

Unipetrol RPA, s.r.o.  Maintenance department	Flange joints – disassembly, assembly and marking	N 13 132

The standard is binding for all entities (physical persons and legal entities) that participate in the activities related to proposing, constructing, assembling, maintaining and repairing flange joints, operator of which is UNIPETROL RPA, s.r.o.

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<b>Replaces:</b>  N 13 132 from 18.9.2020	<b>Standard administrator:</b>  Maintenance support section	<b>Valid from:</b>  7.10.2020
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## **Initial provisions**

This standard specifies and describes in more detail standard procedures for assembling and disassembling flange joints of technological devices and standardization of the procedure for their tightening, including marking during and after assembly, under the conditions at UNIPETROL RPA, s.r.o.

The objective of the standard is to reduce or eliminate the risks related to flange joint leaks during the operation of the given technological equipment.

Maintenance and repairs of flange joints at the company are secured in a contractual manner based on contracts concluded between UNIPETROL RPA, s.r.o. and a qualified service company (contractor).

### **1. Scope of validity**

This standard is valid for the entire UNIPETROL RPA, s.r.o.

The procedure includes assembly, disassembly and controlled tightening of the flange joints on pipeline branches, apparatuses, exchangers, pressure containers, etc.

The rules do not apply to the flange joints of nonprocedural equipment (such as steam heating) and to other, non-flange joints.

When tightening flange joints between a pipeline branch and a device or between individual parts of a device, proceed pursuant to the tightening method specified by the manufacturer. Should the manufacturer not specify any methods for tightening the flange joints, proceed pursuant to this regulation.

The obligation of external companies to accept and comply with this standard must be stated in the corresponding contracts for work or other similar contracts concluded between UNIPETROL RPA, s.r.o. and the given contractor.

## 2. Terminology and definitions

Company	- UNIPETROL RPA, s.r.o.
Flange joints	- flange joints are dismountable joints. They are used when it is necessary to ensure repeated separation of individual joint parts during the given usage period, or when this method is the only possible assembly method. They usually represent pressure elements, such as tanks, fixtures, valves, blind openings, dividing pipeline planes, etc. Flanges are categorized based on ČSN EN 1591-1 as integral flanges, blind flanges, loose flanges, flares or curbs
User	- unit manager (for example, section director, plant director, department manager or production facility or section manager) to whom the operator entrusted assets for use. He/she is responsible for compliance with the conditions for a safe and reliable operation pursuant to the instructions and regulations designated for its use, operation and service
Care taker	- director of the technical unit or the service unit, maintenance department manager or manager of the premises and asset management department or another authorized employee who is responsible for the technical condition of the designated individual groups of tangible assets, including maintenance, repairs, revisions and tests
Client	- employee responsible for the activities associated with work orders related to the maintenance of flange joints
Contractor	- authorized physical person or legal entity, technically capable to assemble and repair flange joints, i.e. including dedicated technical devices, which holds the appropriate TICR authorization pursuant to Section 6, Paragraph 1, Letter b) of Act No. 174/1968 Coll., and which has a valid trade license
TICR	- Technical Inspection of the Czech Republic
Pressure devices	- some of the pressure devices include containers, pipes, safety equipment and pressure equipment; they also include elements connected to parts that are exposed to pressure, for example, flanges, flares, joints, supports, suspension eyes (designated by the valid legislature stated in Chapter 11)

### 3. Main factors that influence tightness of flange joints

Flange joint tightness is particularly affected by the following factors:

- **Flanges**
  - Quality, resp. roughness of the sealing surfaces. Connection/sealing surfaces of the flanges must be made with the required roughness of the sealing surfaces, defined in the corresponding standards. The sealing surfaces must not show any mechanical or corrosion damages.
  - Planeness of the flanges, which is related to the given pipeline assembly.
- **Sealing**
  - Selecting suitable sealing for the corresponding operation conditions.
  - Sealing cleanliness. All dirt must be removed from the sealing and flange connection surfaces prior to installation. The use of Vaseline or other products that make assembly easier is not acceptable, with the exception of cases when the use of a lubrication grease or other products is required.
- **Joint material**
  - Selection of suitable connection material pursuant to Article 9 of this standard and in compliance with the pipeline classes of individual production units.
  - The bolts must be corrosion free and treated with a suitable lubricant that reduces the friction coefficient and protects against corrosion prior to assembly.
  - Rock bolts must be installed in a way that they overlap over the given nut by the same number of threads on both sides, with a tolerance of 2 threads. The minimal number of the threads overlapping over the nut is one pursuant to ČSN EN 13480-4, while the recommended maximal number of the threads overlapping over the nut is 5.
  - When tightening the bolts in accordance with the prescribed tightening torques, use smooth washers that reduce friction on the contact surfaces of the nuts.
  - For flanges PN40 and 150 psi and higher nominal pressure, use only rock bolts (unless the given calculation specifies otherwise).
- **Tightening of the joints**
  - Incorrect tightening methods used for tightening flange joints can cause a small pressure load or plastic deformation of the sealing and subsequent leaks at the given joint.

### 4. Classification of the flange joints

For the purpose of choosing an optimal method for tightening flange joints, the flange joints are divided into two main categories:

- **Category I - standardized flange joint**
  - group I
  - group II
  - group III

- **Category II - unstandardized flange joint**

The division into individual groups within category I and category II pursuant to the given criteria is showed in Table 1

**Table 1**

	<b>Flange joint type</b>	<b>Max. operation overpressure</b>	<b>Max. operation temperature</b>
<b>CATEGORY I GROUP I</b>	joints	up to 25 MPa	up to 370 °C
	all DN 100 and smaller joints regardless of the operation conditions	all pressures	all temperatures
<b>CATEGORY I GROUP II</b>	joints over DN 100	over 25 MPa	all temperatures
	joints over DN 100	up to 25 MPa	over 370 °C
<b>CATEGORY I GROUP III</b>	<b>parameters</b>		
	for bolts from Ø 50mm and values of all operation parameters		
	joints cyclically exposed to thermal loads (> 150 °C and > 50 cycles)		
	insulated joints over 220 °C		
	problematic flange joints with historically repeating leaks		
<b>Category II</b>	<b>parameters</b>		
	all unstandardized flange joints that do not correspond to ČSN, EN and ANSI dimensional standards; they are mostly flange joints on exchangers (chamber-sheathing joint etc.), apparatuses, reactors. etc.		

## 5. Disassembly of flange joints

Disassembly of flange joints of category I, group III, and category II pursuant to this standard, and related works, inspections, etc. are conducted by the contractor exclusively via employees controlled by a mechanic trained on ČSN EN 1591-4, Flanges and flange joints – Part 4: technical capability qualification of the personnel for assembling threaded joints in pressure devices for critical applications.

### 5.1. Occupational safety

The work is subject to an issued work permit pursuant to S 465. Furthermore, all UNI RPA regulations and directives related to OHS and fire protection must be unconditionally observed.

## **5.2. Pipeline transfer**

Pipelines or devices, from which given flange joints will be dismantled, must be put out of operation, separated from all other parts of the given technological unit, depressurized and, when possible, emptied and cleaned.

An authorized representative of the user is responsible for the pipeline to be prepared in this manner. When it is not possible to prepare the pipeline in a way that eliminates the risks of endangering people's lives and health, the user should be obliged to determine appropriate additional conditions in the given work permit for a safe conduct of the works.

A blinding plan must be prepared for the given plugging locations. The plan should be prepared and signed by a given user representative. Prior to handing the device over to the maintenance personnel, the locations of the plugs must be checked by a user representative, who will acquaint a representative of the contractor and, if applicable, administrator with the extent of the plugging. The blinding plan also forms an appendix to the corresponding issued work permit.

## **5.3. Pipeline inspection**

Prior to commencing the disassembly process, the contractor is obliged to check the pipeline installation at least in between the blinding spots.

Should the given employee of the contractor not determine any pipeline installation discrepancies, he/she records this fact on the blinding plan, which forms an appendix to the given work permit.

On the other hand, should there be any discrepancies, the corresponding technical unit of the contractor must propose a solution for fastening the pipeline, based on which the pipeline must be secured against falling prior to starting the disassembly process. The employee in question informs the administrator about this fact.

When the fastening is conducted as a provisional measure, this must be removed and replaced by a suitable permanent solution prior to commencing the pressure/tightness tests and prior to putting the pipeline into operation.

## **5.4. Pipeline inspections by the user**

When the user determines that permanent supervision forms a necessary condition of the given work permit, an employee of the user must be permanently present when the work are being conducted.

Moreover, the user is also responsible for all undesirable substance leaks from the pipelines.

When the pipeline in question is slanted and disassembly of multiple flange joints is being executed on a pipeline branch, it is recommended to start the disassembly process at the lowest point, if possible.

## **5.5. Loosening bolts**

If the technical and structural design allows it, the flange joints should be loosened the same way they are tightened, i.e. the loosening must be controlled - see Appendix D. The loosening procedure must be conducted in a sequential manner. i.e. always loosening the couple of the bolts installed in positions 0-180°, 90-270°, 45-225° and 135-315°.

Should a leak be discovered when loosening the bolts, the flange joint in question must be immediately tightened and, when a flammable substance is involved, all works with an open flame must be unconditionally stopped.

### **5.6. Disassembly of damaged bolts - bolt removal cross method**

Bolts that cannot be loosened in a standard manner and that thus must be removed using a different method (cut by flame, using a rotation grinder or by some manner using special technology) should be removed in a cross manner, i.e. identically to bolts tightening pursuant to Appendix D. The cross bolt cutting method must be implemented in order to prevent a one-sided thermal impact on the flange and in order to ensure an even distribution of the thermal load on the flange. When cutting the bolts using open flame, exposed to a one-sided thermal load of the flange, it is recommended to cool the flanges.

### **5.7. Storing and using dismantled parts**

It is not acceptable for the dismantled connection material to remain freely laying on steel structures, scaffoldings, etc. Dismantled parts must be stored in plastic bags or boxes and they must be protected against the weather condition, corrosion impacts and possible mechanical damages.

Connection material that shows excessive mechanical or corrosion damages must be completely replaced. When the damaged or corroded parts are the strength bolts, all of them on the given flange must be replaced.

Dismantled sealing should always be replaced by new sealing (with the exception of the possibility to repeatedly use of clean and undamaged chasers).

The sealing system is always based on the original project documentation and proposed pipeline classes.

When changing the sealing system in comparison to the original project proposal (older projects, replacement for asbestos sealings,...) the maintenance technician (administrator) should organize the appropriate recalculation and proposal of a new system in cooperation with the given implementation company or another external entity. Alternatively, he/she can use an alternative recommended sealing system pursuant to Table 5.

Definition of the new sealing system forms a part of the prepared work request.

Securing the appropriate connection and sealing material is the responsibility of the given UNI RPA technician (administrator) – with the exception of standard bolts with hexagonal heads and nuts – these can be obtained in a contractual manner.

## **6. Assembling flange joints**

Assembly of flange joints of category I, group III, and category II pursuant to this standard, and related works, inspections, etc. are conducted by the contractor exclusively by employees trained on ČSN EN 1591-4, Flanges and flange joints – Part 4: technical capability qualification of the personnel for assembling threaded joints in pressure devices for critical applications.

When installing flange joints, it's necessary to check the design parameters for assembling flange joints, respectively the corresponding joint construction, material, dimensions and number of bolts.

In terms of the number of flange holes, flanges with the same number of screw holes according to the dimensional standard and pipe class must be installed in the flange joints. Resolve any inspection errors with a maintenance technician.

### 6.1. Occupational safety

The work is subject to an issued work permit pursuant to S 465. Furthermore, all UNI RPA regulations and directives related to OHS and fire protection must be unconditionally observed.

### 6.2. Sealing installation

Only sealing that complies with the specification of the given pipeline class can be installed. Sealing must be cleaned and must not show any signs of mechanical or corrosion damages. When installing the sealing, you need to check its correct position in the given flange joint and, if necessary, to center it. For flange joints with locks (tongue/groove, shoulder/recess), the depth of the free space in the lock must be compared against the sealing thickness / height. When assembling a joint, the locks must always overlap (shoulder must be embedded in the recess, tongue in the groove), making sure the inserted sealing is secured (hidden) in the lock against shooting out along its entire height / thickness.

### 6.3. Tightening flange joints

The following stipulations apply when assembling/tightening a flange joint:

- The threads must be clean and in a good condition
- The threads must be properly lubricated
- The threads of bolts and nuts + contact / sliding fronts of the nuts must be lubricated

Used lubricants must be approved by the administrator. Some recommended manufacturers include: Chesterton, Molykote, Nicro, etc.

For the flange joint tightening procedure, see the Chapter Tightening Methods

### 6.4. Tightening flange joints - permitted tolerances

The planeness of the flange joint must be inspected prior to the actual assembly. The inspection should include a check of the alignment, joint parallelism and planeness of the sealing surfaces.

- Flange joint alignment:  
The recommended maximal deviance from the axis is

DN	Max. deviance
≤ 100	2 mm
> 100	3 mm

- When conducting the flange alignment check, the bolts must be passing freely through the holes of both flanges.

- Flange joint parallelism:
  - The maximal deviance from the flange joint parallelism measured in any direction should not exceed 2.5 mm/m.
- Planeness of the sealing surfaces
  - When the differences and damages are greater than 0.5 mm, suitable measures must be implemented (for example, leveling the sealing, choosing a different sealing, etc.), making sure the seal is implemented evenly, in the most serious cases by flattening the sealing surfaces.

The values stated in individual paragraphs of Point 6.4 should be considered indicative. Should the values be higher, the overall operation and technological device layout should be assessed (installation manner, thermal dilatations, compensations,...) and the entire problem should be solved in cooperation with the given maintenance representative or construction department.

The same procedure and assessment also apply to flange joints between rotational machines and the corresponding pipeline connections, provided this value is not specified by the manufacturer of the rotational machine in question.

#### 6.5. Selection of the flange joint tightening manner

Classification of the flange joints into categories and groups – see Article 4, Table 1.

Tightening manner – see Table 2.

**Table 2**

	<b>Tightening manner</b>
<b>CATEGORY I GROUP I</b>	Torque wrenches pursuant to Appendix A to this standard, without records
<b>CATEGORY I GROUP II</b>	Torque wrenches pursuant to Appendix A to this standard, with a record pursuant to Appendix B <p style="text-align: center;"><b>or</b></p> Hydraulic tightening pursuant to Appendix A to this standard, with a record pursuant to Appendix B <p style="text-align: center;"><b>or</b></p> With measurements of the bolt prolongation pursuant to Appendix A to this standard, with a record pursuant to Appendix B
<b>CATEGORY I GROUP III</b>	Pursuant to the engineering calculation, with a record pursuant to Appendix C



<i>Category II</i>	Pursuant to the engineering calculation, with a record pursuant to Appendix C
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## 6.6. Prescribed maximal tightening torques of the flange joints

- for flanges of the ČSN / DIN type pursuant to Appendix A
- for flanges of the ANSI type pursuant to Appendix A
- for the flanges that do not correspond to the dimensional standards, i.e. the flange dimensions do not correspond to any dimensional ČSN or ANSI standard pursuant to Appendix A, the appropriate engineering calculation of the tightening torques must be used

## 6.7. Manual, uncontrolled tightening

For category I, groups I and II pursuant to this standard, it is conducted in compliance with the current practices, provided Appendix A does not include complete data for determining the correct tightening torque. These situations include the following cases:

- the flange/sealing/connection material combination in Appendix A is not defined
- the required flange joint parameters, such as defined bolt sizes, used sealing, etc., are not stated in Appendix A.

## 6.8. Inspections and tests

It is completely necessary that the contractor conducts an optical inspection of the conducted works. the contractor must particularly check:

- Joint material
  - Mechanical damages
  - Corrosion damages
  - Treatment of bolts and nuts by a suitable lubricant
  - Overlap of the number of threads over the nut
  - Conductive connections
- Sealing
  - Deformations
- Pipeline installation manner
  - Inspection if the provisional fastening, if any, is put into a condition that is sufficient for the given operation
  - If the disassembly process did not cause loosening of an installation part, particularly in the case of axial lines

Upon executing all of the inspections, you need to also inspect the tightness of the flanges/flange joints.

The tightness test can be conducted using water, nitrogen or an operation medium at the maximal operation pressure or at the pressure the given safety valve is set for.

The test must be executed in accordance with the given valid regulations for conducting tightness and pressure tests.

## **7. Marking of the flange joints**

Marking of the flange joints specified in this chapter is conducted only on flange joints of the pipeline systems designated pursuant to the related standard N 11 986, Pipeline distribution lines and Documentation, inspections and accepting proceedings, and on other devices specified under Point 1)

Within the frame of standard N 11 986, the marking applies to:

- Group I pursuant to Article 2.1 of the standard
- Group II pursuant to Article 2.1 of the standard

No marking is conducted on flange joints that do not fall under the above stated two groups of pipeline distribution lines.

marking of the rock bolts within the frame of the system for their tightening corresponds to Appendix D to this regulation.

Flange joints that are dismantled and subsequently remounted are marked directly on the spot. The marking is used for identifying the actual assembly and it is executed in the following manner:

- Upon the completion of the assembly works on a particular flange joint, the corresponding responsible employee of the contractor marks this joint
- The marking is executed by suspending a metal label with a logo or name of the contractor's company. The assembly completion date and the name of the given responsible employee of the contractor are recorded on the label
- All markings on the label must be permanent and unwashable
- Labels must be safely suspended in a way that it cannot fall off due to external impacts
- The label suspension manner on the flange joint is the responsibility of the contractor; using a metal strip is recommended
- In the case of insulated joints, the labels are placed directly on the joints - under the insulation

## **8. Tightening manner**

No additional materials, such as Vaseline etc., should be applied on the sealing surfaces of the flange joints. They must be cleaned and they must correspond to the given specifications. Exceptions can be only permitted by the employees of the administrator, who are authorized by the Maintenance Department manager.

## 8.1. Tightening manner – category I, group I

### Rock bolts must be tightened in the following manner:

- The threads must be clean and in a good condition and lubricated - see Article 6.3
- All nuts should be tightened manually.
- Individual rock bolts should be marked for an easier compliance with the given tightening procedure – applies to flange joints with 12 and more bolts
- When tightening, proceed in a sequential manner in the prescribed order (see Appendix D), i.e. always tighten the couple of the bolts that lie in positions 0-180°, 90-270°, 45-225° and 135-315°
- Tightening – to 40% of the prescribed torque
- Tightening – to 70% of the prescribed torque
- Tightening – to 100% of the prescribed torque
- Check all bolts in the clockwise direction and, if necessary, adjust them to 100% of the prescribed torque
- When completed, make sure that all the rock bolts are tightened evenly

The required tightening torque must be complied with an accuracy of -5 to +5% from the specified value.

Rock bolts can be tightened to different tightening torques than stated in Appendix A only upon approval of the Maintenance Department manager or a person authorized by the Maintenance Department manager.

In compliance with the proper maintenance practices, rock bolts can be also tightened using the standard method, however, only upon approval of the Maintenance Department manager or a person authorized by the Maintenance Department manager.

## 8.2. Tightening manner – category I, group II

Rock bolts must be tightened using one of the following methods:

### 8.2.1. Rock bolts tightened by a hydraulic runner

The required hydraulic pressure is determined based on the type of the used hydraulic runner, making sure it corresponds to the required tightening force stated in Appendix A.

The work can be only conducted by a contractor qualified in this field.

#### Procedure for tightening rock bolts using a hydraulic runner:

- The threads must be clean and in a good condition and lubricated - see Article 6.3
- All nuts should be tightened manually.
- Individual rock bolts should be marked for an easier compliance with the given tightening procedure – applies to flange joints with 12 and more bolts
- When tightening, proceed in a sequential manner in the prescribed order (see Appendix D), i.e. always tighten the couple of the bolts that lie in positions 0-180°, 90-270°, 45-225° and 135-315°.
- Tightening – to 40% of the prescribed torque
- Tightening – to 70% of the prescribed torque

- Tightening – to 100% of the prescribed torque
- Check all bolts in the clockwise direction and, if necessary, adjust them to 100% of the prescribed torque
- When completed, make sure that all the rock bolts are tightened to the same tension.
- The measured values should be recorded in Appendix B. Enter “satisfactory” or “unsatisfactory” in the field called Condition of the contact surfaces, sealing, rock bolts and flanges. Unsatisfactory parts must be replaced.

The required hydraulic pressure must be complied with an accuracy of -5 to +5% from the specified value.

Rock bolts can be tightened to different tightening forces than stated in Appendix A only upon approval of the Maintenance Department manager or a person authorized by the Maintenance Department manager.

### **8.2.2. Rock bolts tightened pursuant to prolongation**

#### **Procedure for tightening rock bolts measured for prolongation:**

- The threads must be clean and in a good condition and lubricated - see Article 6.3
- All nuts should be tightened manually.
- Individual rock bolts should be marked for an easier compliance with the given tightening procedure – applies to flange joints with 12 and more bolts
- When tightening, proceed in a sequential manner in the prescribed order (see Appendix D), i.e. always tighten the couple of the bolts that lie in positions 0-180°, 90-270°, 45-225° and 135-315°.
- Tightening – to 40% of the prescribed torque
- Tightening – to 70% of the prescribed torque
- Tightening – to 100% of the prescribed torque
- Check all bolts in the clockwise direction and, if necessary, adjust them to 100% of the prescribed prolongation
- When completed, make sure that all the rock bolts are tightened to the same tension.
- The measured values should be recorded in Appendix B. Enter “satisfactory” or “unsatisfactory” in the field called Condition of the contact surfaces, sealing, rock bolts and flanges. Unsatisfactory parts must be replaced.

The required overall prolongation must be complied with an accuracy of -5 to +5% from the specified value.

Rock bolts can be tightened to different prolongations than stated in Appendix A only upon approval of the Maintenance Department manager or a person authorized by the Maintenance Department manager.

### **8.2.3. Rock bolts tightened by a torque wrench**

#### **Procedure for tightening rock bolts by a torque wrench:**

- The threads must be clean and in a good condition and lubricated - see Article 6.3

- All nuts should be tightened manually.
- Individual rock bolts should be marked for an easier compliance with the given tightening procedure – applies to flange joints with 12 and more bolts
- When tightening, proceed in a sequential manner in the prescribed order (see Appendix D), i.e. always tighten the couple of the bolts that lie in positions 0-180°, 90-270°, 45-225° and 135-315°
- Tightening – to 40% of the prescribed torque
- Tightening – to 70% of the prescribed torque
- Tightening – to 100% of the prescribed torque
- Check all bolts in the clockwise direction and, if necessary, adjust them to 100% of the prescribed torque
- When completed, make sure that all the rock bolts are tightened evenly
- The measured values should be recorded in Appendix B. Enter “satisfactory” or “unsatisfactory” in the field called Condition of the contact surfaces, sealing, rock bolts and flanges. Unsatisfactory parts must be replaced.

The required tightening torque must be complied with an accuracy of -5 to +5% from the specified value.

Rock bolts can be tightened to different tightening torques than stated in Appendix A only upon approval of the corresponding responsible representative of the UNI RPA maintenance unit.

**8.3. Tightening manner – category I, group III, and category II**

Rock bolts are tightened pursuant to Point 8.2. The difference is that the tightening values stated in Appendix A must be determined by a proper engineering calculation and the corresponding record entered in Appendix C.

**9. Rock bolts and nuts**

The sealing system is always based on the original project documentation and proposed pipeline classes.

Type and material of the bolts and nuts for standardized flange joints of the ANSI, ASTM and DIN pipelines are determined pursuant to Table 3. The corresponding ČSN is determined using Table 4.

**Table 3**

bolt type	PN	Operation temperature (°C)	bolt material	bolt standard	nut material	nut standard
rock bolts with a continuous thread	up to 500	from -100 to 485	A193 Gr.B7 AISI 4112 AISI 4145	ASTM A 354 (inches) DIN 975 (metric)	A194 Gr.2H	ANSI B18.2.2 (inches) ANSI B18.2.4.6M (metric)
flexible rock bolts	up to 420	from -10 to 520	21CrMoV5 7	DIN 2510-1 L	21CrMoV5 7 (24CrMo5)	DIN 2510-5 NF

rock bolts with a continuous thread	up to 100	from -10 to 450	24CrMo5	DIN 976 B	Ck 35	DIN 934
rock bolts with a continuous thread	up to 100	from -253 to 400	A2-70	DIN 976 B	A2-70	DIN 934
rock bolts with a continuous thread	up to 100	from -60 to 400	A4-70	DIN 976 B	A4-70	DIN 934

**Table 4**

<b>bolt type</b>	<b>PN</b>	<b>Operation temperature (°C)</b>	<b>bolt material</b>	<b>bolt standard</b>	<b>nut material</b>	<b>nut standard</b>
Bolts with a hexagon head. Product of class A or B	up to 25	from -20 to 300	W. 8.8 to 10.9 or as agreed (based on the diameter)	ČSN EN 24 014	m. 8 to 10 or as agreed (based on the diameter)	ČSN EN 24 032
smooth rock bolts	up to 400	from -10 to 400	12 050.6	ČSN 13 1520.1	12 040.6	ČSN 13 1530.1
flexible rock bolts (smooth)	up to 400	from -10 to 450	15 320.5	ČSN 13 1520.2	15 236.6	ČSN 13 1530.2
flexible rock bolts (smooth)	up to 400	from -20 to 450	15 236.7	ČSN 13 1520.2	15 236.6	ČSN 13 1530.2
flexible rock bolts (smooth)	up to 400	from -50 to 450	15 320.5	ČSN 13 1520.3	15 236.6	ČSN 13 1530.3
flexible rock bolts (smooth)	up to 400	from -50 to 400	15 330.8	ČSN 13 1520.3 - dimensions	15 330.6	ČSN 13 1530.3 - dimensions
smooth rock bolts	up to 400	from -200 to 550	17 248.4	ČSN 13 1520.4	17 248.4	ČSN 13 1530.4

## 10. Sealing

Sealing is determined pursuant to Table 5 – see Article 5.7

**Table 5**

<b>Pipeline Class</b>	<b>Sealing type</b>
Up to PN40 and max. operation temperature of 450 °C Operation and auxiliary media	Sealing made of expanded graphite with an inner stainless insert - lath mesh or sheet metal Chaser metal sealing with inserts made of expanded graphite
PN greater than 40 – to 100 or max. operation temperature higher than 450°C Operation and auxiliary media	Chaser metal sealing with inserts made of expanded graphite Spiral AISI 316 with graphite filling
PN greater than 100 Operation and auxiliary media	Chaser metal sealing with inserts made of expanded graphite
Up to PN350 and max. operation temperature of 815 °C Media containing hydrogen	Chaser metal sealing with inserts made of expanded graphite
Steam to PN 16	Sealing made of expanded graphite with an inner stainless insert - lath mesh or sheet metal
Steam above PN 16	Sealing made of expanded graphite with an inner stainless insert - lath mesh or sheet metal Chaser metal sealing with inserts made of expanded graphite

The table can be considered a recommendation table. The selection of the proper sealing type must comply with ČSN EN 1591-1, ČSN EN 1591-2 and ČSN EN 13555.

## 11. List of related and other legal regulations

- |                        |  |
|------------------------|--|
| ČSN 69 0010            | Stable pressure containers. Technical rules  |
| ČSN 13 0108            | Pipelines. Pipeline operation and maintenance. Technical regulations   |
| ČSN EN 1591-1          | Flange and flange joints. Rules for designing sealed circular flange joints - Part 1: Calculation  |
| ČSN EN 1591-2          | Flange and flange joints. Rules for designing sealed circular flange joints - Part 2: Sealing parameters   |
| ČSN P CEN/TS 1591-3    | Flange and flange joints. Rules for designing sealed circular flange joints - Part 3: Calculation methods for flange joints with a metal to metal contact                |
| ČSN EN 1591-4          | Flange and flange joints - Part 4: Qualification of professional capability of the personnel for assembling screw-in joints in pressure device for critical applications |
| ČSN EN 13480, Part 1-6 | Industrial metal pipelines   |
| ČSN EN 13555           | Flanges and flange joints - Sealing and testing parameters related to the rules for designing flange joints with circular flanges and sealings                           |
- Decree No. 18/1979 Coll., of the Czech Occupational Safety Office and the Czech Mining Office, which determines dedicated pressure devices and specifies some safety conditions
- Decree No. 21/1979 Coll., of the Czech Occupational Safety Office and the Czech Mining Office, which determines dedicated gas devices and specifies some safety conditions
- Government Directive No. 219/2016 Coll., as amended, on assessing conformity of pressure devices when being put on the market
- Government Directive No. 378/2001 Coll., as amended, which determines more specific requirements for a safe operation and usage of machines, technical equipment, instruments and tools.
- S 465 - Issuing work permits
- S 401 - Basic regulation in the area of OHS
- S 402 - Chempark Záluží safety rules
- S 403 - Basic fire protection regulation
- N 11 004 - Operation rules for gas devices
- N 11 005 - Operation rules for pressure devices
- N 11 012 - Unipetrol electric standards
- N 11 062 - Strength and tightness pressure tests (hydraulic)
- N 11 063 - Strength and tightness pressure tests (pneumatic)



N 11 200 - Standard for accepting devices from the operation to repairs and from repairs to operation

N 11 986 - Pipeline distribution lines, Documentation, inspections and acceptance proceedings

N 16 and N 18 group standards

and other regulations stated in the standard.

## 12. Appendixes

Appendix A – List of tables of the max. tightening forces and torques of the flange joint bolts.

Appendix B - Tightening form for category I of the standardized flange joints, groups II and III

Appendix C – Flange joint installation protocol for category I, group III, and category II of flange joints

Appendix 01 - Tightening torque results for grooved gasket

Appendix 02 - Tightening torque results for spiral gasket

Appendix 03 - Tightening torque results for profile RTJ gasket

Appendix 04 - Tightening torque results for linsen gasket

Appendix 05 - Limit tightening torques for bolt screws M12÷100

### Appendix A:

LIST OF TABLES OF THE MAX. TIGHTENING FORCES AND TORQUES OF THE FLANGE JOINT BOLTS - METRIC THREAD, ČSN / DIN FLANGES

Table 1.1	FLANGES:	ČSN / DIN	TONGUE - GROOVE
	SEALING:	GRAPHITE WITH A LATH MESH STAINLESS INSERT or SPIRAL	
	BOLT TYPE:	FLEXIBLE ROCK BOLTS	MAT. OF THE BOLTS: 15 320.5
Table 1.2	FLANGES:	ČSN / DIN	SHOULDER - RECESS
	SEALING:	GRAPHITE WITH A LATH MESH INSERT AND WITH AN INNER HEM OR SPIRAL WITH AN INNER RING	
	BOLT TYPE:	FLEXIBLE ROCK BOLTS	MAT. OF THE BOLTS: 15 320.5
Table 1.3	FLANGES:	ČSN / DIN	ROUGH / SMOOTH LATH
	SEALING:	GRAPHITE WITH A LATH MESH INSERT AND WITH AN INNER HEM OR WITHOUT HEMS	
	BOLT TYPE:	FLEXIBLE ROCK BOLTS	MAT. OF THE BOLTS: 15 320.5
Table 1.4	FLANGES:	ČSN / DIN	ROUGH / SMOOTH LATH
	SEALING:	SPIRAL WITH AN OUTER RING	
	BOLT TYPE:	FLEXIBLE ROCK BOLTS	MAT. OF THE BOLTS: 15 320.5
Table 1.5	FLANGES:	ČSN / DIN	ROUGH / SMOOTH LATH
	SEALING:	SPIRAL WITH AN INNER AND OUTER RING	
	BOLT TYPE:	FLEXIBLE ROCK BOLTS	MAT. OF THE BOLTS: 15 320.5
Table 1.6	FLANGES:	ČSN / DIN	TONGUE - GROOVE
	SEALING:	GRAPHITE WITH A LATH MESH STAINLESS INSERT or SPIRAL	

	<i>BOLT TYPE:</i>	<b>FLEXIBLE ROCK BOLTS</b>	<i>MAT. OF THE BOLTS:</i>	<b>17 248.4</b>
<b>Table 1.7</b>	<i>FLANGES:</i>	<b>ČSN / DIN</b>	<b>SHOULDER - RECESS</b>	
	<i>SEALING:</i>	<b>GRAPHITE WITH A LATH MESH INSERT AND WITH AN INNER HEM or SPIRAL WITH AN INNER RING</b>		
	<i>BOLT TYPE:</i>	<b>FLEXIBLE ROCK BOLTS</b>	<i>MAT. OF THE BOLTS:</i>	<b>17 248.4</b>
<b>Table 1.8</b>	<i>FLANGES:</i>	<b>ČSN / DIN</b>	<b>ROUGH / SMOOTH LATH</b>	
	<i>SEALING:</i>	<b>GRAPHITE WITH A LATH MESH INSERT AND WITH AN INNER HEM OR WITHOUT HEMS</b>		
	<i>BOLT TYPE:</i>	<b>FLEXIBLE ROCK BOLTS</b>	<i>MAT. OF THE BOLTS:</i>	<b>17 248.4</b>
<b>Table 1.9</b>	<i>FLANGES:</i>	<b>ČSN / DIN</b>	<b>ROUGH / SMOOTH LATH</b>	
	<i>SEALING:</i>	<b>SPIRAL WITH AN OUTER RING</b>		
	<i>BOLT TYPE:</i>	<b>FLEXIBLE ROCK BOLTS</b>	<i>MAT. OF THE BOLTS:</i>	<b>17 248.4</b>
<b>Table 1.10</b>	<i>FLANGES:</i>	<b>ČSN / DIN</b>	<b>ROUGH / SMOOTH LATH</b>	
	<i>SEALING:</i>	<b>SPIRAL WITH AN INNER AND OUTER RING</b>		
	<i>BOLT TYPE:</i>	<b>FLEXIBLE ROCK BOLTS</b>	<i>MAT. OF THE BOLTS:</i>	<b>17 248.4</b>
<b>Table 1.11</b>	<i>FLANGES:</i>	<b>ČSN / DIN</b>	<b>TONGUE - GROOVE</b>	
	<i>SEALING:</i>	<b>GRAPHITE WITH A LATH MESH STAINLESS INSERT or SPIRAL</b>		
	<i>BOLT TYPE:</i>	<b>SMOOTH ROCK BOLTS</b>	<i>MAT. OF THE BOLTS:</i>	<b>12 050.6</b>
<b>Table 1.12</b>	<i>FLANGES:</i>	<b>ČSN / DIN</b>	<b>SHOULDER - RECESS</b>	
	<i>SEALING:</i>	<b>GRAPHITE WITH A LATH MESH INSERT AND WITH AN INNER HEM or SPIRAL WITH AN INNER RING</b>		
	<i>BOLT TYPE:</i>	<b>SMOOTH ROCK BOLTS</b>	<i>MAT. OF THE BOLTS:</i>	<b>12 050.6</b>
<b>Table 1.13</b>	<i>FLANGES:</i>	<b>ČSN / DIN</b>	<b>ROUGH / SMOOTH LATH</b>	
	<i>SEALING:</i>	<b>GRAPHITE WITH A LATH MESH INSERT AND WITH AN INNER HEM OR WITHOUT HEMS</b>		
	<i>BOLT TYPE:</i>	<b>SMOOTH ROCK BOLTS</b>	<i>MAT. OF THE BOLTS:</i>	<b>12 050.6</b>
<b>Table 1.14</b>	<i>FLANGES:</i>	<b>ČSN / DIN</b>	<b>ROUGH / SMOOTH LATH</b>	
	<i>SEALING:</i>	<b>SPIRAL WITH AN OUTER RING</b>		
	<i>BOLT TYPE:</i>	<b>SMOOTH ROCK BOLTS</b>	<i>MAT. OF THE BOLTS:</i>	<b>12 050.6</b>
<b>Table 1.15</b>	<i>FLANGES:</i>	<b>ČSN / DIN</b>	<b>ROUGH / SMOOTH LATH</b>	
	<i>SEALING:</i>	<b>SPIRAL WITH AN INNER AND OUTER RING</b>		
	<i>BOLT TYPE:</i>	<b>SMOOTH ROCK BOLTS</b>	<i>MAT. OF THE BOLTS:</i>	<b>12 050.6</b>
<b>Table 1.16</b>	<i>FLANGES:</i>	<b>ČSN / DIN</b>	<b>TONGUE - GROOVE</b>	
	<i>SEALING:</i>	<b>GRAPHITE WITH A LATH MESH STAINLESS INSERT or SPIRAL</b>		
	<i>BOLT TYPE:</i>	<b>HEXAGONAL, SMOOTH/SMOOTH ROCK BOLTS</b>	<i>MAT. OF THE BOLTS:</i>	<b>5.6</b>

<b>Table 1.17</b>	<b>FLANGES:</b>	<b>ČSN / DIN</b>	<b>SHOULDER - RECESS</b>
	<b>SEALING:</b>	<b>GRAPHITE WITH A LATH MESH INSERT AND WITH AN INNER HEM or SPIRAL WITH AN INNER RING</b>	
	<b>BOLT TYPE:</b>	<b>HEXAGONAL, SMOOTH/SMOOTH ROCK BOLTS</b>	<b>MAT. OF THE BOLTS: 5.6</b>
<b>Table 1.18</b>	<b>FLANGES:</b>	<b>ČSN / DIN</b>	<b>ROUGH / SMOOTH LATH</b>
	<b>SEALING:</b>	<b>GRAPHITE WITH A LATH MESH INSERT AND WITH AN INNER HEM OR WITHOUT HEMS</b>	
	<b>BOLT TYPE:</b>	<b>HEXAGONAL, SMOOTH/SMOOTH ROCK BOLTS</b>	<b>MAT. OF THE BOLTS: 5.6</b>
<b>Table 1.19</b>	<b>FLANGES:</b>	<b>ČSN / DIN</b>	<b>ROUGH / SMOOTH LATH</b>
	<b>SEALING:</b>	<b>SPIRAL WITH AN OUTER RING</b>	
	<b>BOLT TYPE:</b>	<b>HEXAGONAL, SMOOTH/SMOOTH ROCK BOLTS</b>	<b>MAT. OF THE BOLTS: 5.6</b>
<b>Table 1.20</b>	<b>FLANGES:</b>	<b>ČSN / DIN</b>	<b>ROUGH / SMOOTH LATH</b>
	<b>SEALING:</b>	<b>SPIRAL WITH AN INNER AND OUTER RING</b>	
	<b>BOLT TYPE:</b>	<b>HEXAGONAL, SMOOTH/SMOOTH ROCK BOLTS</b>	<b>MAT. OF THE BOLTS: 5.6</b>
<b>Table 1.21</b>	<b>FLANGES:</b>	<b>ČSN / DIN</b>	<b>TONGUE - GROOVE</b>
	<b>SEALING:</b>	<b>GRAPHITE WITH A LATH MESH STAINLESS INSERT or SPIRAL</b>	
	<b>BOLT TYPE:</b>	<b>HEXAGONAL, SMOOTH/SMOOTH ROCK BOLTS</b>	<b>MAT. OF THE BOLTS: 8.8</b>
<b>Table 1.22</b>	<b>FLANGES:</b>	<b>ČSN / DIN</b>	<b>SHOULDER - RECESS</b>
	<b>SEALING:</b>	<b>GRAPHITE WITH A LATH MESH INSERT AND WITH AN INNER HEM or SPIRAL WITH AN INNER RING</b>	
	<b>BOLT TYPE:</b>	<b>HEXAGONAL, SMOOTH/SMOOTH ROCK BOLTS</b>	<b>MAT. OF THE BOLTS: 8.8</b>
<b>Table 1.23</b>	<b>FLANGES:</b>	<b>ČSN / DIN</b>	<b>ROUGH / SMOOTH LATH</b>
	<b>SEALING:</b>	<b>GRAPHITE WITH A LATH MESH INSERT AND WITH AN INNER HEM OR WITHOUT HEMS</b>	
	<b>BOLT TYPE:</b>	<b>HEXAGONAL, SMOOTH/SMOOTH ROCK BOLTS</b>	<b>MAT. OF THE BOLTS: 8.8</b>
<b>Table 1.24</b>	<b>FLANGES:</b>	<b>ČSN / DIN</b>	<b>ROUGH / SMOOTH LATH</b>
	<b>SEALING:</b>	<b>SPIRAL WITH AN OUTER RING</b>	
	<b>BOLT TYPE:</b>	<b>HEXAGONAL, SMOOTH/SMOOTH ROCK BOLTS</b>	<b>MAT. OF THE BOLTS: 8.8</b>
<b>Table 1.25</b>	<b>FLANGES:</b>	<b>ČSN / DIN</b>	<b>ROUGH / SMOOTH LATH</b>
	<b>SEALING:</b>	<b>SPIRAL WITH AN INNER AND OUTER RING</b>	
	<b>BOLT TYPE:</b>	<b>HEXAGONAL, SMOOTH/SMOOTH ROCK BOLTS</b>	<b>MAT. OF THE BOLTS: 8.8</b>

LIST OF TABLES OF THE MAX. TIGHTENING FORCES AND TORQUES OF THE FLANGE JOINT BOLTS - WHITWORTH THREAD, ANSI FLANGES

<b>Table 2.1</b>	<b>FLANGES:</b>	<b>ANSI B 16.5</b>	<b>ROUGH / SMOOTH LATH</b>	
	<b>SEALING:</b>	<b>GRAPHITE WITH A LATH MESH INSERT AND WITH AN INNER HEM</b>		
	<b>BOLT TYPE:</b>	<b>UNWEAKENED ROCK BOLTS</b>	<i>MAT. OF THE BOLTS:</i>	<b>A 193-B7, A-193-B16, A 320-L7</b>
<b>Table 2.2</b>	<b>FLANGES:</b>	<b>ANSI B 16.5</b>	<b>ROUGH / SMOOTH LATH</b>	
	<b>SEALING:</b>	<b>GRAPHITE WITH A LATH MESH INSERT AND WITH AN INNER HEM</b>		
	<b>BOLT TYPE:</b>	<b>UNWEAKENED ROCK BOLTS</b>	<i>MAT. OF THE BOLTS:</i>	<b>A 193-B7, A-193-B16, A 320-L7</b>
<b>Table 2.3</b>	<b>FLANGES:</b>	<b>ANSI B 16.5</b>	<b>ROUGH / SMOOTH LATH</b>	
	<b>SEALING:</b>	<b>SPIRAL WITH AN INNER AND OUTER RING</b>		
	<b>BOLT TYPE:</b>	<b>UNWEAKENED ROCK BOLTS</b>	<i>MAT. OF THE BOLTS:</i>	<b>A 193-B7, A-193-B16, A 320-L7</b>
<b>Table 2.4</b>	<b>FLANGES:</b>	<b>ANSI B 16.5</b>	<b>RJ GROOVES</b>	
	<b>SEALING:</b>	<b>RING JOINT - CARBON OR LOW-ALLOY STEEL</b>		
	<b>BOLT TYPE:</b>	<b>UNWEAKENED ROCK BOLTS</b>	<i>MAT. OF THE BOLTS:</i>	<b>A 193-B7, A-193-B16, A 320-L7</b>
<b>Table 2.5</b>	<b>FLANGES:</b>	<b>ANSI B 16.5</b>	<b>ROUGH / SMOOTH LATH</b>	
	<b>SEALING:</b>	<b>GRAPHITE WITH A LATH MESH INSERT AND WITH AN INNER HEM</b>		
	<b>BOLT TYPE:</b>	<b>UNWEAKENED ROCK BOLTS</b>	<i>MAT. OF THE BOLTS:</i>	<b>A 193-B7M, A 320-L7M</b>
<b>Table 2.6</b>	<b>FLANGES:</b>	<b>ANSI B 16.5</b>	<b>ROUGH / SMOOTH LATH</b>	
	<b>SEALING:</b>	<b>SPIRAL WITH AN OUTER RING</b>		
	<b>BOLT TYPE:</b>	<b>UNWEAKENED ROCK BOLTS</b>	<i>MAT. OF THE BOLTS:</i>	<b>A 193-B7M, A 320-L7M</b>
<b>Table 2.7</b>	<b>FLANGES:</b>	<b>ANSI B 16.5</b>	<b>ROUGH / SMOOTH LATH</b>	
	<b>SEALING:</b>	<b>SPIRAL WITH AN INNER AND OUTER RING</b>		
	<b>BOLT TYPE:</b>	<b>UNWEAKENED ROCK BOLTS</b>	<i>MAT. OF THE BOLTS:</i>	<b>A 193-B7M, A 320-L7M</b>
<b>Table 2.8</b>	<b>FLANGES:</b>	<b>ANSI B 16.5</b>	<b>RJ GROOVES</b>	
	<b>SEALING:</b>	<b>RING JOINT - CARBON OR LOW-ALLOY STEEL</b>		
	<b>BOLT TYPE:</b>	<b>UNWEAKENED ROCK BOLTS</b>	<i>MAT. OF THE BOLTS:</i>	<b>A 193-B7M, A 320-L7M</b>
<b>Table 2.9</b>	<b>FLANGES:</b>	<b>ANSI B 16.5</b>	<b>ROUGH / SMOOTH LATH</b>	
	<b>SEALING:</b>	<b>GRAPHITE WITH A LATH MESH INSERT AND WITH AN INNER HEM</b>		
	<b>BOLT TYPE:</b>	<b>UNWEAKENED ROCK BOLTS</b>	<i>MAT. OF THE BOLTS:</i>	<b>A 193-B8 class 2</b>
<b>Table 2.10</b>	<b>FLANGES:</b>	<b>ANSI B 16.5</b>	<b>ROUGH / SMOOTH LATH</b>	
	<b>SEALING:</b>	<b>SPIRAL WITH AN OUTER RING</b>		

	<i>BOLT TYPE:</i>	<b>UNWEAKENED ROCK BOLTS</b>	<i>MAT. OF THE BOLTS:</i>	<b>A 193-B8 class 2</b>
<b>Table 2.11</b>	<i>FLANGES:</i>	<b>ANSI B 16.5</b>	<b>ROUGH / SMOOTH LATH</b>	
	<i>SEALING:</i>	<b>SPIRAL WITH AN INNER AND OUTER RING</b>		
	<i>BOLT TYPE:</i>	<b>UNWEAKENED ROCK BOLTS</b>	<i>MAT. OF THE BOLTS:</i>	<b>A 193-B8 class 2</b>
<b>Table 2.12</b>	<i>FLANGES:</i>	<b>ANSI B 16.5</b>	<b>RJ GROOVES</b>	
	<i>SEALING:</i>	<b>RING JOINT - AUSTENITIC STAINLESS STEEL</b>		
	<i>BOLT TYPE:</i>	<b>UNWEAKENED ROCK BOLTS</b>	<i>MAT. OF THE BOLTS:</i>	<b>A 193-B8 class 2</b>

LIST OF TABLES OF THE MAX. TIGHTENING FORCES AND TORQUES OF THE FLANGE JOINT BOLTS - METRIC THREAD, FLANGES THAT DO NOT CORRESPOND TO THE DIMENSIONAL STANDARDS

<b>Table 3.1</b>	<i>SEALING:</i>	<b>AN ADDITIONAL INSPECTION MUST BE CONDUCTED FOR THE GIVEN SEALING TYPE</b>		
	<i>BOLT TYPE:</i>	<b>FLEXIBLE ROCK BOLTS</b>	<i>MAT. OF THE BOLTS:</i>	<b>15 320.5</b>
<b>Table 3.2</b>	<i>SEALING:</i>	<b>AN ADDITIONAL INSPECTION MUST BE CONDUCTED FOR THE GIVEN SEALING TYPE</b>		
	<i>BOLT TYPE:</i>	<b>FLEXIBLE ROCK BOLTS</b>	<i>MAT. OF THE BOLTS:</i>	<b>17 248.4</b>
<b>Table 3.3</b>	<i>SEALING:</i>	<b>AN ADDITIONAL INSPECTION MUST BE CONDUCTED FOR THE GIVEN SEALING TYPE</b>		
	<i>BOLT TYPE:</i>	<b>SMOOTH ROCK BOLTS</b>	<i>MAT. OF THE BOLTS:</i>	<b>12 050.6</b>
<b>Table 3.4</b>	<i>SEALING:</i>	<b>AN ADDITIONAL INSPECTION MUST BE CONDUCTED FOR THE GIVEN SEALING TYPE</b>		
	<i>BOLT TYPE:</i>	<b>HEXAGONAL, SMOOTH/SMOOTH ROCK BOLTS</b>	<i>MAT. OF THE BOLTS:</i>	<b>5.6</b>
<b>Table 3.5</b>	<i>SEALING:</i>	<b>AN ADDITIONAL INSPECTION MUST BE CONDUCTED FOR THE GIVEN SEALING TYPE</b>		
	<i>BOLT TYPE:</i>	<b>HEXAGONAL, SMOOTH/SMOOTH ROCK BOLTS</b>	<i>MAT. OF THE BOLTS:</i>	<b>8.8</b>

LIST OF TABLES OF THE MAX. TIGHTENING FORCES AND TORQUES OF THE FLANGE JOINT BOLTS - WHITWORTH THREAD, FLANGES THAT DO NOT CORRESPOND TO THE DIMENSIONAL STANDARDS

<p><b>Table 4.1</b></p>	<p><i>SEALING:</i> <i>BOLT TYPE:</i></p>	<p><b>AN ADDITIONAL INSPECTION MUST BE CONDUCTED FOR THE GIVEN SEALING TYPE</b> <b>UNWEAKENED ROCK BOLTS</b>      <i>MAT. OF THE BOLTS:</i>      <b>A 193-B7, A-193-B16, A 320-L7</b></p>
<p><b>Table 4.2</b></p>	<p><i>SEALING:</i> <i>BOLT TYPE:</i></p>	<p><b>AN ADDITIONAL INSPECTION MUST BE CONDUCTED FOR THE GIVEN SEALING TYPE</b> <b>UNWEAKENED ROCK BOLTS</b>      <i>MAT. OF THE BOLTS:</i>      <b>A 193-B7M, A 320-L7M</b></p>
<p><b>Table 4.3</b></p>	<p><i>SEALING:</i> <i>BOLT TYPE:</i></p>	<p><b>AN ADDITIONAL INSPECTION MUST BE CONDUCTED FOR THE GIVEN SEALING TYPE</b> <b>UNWEAKENED ROCK BOLTS</b>      <i>MAT. OF THE BOLTS:</i>      <b>A 193-B8 class 2</b></p>

CALCULATION TABLES IN THE SEPARATE APPENDIX CONSIST OF 45 PAGES

**Appendix B:** Tightening form for category I of the standardized flange joints, groups II and III - the heading should be completed by the administrator, while the content should be entered by the contractor

Tech. location	Pipe branch number / Position / Flange marking	DN	PN
Joint type	Flange/Flange	Flange / Valve	Flange / Plug
Rough lath			
Tongue / Groove			
Shoulder / Recess			
Metal ring - oval			
Metal ring - octagonal			
Other	Specify		
Joint inspection after disassembly	Satisfactory		Unsatisfactory
Condition of the sealing surfaces			
Joint material			
Geometry (alignment, planeness)			
Should any of the points be unsatisfactory, consult appropriate corrective measures with a maintenance technician and record this process in the "Note" field on this form			
Flange joint assembly			
Joint material	Kept		Replaced
Used thread lubricant			
Flange conductive connection type	Clamp *		
Tightening torque (Nm)			
Bolt prolongation (mm)			
Sealing type used for the assembly	SG - sandwich sealing (perforated sheet metal / lath mesh with a graphite foil)		SW - spiral sealing
			RTJ - metal ring - oval
			RTJ - metal ring - octagonal
	Other (specify)		
Notes			

\* Due to the gradual transition to controlled tightening, the standard at UNI RPA is the use of clamps as a part of the given conductive connection

Flange joint implemented by:

Name:

Date:

Signature

.....

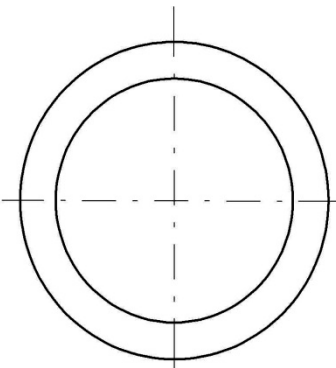


**Appendix C:** Flange joint installation protocol for category I, group III, and category II of flange joints - the heading should be completed by the administrator, while the content should be entered by the contractor

### 1. Device

Operation	
Device marking	
Operation set	
Device name	
Flange joint name	
Flange marking	
Drawing number	
Installation date	

### 2. Sealing

Dimension			
Material			
Manufacturer			
Drawing number			
Storage time			
Sealing condition	Clean	YES	NO
	Dry	YES	NO
	Damaged	YES	NO
Defects, if any to be marked on the sketch	Sketch and orientation 		
Sealing fixation used	YES	NO	
Glue type			
Foil for covering defects used	YES	NO	

### 3. Flanges

Sealing surface type			
Condition of the sealing surfaces for sealing	Flattened	YES	NO
	Damaged	YES	NO
Damage description			
Foil for covering defects used	YES	NO	
Degreased surface	YES	NO	
Condition of the contact surface for nuts or bolt heads	Flattened	YES	NO
	Damaged	YES	NO
Damage description			
Planeness inspection conducted	YES	NO	
Sealing surface roughness must comply with $R_a = 3.2$ to $25$	YES	NO	

#### 4. Bolts (pins)

Marking			
Material			
Number			
New	YES	NO	
Thread damages	YES	NO	
Cleaned threads	YES	NO	
Lubrication product used	YES	NO	
Lubrication product type			
Roughness on the bolt head must comply with $R_a = \max. 1.6$	YES	NO	

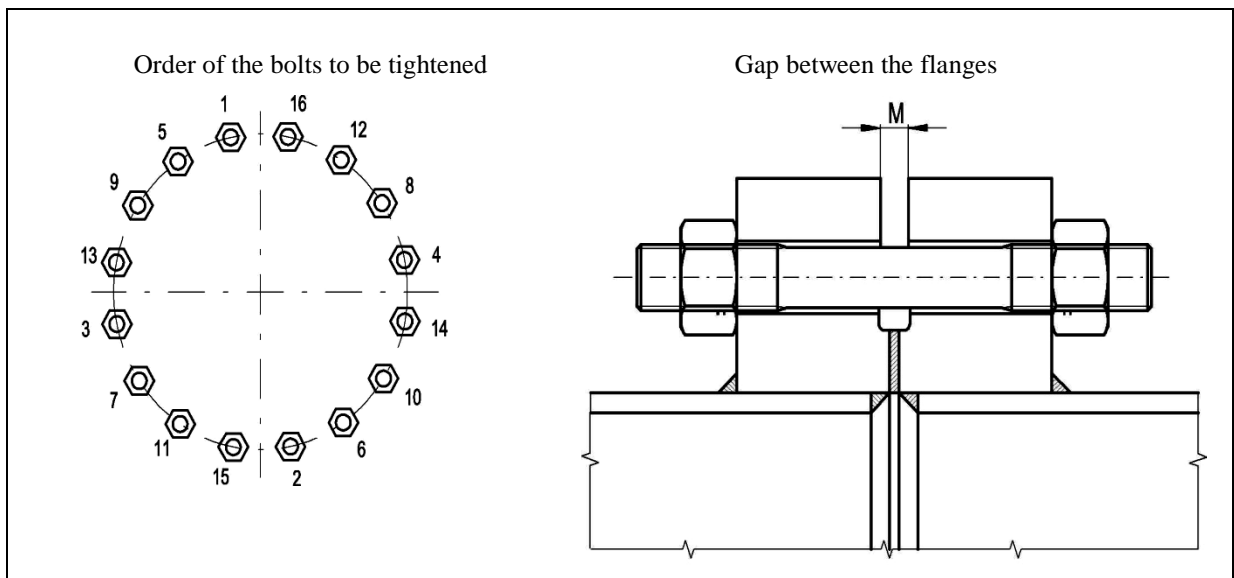
#### 5. Nuts

Marking			
Material			
Number			
New	YES	NO	
Thread damages	YES	NO	
Cleaned threads	YES	NO	
Roughness of the contact surface must comply with $R_a = \max. 1.6$	YES	NO	

**6. Tightening**

Tightening torque	YES	NO
Prescribed value		
Bolt prolongation	YES	NO
Prescribed value		
Torque wrench type for step 1	Scope	
	Accuracy	
	Wrench accuracy inspection protocol	
Torque wrench type for step 2	Scope	
	Accuracy	
	Wrench accuracy inspection protocol	
Torque wrench type for step 3	Scope	
	Accuracy	
	Wrench accuracy inspection protocol	

Tightening bolts	Main measurements	Auxiliary measurements of the gap between the flanges for bolt no.			
		Torque (Nm)	1 (mm)	2 (mm)	3 (mm)
Step 1 40%					
Step 2 70%					
Step 3 100%					
Step 4 after 30 minutes 100%					
Step 5 prior to the tightness test 100%					



**Flange joint implemented by:**

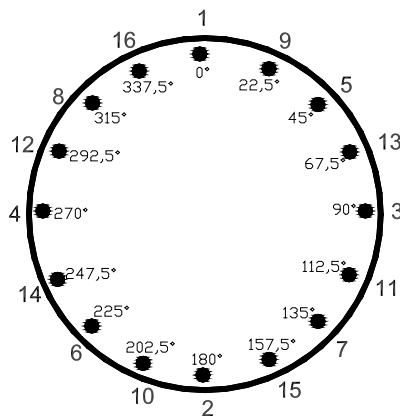
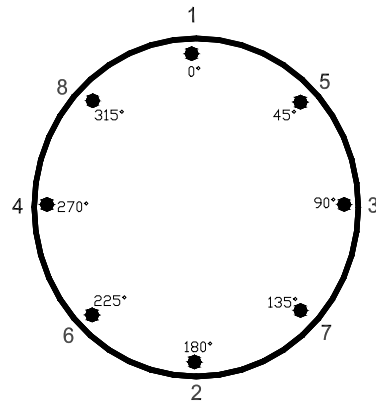
**Name:**

**Date:**

**Signature:**

**Appendix D:** Tightening/loosening flange joints

Schematic diagram



Indicative table for tightening/loosening flange joints

Sequential order	Rotation order	Sequential order	Rotation order
1- 2	1	1- 2	1
3- 4	5	3- 4	9
5- 6	3	5- 6	5
7- 8	7	7- 8	13
	2	9-10	3
	6	11-12	11
	4	13-14	7
	8	15-16	15
			2
			10
			6
			14
			4
			12
			8
			16