M30	24	298,1	2159	2882	2454	528	705	**600**	282	376	**320**	880	1175	**1000**
900	M30	28	335,2	2573	3733	2863	539	782	**600**	287	417	**320**	898	1303	**1000**
1000	M33	28	416,5	3097	4144	3506	707	946	**800**	377	505	**427**	1178	1577	**1333**

8.13 Table 13: Pipe class A210, A211, A241, I200 / PN16 – Fiber gasket

Pipe class	A210, A211, A241, I200
Pipe system	PN16
Flange Material	P250GH
Bolt Material	25CrMo4 / 8.8
Gasket Material	KLINGERSIL C-4400 2mm
Gasket Manufacture	KLINGER® GmbH & Co. KG
Gasket type	IBC
Leak tighness	L0.01
Friction	0,15
Design pressure	According to the pipe class
Design Temperature	200°C considered in the calculation
External force and moments	DN15 -- DN1000 = according EN1092 -1 (reduced)

Table 13

Remarks

- Depending on lubrication, state of bolt and external forces the actual required torque may differ from the below advised calculated torque
- Afhankelijk van de smering, staat van de bouten en externe krachten kan het werkelijk benodigde aanhaalmoment afwijken van het hieronder berekende aanhaalmoment

Flange size			External	Bolt Force KN			Torque Nm								
							Oil 0,15			Molycoat 0,08			No Lubrication 0,25		
(DN)	Bolt size	Number	axial force (KN)	Min	Max	Used	Min	Max	**Used**	Min	Max	**Used**	Min	Max	**Used**
15	M12	4	13,6	82	115	100	49	69	**60**	26	37	**32**	82	115	**100**
20	M12	4	20	83	113	100	50	68	**60**	27	36	**32**	83	113	**100**
25	M12	4	22,6	77	107	100	46	64	**60**	25	34	**32**	77	107	**100**
32	M16	4	29	131	214	180	102	167	**140**	54	89	**75**	170	278	**233**
40	M16	4	36,2	156	215	180	121	167	**140**	65	89	**75**	202	278	**233**
50	M16	4	45,3	176	220	193	137	171	**150**	73	91	**80**	228	285	**250**
65	M16	8	58,8	218	415	360	85	162	**140**	45	86	**75**	142	270	**233**
80	M16	8	72,4	244	452	360	95	176	**140**	51	94	**75**	158	293	**233**
100	M16	8	88,1	286	452	385	111	176	**150**	59	94	**80**	185	293	**250**
125	M16	8	101,2	336	452	385	131	176	**150**	70	94	**80**	218	293	**250**
150	M20	8	110,8	411	681	515	200	331	**250**	107	177	**133**	333	552	**417**
200	M20	12	128	538	859	772	174	278	**250**	93	148	**133**	290	463	**417**
250	M24	12	143,1	620	1010	781	238	388	**300**	127	207	**160**	397	647	**500**
300	M24	12	173,2	751	1467	1042	288	563	**400**	154	300	**213**	480	938	**667**
350	M24	16	164,8	1005	1830	1389	289	527	**400**	154	281	**213**	482	878	**667**
400	M27	16	176,1	1150	2023	1537	374	658	**500**	199	351	**267**	623	1097	**833**
450	M27	20	186,8	1458	2121	1729	379	552	**450**	202	294	**240**	632	920	**750**
500	M30	20	196,9	1751	2237	1875	514	656	**550**	274	350	**293**	857	1093	**917**
600	M33	20	310,5	2446	3168	2661	781	1012	**850**	417	540	**453**	1302	1687	**1417**
700	M33	24	319,6	2532	3310	2817	674	881	**750**	359	470	**400**	1123	1468	**1250**
800	M36	24	415,3	3271	3629	3316	947	1051	**960**	505	561	**512**	1578	1752	**1600**
900	M36	28	467,7	954	4371	3908	954	1085	**970**	509	579	**517**	1590	1808	**1617**
1000	M39	28	520,6	4243	5671	4848	1138	1521	**1300**	607	811	**693**	1897	2535	**2167**

8.14 Table 14: Pipe class A400, A401, A450 / PN40 – Fiber gasket

Pipe class	A400, A401, A450
Pipe system	PN40
Flange Material	P250GH
Bolt Material	25CrMo4 / 8.8
Gasket Material	KLINGERSIL C-4400 2mm
Gasket Manufacture	KLINGER® GmbH & Co. KG
Gasket type	IBC
Leak tighness	L0.01
Friction	0,15
Design pressure	According to the pipe class
Design Temperature	200°C considered in the calculation
External force and moments	DN15 -- DN600 = according EN1092 -1 (reduced)

Table 14

Remarks

- Depending on lubrication, state of bolt and external forces the actual required torque may differ from the below advised calculated torque
- Afhankelijk van de smering, staat van de bouten en externe krachten kan het werkelijk benodigde aanhaalmoment afwijken van het hieronder berekende aanhaalmoment

Flange size			External axial force	Bolt Force KN			Torque Nm								
							Oil 0,15			Molycoat 0,08			No Lubrication 0,25		
(DN)	Bolt size	Number	(KN)	Min	Max	Used	Min	Max	**Used**	Min	Max	**Used**	Min	Max	**Used**
15	M12	4	13,6												
20	M12	4	18,1	88	113	100	53	68	**60**	28	36	**32**	88	113	**100**
25	M12	4	22,6	83	107	100	50	64	**60**	27	34	**32**	83	107	**100**
32	M16	4	29	133	214	180	104	167	**140**	55	89	**75**	173	278	**233**
40	M16	4	36,2	158	216	180	123	168	**140**	66	90	**75**	205	280	**233**
50	M16	4	45,3	191	216	193	149	168	**150**	79	90	**80**	248	280	**250**
65	M16	8	58,8	227	443	385	88	172	**150**	47	92	**80**	147	287	**250**
80	M16	8	72,4	252	448	385	98	174	**150**	52	93	**80**	163	290	**250**
100	M20	8	88,1	338	680	515	164	330	**250**	87	176	**133**	273	550	**417**
125	M24	8	101,2	420	833	608	242	480	**350**	129	256	**187**	403	800	**583**
150	M24	8	110,8	487	1005	781	280	579	**450**	149	309	**240**	467	965	**750**
200	M27	12	128	739	1484	1153	321	644	**500**	171	343	**267**	535	1073	**833**
250	M30	12	143,1	971	2125	1636	475	1039	**800**	253	554	**427**	792	1732	**1333**
300	M30	16	152,5	1136	2690	2182	417	986	**800**	222	526	**427**	695	1643	**1333**
350	M33	16	164,8	1138	3241	2504	454	1294	**1000**	242	690	**533**	757	2157	**1667**
400	M36	16	180,5	1366	4304	3454	593	1869	**1500**	316	997	**800**	988	3115	**2500**
450	M36	20	230,6	1465	4706	4029	509	1635	**1400**	271	872	**747**	848	2725	**2333**
500	M39	20	291	1776	5445	3995	667	2044	**1500**	356	1090	**800**	1112	3407	**2500**
600	M45	20	394,4	2220	7390	5466	975	3245	**2400**	520	1731	**1280**	1625	5408	**4000**

8.15 Table 15: Pipe class F020, F022, H130 / PN10 – Fiber gasket

Pipe class	F020, F022, H130
Pipe system	PN10
Flange Material	1.4404 / 1.4539 / 1.4571
Bolt Material	A4-70
Gasket Material	KLINGERSIL C-4400 2mm
Gasket Manufacture	KLINGER® GmbH & Co. KG
Gasket type	IBC
Leak tighness	L0.01
Friction	0,15
Design pressure	According to the pipe class
Design Temperature	200°C considered in the calculation
External force and moments	DN15 -- DN600 = according EN1092 -1 (reduced)

Table 15

Remarks

- Depending on lubrication, state of bolt and external forces the actual required torque may differ from the below advised calculated torque
- Afhankelijk van de smering, staat van de bouten en externe krachten kan het werkelijk benodigde aanhaalmoment afwijken van het hieronder berekende aanhaalmoment

Flange size			External	Bolt Force KN			Torque Nm								
							Oil 0,15			Molycoat 0,08			No Lubrication 0,25		
(DN)	Bolt size	Number	axial force (KN)	Min	Max	Used	Min	Max	**Used**	Min	Max	**Used**	Min	Max	**Used**
15	M12	4	11,8	74	117	100	44	70	**60**	23	37	**32**	73	117	**100**
20	M12	4	15,7	76	117	100	45	70	**60**	24	37	**32**	75	117	**100**
25	M12	4	19,6	94	117	100	56	70	**60**	30	37	**32**	93	117	**100**
32	M16	4	25,1	112	227	193	87	177	**150**	46	94	**80**	145	295	**250**
40	M16	4	31,4	136	227	193	106	177	**150**	57	94	**80**	177	295	**250**
50	M16	4	39,3	159	227	193	124	177	**150**	66	94	**80**	207	295	**250**
65	M16	8	51,1	169	374	257	66	146	**100**	35	78	**53**	110	243	**167**
80	M16	8	62,9	203	462	385	79	180	**150**	42	96	**80**	132	300	**250**
100	M16	8	78,6	228	462	385	89	180	**150**	47	96	**80**	148	300	**250**
125	M16	8	87,8	274	462	385	107	180	**150**	57	96	**80**	178	300	**250**
150	M20	8	96,2	321	638	515	156	310	**250**	83	165	**133**	260	517	**417**
200	M20	8	111,1	392	711	515	190	345	**250**	101	184	**133**	317	575	**417**
250	M20	12	124,2	465	988	772	151	320	**250**	81	171	**133**	252	533	**417**
300	M20	12	136,1	550	1066	772	178	345	**250**	95	184	**133**	297	575	**417**
350	M20	16	147	814	1185	1029	198	288	**250**	106	154	**133**	330	480	**417**
400	M24	16	157,1	931	1337	1042	268	385	**300**	143	205	**160**	447	642	**500**
450	M24	20	166,7	1005	1388	1215	232	320	**280**	124	171	**149**	387	533	**467**
500	M24	20	175,7	1127	1481	1302	260	341	**300**	139	182	**160**	433	568	**500**
600	M27	20	192,5	1317	1705	1460	343	444	**380**	183	237	**203**	572	740	**633**

8.16 Table 16: Pipe class F210, F212 / PN16 – Fiber gasket

Pipe class	F210, F212
Pipe system	PN16
Flange Material	1.4307 / 1.4571
Bolt Material	A4-70
Gasket Material	KLINGERSIL C-4400 2mm
Gasket Manufacture	KLINGER® GmbH & Co. KG
Gasket type	IBC
Leak tighness	L0.01
Friction	0,15
Design pressure	According to the pipe class
Design Temperature	200°C considered in the calculation
External force and moments	DN15 -- DN600 = according EN1092 -1 (reduced)

Table 16

Remarks

- Depending on lubrication, state of bolt and external forces the actual required torque may differ from the below advised calculated torque
- Afhankelijk van de smering, staat van de bouten en externe krachten kan het werkelijk benodigde aanhaalmoment afwijken van het hieronder berekende aanhaalmoment

Flange size			External axial force	Bolt Force KN			Torque Nm								
							Oil 0,15			Molycoat 0,08			No Lubrication 0,25		
(DN)	Bolt size	Number	(KN)	Min	Max	Used	Min	Max	**Used**	Min	Max	**Used**	Min	Max	**Used**
15	M12	4	11,8												
20	M12	4	15,7	90	117	100	54	70	**60**	29	37	**32**	90	117	**100**
25	M12	4	19,6	86	117	100	51	70	**60**	27	37	**32**	85	117	**100**
32	M16	4	25,1	133	227	193	104	177	**150**	55	94	**80**	173	295	**250**
40	M16	4	31,4	155	227	193	121	177	**150**	65	94	**80**	202	295	**250**
50	M16	4	39,3	175	227	193	136	177	**150**	73	94	**80**	227	295	**250**
65	M16	8	51,1	235	371	308	91	144	**120**	49	77	**64**	152	240	**200**
80	M16	8	62,9	252	462	385	98	180	**150**	52	96	**80**	163	300	**250**
100	M16	8	78,6	304	462	385	118	180	**150**	63	96	**80**	197	300	**250**
125	M16	8	87,8	347	462	385	135	180	**150**	72	96	**80**	225	300	**250**
150	M20	8	96,2	420	626	515	204	304	**250**	109	162	**133**	340	507	**417**
200	M20	12	111,1	544	791	618	176	256	**200**	94	137	**107**	293	427	**333**
250	M24	12	124,2	601	931	781	231	357	**300**	123	190	**160**	385	595	**500**
300	M24	12	136,1	714	1277	781	274	490	**300**	146	261	**160**	457	817	**500**
350	M24	16	147	859	1762	1389	247	507	**400**	132	270	**213**	412	845	**667**
400	M27	16	157,1	961	1962	1537	313	638	**500**	167	340	**267**	522	1063	**833**
450	M27	20	166,7	1119	2070	1729	291	539	**450**	155	287	**240**	485	898	**750**
500	M30	20	175,7	1307	2207	1704	383	647	**500**	204	345	**267**	638	1078	**833**
600	M33	20	244	1783	2802	2191	570	895	**700**	304	477	**373**	950	1492	**1167**

8.17 Table 17: Pipe class F400, F401 / PN40 – Fiber gasket

Pipe class	F400, F401
Pipe system	PN40
Flange Material	1.4404 / 1.4571
Bolt Material	21CrMo5-7 / A4-70
Gasket Material	KLINGERSIL C-4400 2mm
Gasket Manufacture	KLINGER® GmbH & Co. KG
Gasket type	IBC
Leak tighness	L0.01
Friction	0,15
Design pressure	According to the pipe class
Design Temperature	200°C considered in the calculation
External force and moments	DN15 -- DN400 = according EN1092 -1 (reduced)

Table 17

Remarks

- Depending on lubrication, state of bolt and external forces the actual required torque may differ from the below advised calculated torque
- Afhankelijk van de smering, staat van de bouten en externe krachten kan het werkelijk benodigde aanhaalmoment afwijken van het hieronder berekende aanhaalmoment

Flange size			External	Bolt Force KN			Torque Nm								
							Oil 0,15			Molycoat 0,08			No Lubrication 0,25		
(DN)	Bolt size	Number	axial force (KN)	Min	Max	Used	Min	Max	**Used**	Min	Max	**Used**	Min	Max	**Used**
15	M12	4	11,8	50	136	100	30	81	**60**	16	43	**32**	50	135	**100**
20	M12	4	15,7	76	127	100	45	76	**60**	24	41	**32**	75	127	**100**
25	M12	4	19,6	68	122	100	41	73	**60**	22	39	**32**	68	122	**100**
32	M16	4	25,1	124	244	193	97	190	**150**	52	101	**80**	162	317	**250**
40	M16	4	31,4	150	246	193	117	192	**150**	62	102	**80**	195	320	**250**
50	M16	4	39,3	185	243	193	144	189	**150**	77	101	**80**	240	315	**250**
65	M16	8	19,7	184	441	385	72	172	**150**	38	92	**80**	120	287	**250**
80	M16	8	62,9	243	504	385	95	196	**150**	51	105	**80**	158	327	**250**
100	M20	8	78,6	320	550	412	155	267	**200**	83	142	**107**	258	445	**333**
125	M24	8	87,8	379	658	521	218	379	**300**	116	202	**160**	363	632	**500**
150	M24	8	96,2	450	839	608	259	483	**350**	138	258	**187**	432	805	**583**
200	M27	12	111,1	645	1155	922	280	501	**400**	149	267	**213**	467	835	**667**
250	M30	12	124,2	828	1681	1227	405	822	**600**	216	438	**320**	675	1370	**1000**
300	M30	16	136,1	1021	2171	1636	374	796	**600**	199	425	**320**	623	1327	**1000**
350	M33	16	160,4	1351	2839	2003	540	1134	**800**	288	605	**427**	900	1890	**1333**
400	M36	16	161	1832	3614	2533	796	1570	**1100**	425	837	**587**	1327	2617	**1833**

8.18 Table 18: Pipe class A060 / PN10 – PTFE based gasket

Pipe class	A060
Pipe system	PN10
Flange Material	P250GH
Bolt Material	25CrMo4
Gasket Material	KLINGER® top-chem2000 2,0mm
Gasket Manufacture	KLINGER® GmbH & Co. KG
Gasket type	IBC
Leak tighness	L0.01
Friction	0,15
Design pressure	According to the pipe class
Design Temperature	200°C considered in the calculation
External force and moments	DN15 -- DN350 = according EN1092 -1 (reduced)
	DN400 -DN500 - 1.35 times of internal pressure
	DN600 & above - 1 times of internal pressure

Table 18

Remarks

- Depending on lubrication, state of bolt and external forces the actual required torque may differ from the below advised calculated torque
- Afhankelijk van de smering, staat van de bouten en externe krachten kan het werkelijk benodigde aanhaalmoment afwijken van het hieronder berekende aanhaalmoment

Flange size			External axial force	Bolt Force KN			Torque Nm								
							Oil 0,15			Molycoat 0,08			No Lubrication 0,25		
(DN)	Bolt size	Number	(KN)	Min	Max	Used	Min	Max	**Used**	Min	Max	**Used**	Min	Max	**Used**
15	M12	4	13,6												
20	M12	4	18,1	37	119	85	22	70	**50**	12	37	**27**	37	117	**83**
25	M12	4	22,6	48	117	85	28	68	**50**	15	36	**27**	47	113	**83**
32	M16	4	29	61	240	196	47	184	**150**	25	98	**80**	78	307	**250**
40	M16	4	36,2	77	239	196	59	183	**150**	31	98	**80**	98	305	**250**
50	M16	4	50	99	240	196	76	184	**150**	41	98	**80**	127	307	**250**
65	M16	8	58,8	161	485	392	62	184	**150**	33	98	**80**	103	307	**250**
80	M16	8	72,4	184	488	392	70	187	**150**	37	100	**80**	117	312	**250**
100	M16	8	100	258	488	392	99	187	**150**	53	100	**80**	165	312	**250**
125	M16	8	101,2	266	488	392	102	187	**150**	54	100	**80**	170	312	**250**
150	M20	8	122,5	354	695	515	172	338	**250**	92	180	**133**	287	563	**417**
200	M20	8	128	387	695	515	188	338	**250**	100	180	**133**	313	563	**417**
250	M20	12	143,1	470	1051	772	152	340	**250**	81	181	**133**	253	567	**417**
300	M20	12	156,8	556	1051	772	180	340	**250**	96	181	**133**	300	567	**417**
350	M20	16	169,3	827	1408	1029	201	342	**250**	107	182	**133**	335	570	**417**
400	M24	16	135,4	879	1719	1215	253	495	**350**	135	264	**187**	422	825	**583**
450	M24	20	170,5	1159	1733	1302	267	399	**300**	142	213	**160**	445	665	**500**
500	M24	20	227,5	1423	1786	1519	328	411	**350**	175	219	**187**	547	685	**583**
600	M27	20	196,8	1664	2098	1729	433	546	**450**	231	291	**240**	722	910	**750**
700	M27	24	203,9	1764	2671	2075	383	579	**450**	204	309	**240**	638	965	**750**
800	M30	24	298,1	2213	3095	2454	541	757	**600**	289	404	**320**	902	1262	**1000**
900	M30	28	335,2	2635	3998	3341	552	838	**700**	294	447	**373**	920	1397	**1167**
1000	M33	28	416,5	3159	4405	3506	721	1005	**800**	385	536	**427**	1202	1675	**1333**

8.19 Table 19: Pipe class F020, F022 / PN10 – PTFE based gasket

Pipe class	F020, F022
Pipe system	PN10
Flange Material	1.4404 /1.4571
Bolt Material	A4-70
Gasket Material	KLINGER® top-chem2000 2,0mm
Gasket Manufacture	KLINGER® GmbH & Co. KG
Gasket type	IBC
Leak tighness	L0.01
Friction	0,15
Design pressure	According to the pipe class
Design Temperature	200°C considered in the calculation
External force and moments	DN15 -- DN600 = according EN1092 -1 (reduced)

Table 19

Remarks

- Depending on lubrication, state of bolt and external forces the actual required torque may differ from the below advised calculated torque
- Afhankelijk van de smering, staat van de bouten en externe krachten kan het werkelijk benodigde aanhaalmoment afwijken van het hieronder berekende aanhaalmoment

Flange size			External axial force	Bolt Force KN			Torque Nm								
							Oil 0,15			Molycoat 0,08			No Lubrication 0,25		
(DN)	Bolt size	Number	(KN)	Min	Max	Used	Min	Max	**Used**	Min	Max	**Used**	Min	Max	**Used**
15	M12	4	11,8												
20	M12	4	15,7	38	117	100	23	70	**60**	12	37	**32**	38	117	**100**
25	M12	4	19,6	49	117	100	29	70	**60**	15	37	**32**	48	117	**100**
32	M16	4	25,1	62	227	193	48	177	**150**	26	94	**80**	80	295	**250**
40	M16	4	31,4	78	227	193	61	177	**150**	33	94	**80**	102	295	**250**
50	M16	4	39,3	100	227	193	78	177	**150**	42	94	**80**	130	295	**250**
65	M16	8	51,1	157	437	385	61	170	**150**	33	91	**80**	102	283	**250**
80	M16	8	62,9	186	462	385	72	180	**150**	38	96	**80**	120	300	**250**
100	M16	8	78,6	241	462	385	94	180	**150**	50	96	**80**	157	300	**250**
125	M16	8	87,8	269	462	385	105	180	**150**	56	96	**80**	175	300	**250**
150	M20	8	96,2	335	711	618	163	345	**300**	87	184	**160**	272	575	**500**
200	M20	8	111,1	393	711	618	191	345	**300**	102	184	**160**	318	575	**500**
250	M20	12	124,2	477	1075	926	154	348	**300**	82	186	**160**	257	580	**500**
300	M20	12	136,1	563	1075	926	182	348	**300**	97	186	**160**	303	580	**500**
350	M20	16	147	822	1363	1029	200	331	**250**	107	177	**133**	333	552	**417**
400	M24	16	157,1	977	1531	1215	281	441	**350**	150	235	**187**	468	735	**583**
450	M24	20	166,7	1051	1580	1302	242	364	**300**	129	194	**160**	403	607	**500**
500	M24	20	175,7	1174	1671	1302	270	385	**300**	144	205	**160**	450	642	**500**
600	M27	20	192,5	1364	1896	1729	355	493	**450**	189	263	**240**	592	822	**750**

8.20 Table 20: Pipe class F212 / PN16 – PTFE based gasket

Pipe class	F212
Pipe system	PN16
Flange Material	1,4571
Bolt Material	A4-70
Gasket Material	KLINGER® top-chem2000 2,0mm
Gasket Manufacture	KLINGER® GmbH & Co. KG
Gasket type	IBC
Leak tighness	L0.01
Friction	0,15
Design pressure	According to the pipe class
Design Temperature	200°C considered in the calculation
External force and moments	DN15 -- DN600 = according EN1092 -1 (reduced)

Table 20

Remarks

- Depending on lubrication, state of bolt and external forces the actual required torque may differ from the below advised calculated torque
- Afhankelijk van de smering, staat van de bouten en externe krachten kan het werkelijk benodigde aanhaalmoment afwijken van het hieronder berekende aanhaalmoment

Flange size			External axial force	Bolt Force KN			Torque Nm								
							Oil 0,15			Molycoat 0,08			No Lubrication 0,25		
(DN)	Bolt size	Number	(KN)	Min	Max	Used	Min	Max	**Used**	Min	Max	**Used**	Min	Max	**Used**
15	M12	4	11,8												
20	M12	4	15,7	52	117	100	31	70	**60**	17	37	**32**	52	117	**100**
25	M12	4	19,6	67	117	100	40	70	**60**	21	37	**32**	67	117	**100**
32	M16	4	25,1	83	227	193	65	177	**150**	35	94	**80**	108	295	**250**
40	M16	4	31,4	102	227	193	79	177	**150**	42	94	**80**	132	295	**250**
50	M16	4	39,3	126	227	193	98	177	**150**	52	94	**80**	163	295	**250**
65	M16	8	51,1	337	435	385	131	169	**150**	70	90	**80**	218	282	**250**
80	M16	8	62,9	267	462	385	104	180	**150**	55	96	**80**	173	300	**250**
100	M16	8	78,6	321	462	385	125	180	**150**	67	96	**80**	208	300	**250**
125	M16	8	87,8	358	462	385	139	180	**150**	74	96	**80**	232	300	**250**
150	M20	8	96,2	500	711	618	243	345	**300**	130	184	**160**	405	575	**500**
200	M20	12	111,1	619	953	772	200	309	**250**	107	165	**133**	333	515	**417**
250	M24	12	124,2	672	1098	912	258	422	**350**	138	225	**187**	430	703	**583**
300	M24	12	136,1	724	1462	1172	278	561	**450**	148	299	**240**	463	935	**750**
350	M24	16	147	870	1981	1563	251	570	**450**	134	304	**240**	418	950	**750**
400	M27	16	157,1	973	2186	1691	317	711	**550**	169	379	**293**	528	1185	**917**
450	M27	20	166,7	1130	2298	1921	294	598	**500**	157	319	**267**	490	997	**833**
500	M30	20	175,7	1338	2431	1875	393	713	**550**	210	380	**293**	655	1188	**917**
600	M33	20	244	1830	3053	2504	585	975	**800**	312	520	**427**	975	1625	**1333**

8.21 Table 21: Pipe class M120, M170, M190 / PN10 – Hypalon gasket

Table not yet available. For details contact the gasket supplier.

8.22 Table 22: Pipe class A060, A120, I010, F020, F022 / PN10 – Rubber gasket

Pipe class	A060, A120, I010, F020, F022
Pipe system	PN10
Flange Material	P250GH / 1.4404 / 1.4571
Bolt Material	25CrMo4 / A4-70
Gasket Material	NBR
Gasket Manufacture	Eriks
Gasket type	IBC
Leak tighness	L0.01
Friction	0,15
Design pressure	5 bar (g)
Design Temperature	75ºC considered in the calculation
External force and moments	DN15 - DN150 - 1.6 times of internal pressure
	DN200 -DN250 - 1.35 times of internal pressure
	DN300 & DN500 - 1 times of internal pressure
	DN600 & above -100KN

Table 22

Remarks

- Depending on lubrication, state of bolt and external forces the actual required torque may differ from the below advised calculated torque
- Afhankelijk van de smering, staat van de bouten en externe krachten kan het werkelijk benodigde aanhaalmoment afwijken van het hieronder berekende aanhaalmoment

Flange size			External axial force	Bolt Force KN			Torque Nm								
							Oil 0,15			Molycoat 0,08			No Lubrication 0,25		
(DN)	Bolt size	Number	(KN)	Min	Max	Used	Min	Max	**Used**	Min	Max	**Used**	Min	Max	**Used**
15	M12	4	0,2	5	14	8	3	8	**5**	2	4	**3**	5	13	**8**
20	M12	4	0,3	7	24	17	4	14	**10**	2	7	**5**	7	23	**17**
25	M12	4	0,5	9	32	17	5	19	**10**	3	10	**5**	8	32	**17**
32	M16	4	1,4	12	39	26	9	30	**20**	5	16	**11**	15	50	**33**
40	M16	4	1,2	15	50	26	11	38	**20**	6	20	**11**	18	63	**33**
50	M16	4	1,9	18	63	39	14	48	**30**	7	26	**16**	23	80	**50**
65	M16	8	3,1	25	85	52	10	33	**20**	5	18	**11**	17	55	**33**
80	M16	8	4,3	31	106	52	12	41	**20**	6	22	**11**	20	68	**33**
100	M16	8	6,1	35	114	78	13	44	**30**	7	23	**16**	22	73	**50**
125	M16	8	9,2	49	153	78	19	59	**30**	10	31	**16**	32	98	**50**
150	M20	8	13,5	57	168	103	28	82	**50**	15	44	**27**	47	137	**83**
200	M20	8	22,6	88	247	165	43	120	**80**	23	64	**43**	72	200	**133**
250	M20	12	35,9	119	305	185	39	99	**60**	21	53	**32**	65	165	**100**
300	M20	12	37,7	142	349	185	46	113	**60**	25	60	**32**	77	188	**100**
350	M20	16	45,8	239	639	329	58	155	**80**	31	83	**43**	97	258	**133**
400	M24	16	60,4	295	733	417	85	211	**120**	45	113	**64**	142	352	**200**
450	M24	20	77	357	808	521	82	186	**120**	44	99	**64**	137	310	**200**
500	M24	20	96	430	928	521	99	214	**120**	53	114	**64**	165	357	**200**
600	M27	20	100	524	1071	615	136	279	**160**	73	149	**85**	227	465	**267**
700	M27	24	100	689	1471	830	149	319	**180**	79	170	**96**	248	532	**300**
800	M30	24	100	862	1748	982	211	427	**240**	113	228	**128**	352	712	**400**
900	M30	28	100	1022	1914	1241	214	401	**260**	114	214	**139**	357	668	**433**
1000	M33	28	100	1250	2214	1315	285	505	**300**	152	269	**160**	475	842	**500**

8.23 Table 23: Pipe class A060, A120, I010, A210, I200 / PN10/16 – Rubber gasket

Pipe class	A060, A120, I010, A210, I200
Pipe system	PN10 / PN16
Flange Material	P250GH
Bolt Material	25CrMo4
Gasket Material	G-ST-P/S EPDM 4,0mm
Gasket Manufacture	Kroll + Ziller GmbH & Co.KG.
Gasket type	IBC
Leak tighness	L0.01
Friction	0,15
Design pressure	10 bar (g) or according to the pipe class
Design Temperature	75ºC considered in the calculation
External force and moments	DN32 -- DN80 = 1.6 times internal pressure
	DN100 -DN250 - 1.35 times of internal pressure
	DN300 -DN450 - 1 times of internal pressure
	DN500 & above 150KN External force

Table 23

Remarks

- Depending on lubrication, state of bolt and external forces the actual required torque may differ from the below advised calculated torque
- Afhankelijk van de smering, staat van de bouten en externe krachten kan het werkelijk benodigde aanhaalmoment afwijken van het hieronder berekende aanhaalmoment

Flange size			External	Bolt Force KN			Torque Nm								
							Oil 0,15			Molycoat 0,08			No Lubrication 0,25		
(DN)	Bolt size	Number	axial force (KN)	Min	Max	Used	Min	Max	**Used**	Min	Max	**Used**	Min	Max	**Used**
15	M12	4													
20	M12	4													
25	M12	4													
32	M16	4	1,4	27	120	65	21	92	**50**	11	49	**27**	35	153	**83**
40	M16	4	1,9	34	152	65	26	116	**50**	14	62	**27**	43	193	**83**
50	M16	4	3,1	42	190	78	32	145	**60**	17	77	**32**	53	242	**100**
65	M16	8	5,2	58	239	131	22	91	**50**	12	49	**27**	37	152	**83**
80	M16	8	7,1	72	287	131	28	110	**50**	15	59	**27**	47	183	**83**
100	M16	8	12,2	86	323	157	33	124	**60**	18	66	**32**	55	207	**100**
125	M16	8	15,3	117	399	209	45	153	**80**	24	82	**43**	75	255	**133**
150	M20	8	26,9	143	450	247	69	219	**120**	37	117	**64**	115	365	**200**
200	M20	8	39,8	219	630	309	106	306	**150**	57	163	**80**	177	510	**250**
250	M20	12	59,7	297	756	463	96	245	**150**	51	131	**80**	160	408	**250**
300	M20	12	62,5	355	872	463	115	282	**150**	61	150	**80**	192	470	**250**
350	M20	16	80,6	519	1209	618	126	294	**150**	67	157	**80**	210	490	**250**
400	M24	16	100,3	654	1333	764	188	384	**220**	100	205	**117**	313	640	**367**
450	M24	20	126,3	813	1379	955	187	318	**220**	100	170	**117**	312	530	**367**
500	M24	20	150	933	1500	1085	215	346	**250**	115	185	**133**	358	577	**417**
600	M27	20	150	1153	1757	1268	300	457	**330**	160	244	**176**	500	762	**550**
700	M27	24	150	1219	2268	1383	264	492	**300**	141	262	**160**	440	820	**500**
800	M30	24	150	1539	2749	1718	376	672	**420**	201	358	**224**	627	1120	**700**
900	M30	28	150	1806	3487	1909	378	731	**400**	202	390	**213**	630	1218	**667**
1000	M33	28	150	2216	3826	2410	506	873	**550**	270	466	**293**	843	1455	**917**

8.24 Table 24: Pipe class F020, F022, H130, F212 / PN10/16 – Rubber gasket

Pipe class	F020, F022, H130, F212
Pipe system	PN10 / PN16
Flange Material	1.4404 / 1.4539 / 1.4571
Bolt Material	A4-70
Gasket Material	G-ST-P/S EPDM 4,0mm
Gasket Manufacture	Kroll + Ziller GmbH & Co.KG.
Gasket type	IBC
Leak tighness	L0.01
Friction	0,15
Design pressure	10 bar (g) or according to the pipe class
Design Temperature	75°C considered in the calculation
External force and moments	DN32 -- DN80 = 1.6 times internal pressure
	DN100 -DN250 - 1.35 times of internal pressure
	DN300 -DN500 - 1 times of internal pressure
	DN600 150KN External force

Table 24

Remarks

- Depending on lubrication, state of bolt and external forces the actual required torque may differ from the below advised calculated torque
- Afhankelijk van de smering, staat van de bouten en externe krachten kan het werkelijk benodigde aanhaalmoment afwijken van het hieronder berekende aanhaalmoment

Flange size			External	Bolt Force KN			Torque Nm								
							Oil 0,15			Molycoat 0,08			No Lubrication 0,25		
(DN)	Bolt size	Number	axial force (KN)	Min	Max	Used	Min	Max	**Used**	Min	Max	**Used**	Min	Max	**Used**
15	M12	4													
20	M12	4													
25	M12	4													
32	M16	4	1,6	28	120	77	22	93	**60**	12	50	**32**	37	155	**100**
40	M16	4	2,2	35	152	77	27	118	**60**	14	63	**32**	45	197	**100**
50	M16	4	3,5	44	190	103	34	148	**80**	18	79	**43**	57	247	**133**
65	M16	8	5,8	60	240	128	23	93	**50**	12	50	**27**	38	155	**83**
80	M16	8	8	75	289	154	29	112	**60**	15	60	**32**	48	187	**100**
100	M16	8	11,3	86	317	154	33	123	**60**	18	66	**32**	55	205	**100**
125	M16	8	17,1	118	404	206	46	157	**80**	25	84	**43**	77	262	**133**
150	M20	8	25	141	443	247	69	215	**120**	37	115	**64**	115	358	**200**
200	M20	8	42	221	641	329	107	311	**160**	57	166	**85**	178	518	**267**
250	M20	12	67	299	781	432	97	253	**140**	52	135	**75**	162	422	**233**
300	M20	12	70	358	903	494	116	292	**160**	62	156	**85**	193	487	**267**
350	M20	16	83,3	524	1095	741	127	266	**180**	68	142	**96**	212	443	**300**
400	M24	16	93	615	1214	764	177	350	**220**	94	187	**117**	295	583	**367**
450	M24	20	100	664	1270	868	153	293	**200**	82	156	**107**	255	488	**333**
500	M24	20	124,5	801	1366	955	185	315	**220**	99	168	**117**	308	525	**367**
600	M27	20	150	944	1592	1230	246	414	**320**	131	221	**171**	410	690	**533**