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## General installation instructions:

### 1.1 Assembly

Installation work should be carried out by qualified personnel (DIN EN 1591-4 / VDI 2290).

**Note:** No welding may be performed under any circumstances on lined parts, otherwise the fluorine plastic can be destroyed.

### 1.2 Protective cover

To protect the lining from soiling and mechanical damage from handling and storage and to hold down the flare, all parts are provided with a protective cover. These may only be removed immediately before installation!

### 1.3 Seals

Additional seals between the PTFE/ PFA sealing surfaces are usually not necessary. There are exceptions, e.g. in the case of transition to metal, glass, ceramics, enamel, ETFE, PVDF, etc. Another exception are flange connections, which often have to be separated and reassembled for usage purposes. For these, it makes sense to use an additional PTFE seal from the 2nd assembly onwards, as the PTFE flares loses the necessary elasticity after being pressed too often.

### 1.4 Bolts

Flange bolted connections must be cross-tightened in several steps with a torque spanner at **room temperature** and finally tightened evenly in a clockwise direction according to the use-specific installation torque table (please also see VCI-guidelines).

The installation instructions deal with piping systems without specific tightness requirements and systems according to the TA Luft (air pollution control) specification.

Due to the flow behaviour of the PTFE sealing surface in the flare of the components, the screw connections should ideally be retightened after one day, at the earliest after a settling break of 6 hours. The flange is the PTFE/PFA lining of the component, which is formed outwards in the flange area during manufacture and is used as a transition-free sealing surface from the inner pipe to the flange.

For use temperatures above 60°C, it is recommended to run a temperature cycle at max. use temperature with 2h holding time after each retightening. The next retightening takes place again at room temperature.

To avoid damage to the seal due to excessive pressing, please observe the specified assembly torques (see chapter 3).

The number of tightening/ retightening operations with assembly torque is normally limited to three processes. After that, only 50% of the assembly torque may be applied. If there are still leakage problems at the flange connection afterwards, it may be necessary to work with an additional seal.

### 1.5 Potential equalisation

Electrostatic charges may occur outside non-grounded metallic pipelines. These can lead to life-threatening electric shocks and ignition sparks when touched. Therefore, pipelines should ideally be earthed throughout in accordance with the factory safety regulations.

In the case of non-conductive lining materials (natural PTFE), electrical charges can also build up inside the cables due to flowing media. These charges strike through at a corresponding voltage, damage the liner and reach the metal tube. This effect must be taken into account by the designer of the system. By using conductive lined liners, the charge can be dissipated to the outside so that it cannot build up.

For electrical connection (earthing) of the piping, lock washers (between bolt head and flange /nut and flange) and earthing bolts/sleeves/brackets- see catalogue can be used.

**Note:** Lock washers are not suitable for repeated installation and removal (wear)

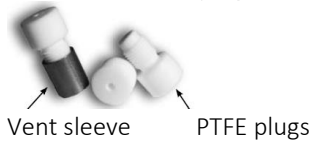
## 1.6 Splash guard

Many systems in the chemical industry are operated with aggressive media that must not get into the environment. Splash guards (see catalogue) offer the protection of detecting the first leaks in good time, without the medium in the system having escaped. Then the system can be shut down in time without damage.

## 1.7 Ventilation holes

With the exception of blind flanges, reducing flanges and G shaped spacers, all PTFE parts have ventilation holes with a diameter of approx. 3 mm. These are used for leak testing after production, as a leakage indicator during operation and, if required, as a permeate outlet on the system. When installing, make sure that they are not blocked by paint or insulation. If the vent holes are closed by the customer, the manufacturer's warranty for possible damage is excluded. For systems with substances that have a high permeation tendency, the permeate can be extracted at the vents and discharged separately.

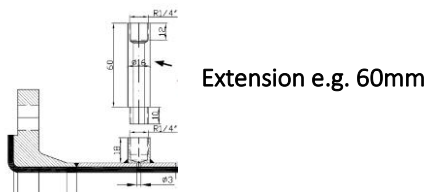
### Vent sleeve/PTFE plugs



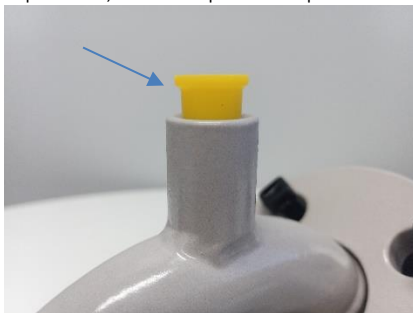
Depending on the design, vent sleeves are welded on above the vent openings. A PTFE plug can be fitted in these for control and pressure equalisation.

For insulated cables, the transfer point is led out of the insulation via PTFE extension sleeves (see below).

Extraction systems can be connected to these points if required. Specific plugs are required for fixed connections to the extraction systems.



If present, remove plastic caps on vent sleeves for protection before commissioning.



### Flange stopper

Flange stoppers can be fitted behind a loose flange to prevent the loose flange from moving freely on the pipe or fitting.

## Instructions for use

### 1.8 Maximum permissible continuous operating temperature of PTFE/PFA-lined components

PTFE- and PFA-lined flanged pipes, bends, T-pieces, expansion joints, etc. may be used in continuous operation up to max. 230°C. This limitation results from the temperature-dependent strength and thermal stability of the lining plastics. Thermal decomposition of the PTFE begins at 280°C. If temperatures >400 °C are reached due to a malfunction in a plant, the personnel must leave the area immediately, as corrosive decomposition products of the plastics that are hazardous to health are produced and outgassed within a short time.

### 1.9 Temperature-dependent pressure resistance of PTFE/PFA-lined components

The max. permissible permanent and peak pressure resistance of PTFE- and PFA-lined components (no PTFE expansion joints) up to PN 25 only depends on the steel reinforcement. For PN 40, the temperature-dependent stability of the PTFE is also taken into account. For PTFE bellows expansion joints, please request the specific pressure temperature diagrams of the respective expansion joints from BAUM.

The typical steel materials of steel/PTFE piping belong to material group 3E0 according to the AD 2000 regulations. The following temperature-dependent pressure resistance results for these components:

Pressure level	Max. pressure in <sup>5</sup> [Pa] 0 [bar]						
	T [°C]	-20	25	100	150	180	200
PN10	10	10	8.5	8.3	7.9	7.7	7.3
PN16	16	16	13.7	13.3	12.8	12.4	11.7
PN25	25	25	21.4	20.8	20	19.4	18.4
PN40	40	40	34.2	28.3	24.9	22.6	19.6

For other material groups, the values from DIN EN 1092.1, AD 2000, DIN EN 13480, DIN EN 13445, ASME B16.5, ASME B31.3 or other regulations applicable to pressure equipment apply

### 1.10 Vacuum resistance of PTFE lined components

PTFE-lined flanged pipes, bends, T-pieces, expansion joints, etc. are fully or partially vacuum resistant depending on the lining series, operating temperature and dimension.

Please request these properties directly from BAUM if required.

### 1.11 General information

PTFE and PFA have proven themselves as long term corrosion protection.

For electrically conductive lining material (black), it is recommended to test components regularly for the remaining conductivity.

Depending on various factors, symptoms of permeation and absorption may appear. The term permeation refers to the transport of medium through the lining.

Due to the effects mentioned we recommend a regular check of all components for reasons of operational safety.

Upon request, liners can be supplied with FDA approval according to CFR177.1550. However, it is the user's responsibility to check the suitability of the supplied components in relation to the intended use.

## Assembly torque tables

### 1.12 Foreword

For the assembly (flange connections) of piping systems made of PTFE-lined flange pipes, fittings, expansion joints, etc., the fitter requires assembly torque tables in order to be able to connect the components tightly together in accordance with the system specification.

According to the current state of the art, a distinction is made between systems without specific tightness requirements and systems that must comply with the new TA Luft 2021.

#### 1.12.1 Installations without specific tightness requirements

In the systems without specific tightness requirements, the PTFE sealing surface is compressed with a surface pressure of 20MPa when the flange screws are tightened so that the PTFE starts to flow and seal (see assembly torque table chapter 3.2.).

The time and temperature-dependent setting behaviour of the PTFE as well as the design properties of the flanges are compensated for by repeated retightening of the flange connection until the subjective tightness is achieved.

#### 1.12.2 Installations with TA Luft 2021 specific tightness requirements

For systems with TA Luft-specific tightness requirements, information on the number of retightening operations and notes on pipe support are given in addition to the installation torque (from specific diameters on a pipe stress analysis of the pipeline is necessary, provided by enduser).

In determining these torque tables, a calculation was carried out for each flange size and type as well as the planned operating temperature, in which the sealing characteristics, bolt material and flange geometry are taken into account. After the installation of the flange connections documented by the installer according to the table (chapter 3.3.), the flange connection achieves the tightness requirement of TA Luft 2021.

## 1.13 Torque table for installations without specific tightness requirements

### 1.13.1 DIN-Standard

Diameter Nominal [DN]	PN10		PN16		PN25		PN40	
	bolts	Torque [Nm]	bolts	Torque [Nm]	bolts	Torque [Nm]	bolts	Torque [Nm]
15	4 x M12	15	-	-	-	-	-	-
20	4 x M12	25	-	-	-	-	-	-
25	4 x M12	34	4 x M12	34	4 x M12	34	4 x M12	34
32	4 x M16	55	4 x M16	55	4 x M16	55	4 x M16	55
40	4 x M16	68	4 x M16	68	4 x M16	68	4 x M16	68
50	4 x M16	86	4 x M16	86	4 x M16	86	4 x M16	86
65**	4 x M16	115	4 x M16	115	-	-	-	-
65	8 x M16	58	8 x M16	58	8 x M16	58	8 x M16	58
80	8 x M16	71	8 x M16	71	8 x M16	71	8 x M16	71
100	8 x M16	78	8 x M16	78	8 x M20	107	8 x M20	107
125	8 x M16	89*	8 x M16	89*	8 x M24	156	8 x M24	156
150	8 x M20	141	8 x M20	141	8 x M24	192	8 x M24	192
200	8 x M20	181*	12 x M20	141	12 x M24	200	12 x M27	252
250	12 x M20	166	12 x M24	201	12 x M27	296	12 x M30	378
300	12 x M20	169*	12 x M24	273*	16 x M27	301	16 x M30	399
350	16 x M20	212*	16 x M24	280	16 x M30	479	16 x M33	611
400	16 x M24	291*	16 x M27	430	16 x M33	562	16 x M36	1137
500	20 x M24	315*	20 x M30	567	20 x M33	609	20 x M39	1008
600	20 x M27	457	20 x M33	829	20 x M36	1049	20 x M45	1596
700	24 x M27	467*	-	-	-	-	-	-
800	24 x M30	611*	-	-	-	-	-	-
	- For all torque specifications without special remarks, bolt grade 5.6, A2-70, A4-70 or comparable approved grade is recommended.							
*	- For the flange connections marked with *, a lightly oiled screw made of the material 25CrMo4 or higher is required for reasons of screw load.							
**	- This flange is an older standard. In this special case, screws made of the material 25CrMo4 or higher must be used.							

Source: Tightening torques DIN & ANSI - PTFE components Rev.6

Tightening torques apply to lightly oiled/greased bolts at normal temperature and are designed to allow the liner to flow easily for a secure seal.

Any further increase of the indicated torques does not necessarily lead to a better seal, but can lead to a deformation of the flange.

## 1.13.2 ANSI-Standard

Nominal pipe size [NPS]	Pressure class 150			Pressure class 300		
	no. of bolts x thread	Torque [Nm]	Torque [ft-lb]	no. of bolts x thread	Torque [Nm]	Torque [ft-lb]
1/2"	4 x 1/2"	6	4.4	4 x 1/2"	6	4.4
3/4"	4 x 1/2"	10	7.4	4 x 5/8"	12	8.8
1"	4 x 1/2"	14	10.3	4 x 5/8"	18	13.3
1 1/2"	4 x 1/2"	28	20.6	4 x 3/4"	41	30.2
2"	4 x 5/8"	53	39.1	8 x 5/8"	27	19.9
2 1/2"	4 x 5/8"	66	48.7	8 x 3/4"	39	28.8
3"	4 x 5/8"	94	69.3	8 x 3/4"	56	41.3
4"	8 x 5/8"	67	49.4	8 x 3/4"	80	59
5"	8 x 3/4"	101	74.5	8 x 3/4"	101	74.5
6"	8 x 3/4"	128	94.4	12 x 3/4"	73	53.8
8"	8 x 3/4"	178	131.3	12 x 7/8"	138	101.8
10"	12 x 7/8"	175	129.1	16 x 1"	150	110.6
12"	12 x 7/8"	228	168.1	16 x 1 1/8"	220	162.2
14"	12 x 1"	285	210.2	20 x 1 1/8"	192	141.7
16"	16 x 1"	265	195.4	20 x 1 1/4"	265	195.6
18"	16 x 1 1/8"	389	286.9	24 x 1 1/4"	288	212.5
20"	20 x 1 1/8"	344	253.7	24 x 1 1/4"	318	234.7
24"	20 x 1 1/4"	487	359.1	24 x 1 1/2"	487	359.4

- ASTM A193 Grade B7 or equivalent approved grade is recommended for all torque specifications.

Source: Tightening torques DIN & ANSI - PTFE components Rev.6

Tightening torques apply to lightly oiled/greased bolts at normal temperature and are designed to allow the liner to flow easily for a secure seal.

Any further increase of the indicated torques does not necessarily lead to a better seal, but can lead to a deformation of the flange.

## 1.14 Torque table for systems with TA Luft 2021 specific tightness requirements

### 1.14.1 Requirements for flange connections systems with TA Luft 2021 specific tightness requirements

In order to be able to comply with the requirement of TA Luft 2021 for flange connections of steel PTFE piping, the requirements listed below must be met. Since the settling behaviour of PTFE seals and the resulting sealing behaviour is strongly temperature-dependent, the tables corresponding to the operating conditions (pressure/temperature) must be used. If the requirement of the operating conditions is higher than the table values, a specific design of the flange connections is necessary.

- The manufacturer of the pipe components must confirm the basic suitability of the components for this application (materials, manufacturing process, operating approval, etc.)
- For existing installations, compliance with the materials prescribed in the table must be checked. Components that do not comply with this profile must be replaced.
- For the assembly, screws of grade 25CrMo4 or higher, including washers, approved in the PED (Pressure Equipment Directive) must be used.
- The screws must be oiled so that a coefficient of friction of approx. 0.13 is maintained.
- The pipe fastening (support ) must be carried out according to the classification in the table 3.3.2. Consultation with specialist pipe engineers (possibly Pipe Stress Analysis) is required here.
- The assembly torque tables are divided into temperature levels. For tables with a higher design temperature, those with a lower design temperature are also covered.
- By use of additional seals between the flares, a new evidence of conformity to TA-Luft 2021 is needed.

### 1.14.2 Notes for the pipe construction specialist engineer

When calculating the flange connections according to the new TA Luft 2021, the permissible flange engagement forces and moments had to be reduced or equalised due to the settling behaviour of the PTFE.

In order to be able to apply the assembly tightening torques of the new TA Luft 2021, a static test (pipe - stress analysis) for certain pipe dimensions upwards is required for pipe construction. The pipe support must be carried out according to these results. The enclosed table 3.3.2. shows the max. permissible additional pipe forces at the flange connections for the calculation engineer (depending on the pipe dimension).

Diameter nominal	Add. pipe force PN10 [kN]	Add. pipe force PN16 [kN]	Add. pipe force PN25 [kN]		Additional pipe force stainl.st. / PN10 [kN]
DN25	19	19	19		19
DN32	25	25	25		24
DN40	31	31	31		30
DN50	38	38	38		38
DN65	50	50	50		49
DN80	61	61	61		60
DN100	77	77	77		75
DN125	11	17	27		11
DN150	16	25	40		16
DN200	27	43	67		26
DN250	42	86	105		42
DN300	60	96	149 1.)		30 2.)
DN350	73	--	--		35 2.)
DN400	96	--	--		50 2.)
DN450	--	--	--		65 2.)
DN500	--	--	--		80 2.)

Table 3.3.2. – additional pipe force

1.) = 130 for VF-VF 2.) different from EN 1092-1 (red)



## 1.14.3 Material group carbon steel

### 1.14.3.1 Assembly torque table for operating temperature -20°C to +100°C

For the permissible maximum pressure (temperature-dependent), please refer to chapter 1.9.

Torques apply to assembly at RT (20°C). Flange connection must be retightened at least 1x after first, complete temperature curve. For pressure class PN 25, dimensions from size 250 and 300 have to be retightened twice (after each complete temperature curve)

Diameter Nominal [DN]	PN10		PN25	
	bolts	Torque [Nm]	bolts	Torque [Nm]
15	4 x M12	35	4 x M12	35
20	4 x M12	55	4 x M12	55
25	4 x M12	55	4 x M12	55
32	4 x M16	125	4 x M16	125
40	4 x M16	125	4 x M16	125
50	4 x M16	140	4 x M16	140
65	8 x M16	100	8 x M16	125
80	8 x M16	125	8 x M16	125
100	8 x M16	140	8 x M20	240
125	8 x M16	125	8 x M24	340
150	8 x M20	260	8 x M24	340
200	8 x M20	260	12 x M24	340
250	12 x M20	260	12 x M27	490 1.)
300	12 x M20	260	16 x M27	490 1.)

1.) = to be retightened twice !

### 1.14.3.2 Assembly torque table for operating temperature -20°C to +180°C

For the permissible maximum pressure (temperature-dependent), please refer to chapter 1.9.

Torques apply to assembly at RT (20°C). Flange connection must be retightened at least 1x after first, complete temperature curve. For pressure class PN16 and PN 25, dimensions from size 250 and 300 have to be retightened twice (after each complete temperature curve), for PN16 additionally for DN200.

Diameter Nominal [DN]	PN10		PN16		PN25	
	bolts	Torque [Nm]	bolts	Torque [Nm]	bolts	Torque [Nm]
15	4 x M12	35	4 x M12	35	4 x M12	35
20	4 x M12	55	4 x M12	55	4 x M12	55
25	4 x M12	55	4 x M12	55	4 x M12	60
32	4 x M16	125	4 x M16	125	4 x M16	125
40	4 x M16	125	4 x M16	140	4 x M16	140
50	4 x M16	140	4 x M16	145	4 x M16	150
65	8 x M16	100	8 x M16	105	8 x M16	125
80	8 x M16	125	8 x M16	140	8 x M16	140
100	8 x M16	140	8 x M16	145	8 x M20	240
125	8 x M16	125	8 x M16	140	8 x M24	340
150	8 x M20	260	8 x M20	240	8 x M24	400
200	8 x M20	260	12 x M20	230 1.)	12 x M24	340
250	12 x M20	260	12 x M24	320 1.)	12 x M27	550 1.)
300	12 x M20	260	16 x M24	420 1.)	16 x M27	495 1.)
350	16 x M20	260	-	-	-	-
400	16 x M24	370	-	-	-	-

1.) = to be retightened twice !

## 1.14.4 Material group stainless steel

### 1.14.4.1 Assembly torque table for operating temperature -20°C to +180°C

Torques apply to assembly at RT (20°C). Flange connection must be retightened at least 1x after first, complete temperature curve. Dimensions from size 250 to 500 have to be retightened twice (after each complete temperature curve).

Diameter Nominal [DN]	Stainless steel / PN10	
	bolts	Torque [Nm]
15	4 x M12	35
20	4 x M12	55
25	4 x M12	55
32	4 x M16	125
40	4 x M16	145
50	4 x M16	145
65	8 x M16	110
80	8 x M16	145
100	8 x M16	145
125	8 x M16	145
150	8 x M20	275
200	8 x M20	275
250	12 x M20	195 1.)
300	12 x M20	275 1.)
350	16 x M20	275 1.)
400	16 x M24	370 1.)
450	20 x M24	370 1.)
500	20 x M24	410 1.)

1.) = to be retightened twice !