NORSOK Compact Flange

Installation and Assembly Procedure

Hytorc Norway
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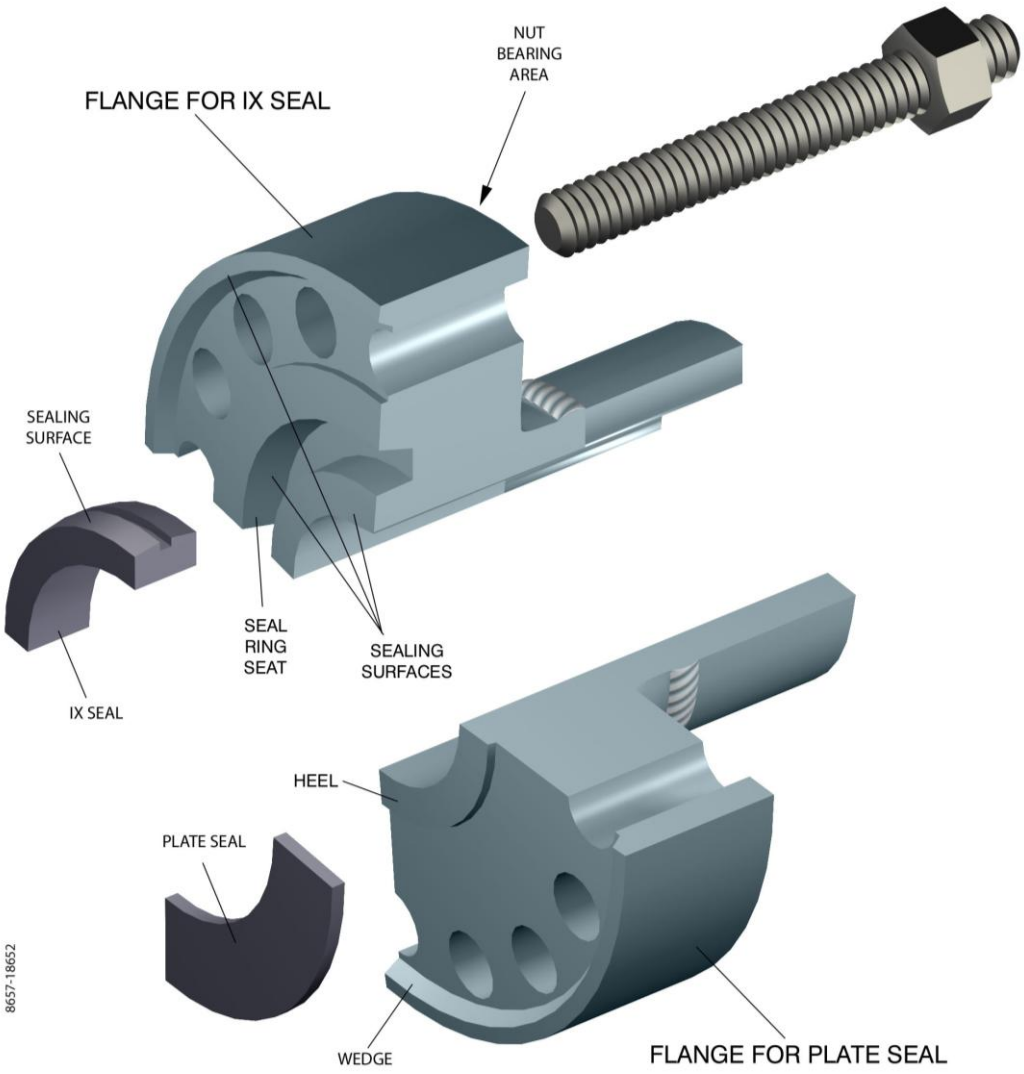
P.Nødland.

INTRODUCTION

Scope

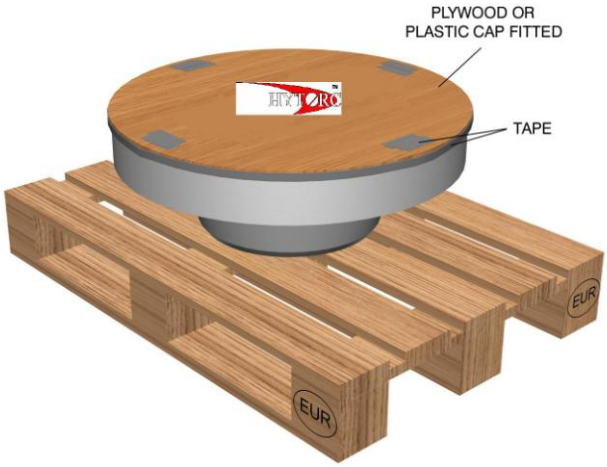
The following main operations are covered in this section:

- Assembly/disassembly
- Welding & Painting
- Protection and Handling
- Cleaning and Inspection
- Preparation
- Maintenance and repair



PROTECTION AND HANDLING

Flanges to be stored on a pallet with the flange face up. Do NOT remove flange protection until inspection/installation.



Protected Flange on a pallet

Seals must remain in their original package until installation (inspection).

Seal in original package

When lifting the Flange use soft slings through boltholes.
When lifting the Blind Flange use soft slings or hook through lifting padeye.

Do NOT remove Flange/Blind Flange protection before lifting/handling.

Inspect slings before lifting.

Welding

Ensure that the sealing faces are protected from scratching and weld splatter.

If removal of flange protection is required, the protection must be refitted after welding.

Inspect the flange before refitting the flange protection.

Alignment tolerances are as for conventional ASME/ANSI flanges.

Painting

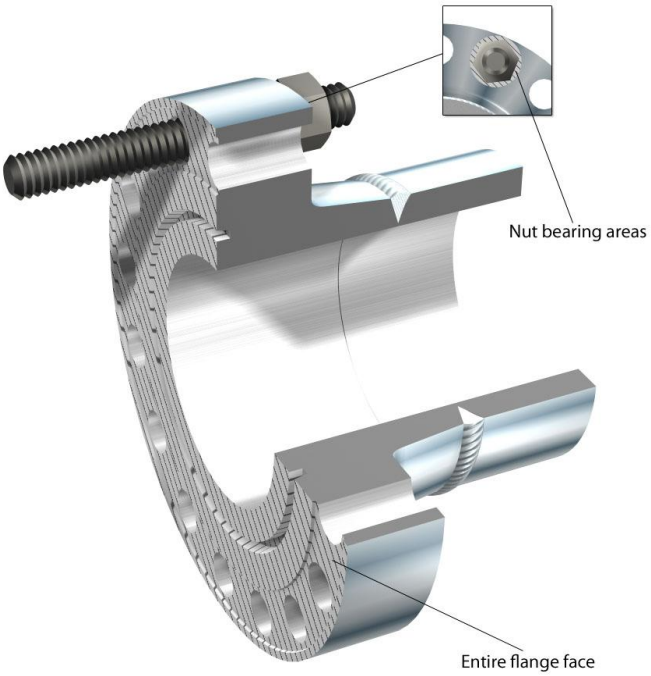
Do not remove the flange protection if the flange is to be shot-blasted and painted, seal off with strong adhesive tape to protect sealing faces.

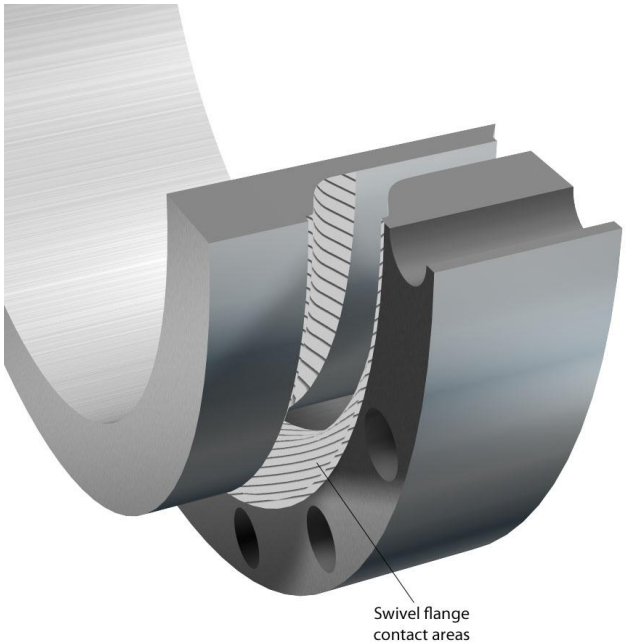
Do not paint:

- **contact areas, i.e. flange face**
- **nut bearing areas**
- **swivel flange contact areas**

WELDING

Keep flange face protected during welding. Seal off with protection plastic cap or plywood with strong adhesive tape.





The areas shown in the figures above must not be painted.

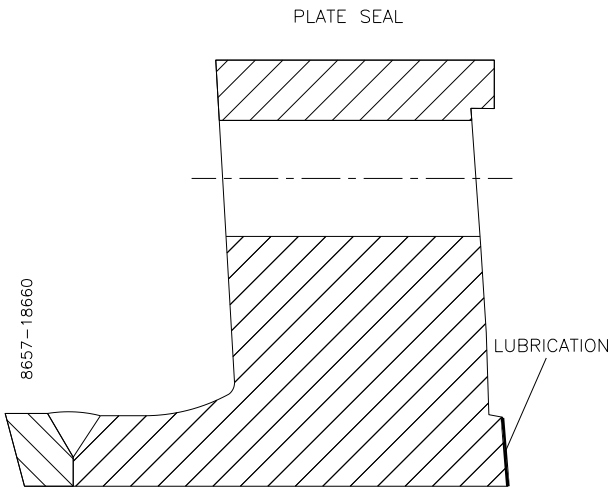
PREPARATION

Cleaning and inspection

Carefully remove the flange face protection.
Use a nonabrasive soft cloth and solvent to clean all components to remove grease, preservation and dirt. Take special care on sealing faces and contact areas. Verify that all components are of correct material and size.

- Carbon steel seal rings are normally blue.
- Stainless steel seal rings are normally yellow/orange or red.
- Seal rings in nickel alloys are black.

Examine all sealing surfaces for mechanical damage and rust. Run a fingertip over seal surfaces to detect dents and gouges.
If any repair is required refer to section *Maintenance and Repair* on page 13.



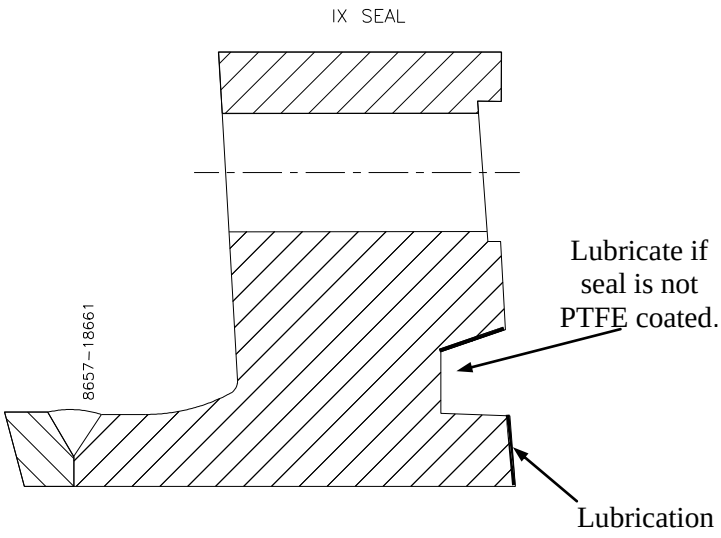
Norsok Compact Flange for Plate Seal - lubrication

MoS_2. Molykote G-Rapid plus or
Gleitmo 545 plus or equivalent may be used.

Check for IX seal Stand-off

Perform Stand-off check for IX-seal ring as follows: Place the seal in the grove.

- if seal ring can be rocked slightly: OK
- if seal ring cannot be rocked (contact in groove bottom): REPLACE



Norsok Compact Flange for IX Seal – lubrication

MoS_2. Molykote G-Rapid plus or
Gleitmo 545 plus or equivalent may be used.

Lubrication

Prior to assembly, lubricate flange heel with clean lubricant. If non-coated seals are used, lubricate also the groove seal faces.
If torque tools are used, lubricate the nut threads and the nut-bearing interface on the flange.
Usually seal rings are coated which acts as lubricant during make-up. If required light oil or MoS2 spray can be used.

Take care that no foreign particles are present in the lubricant.

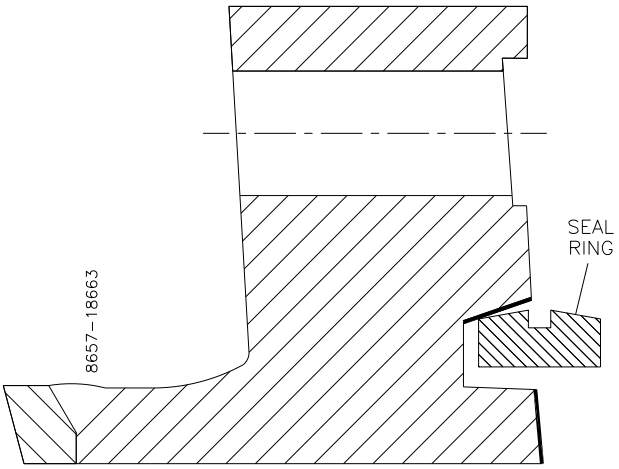
REFER TO THE RELEVANT HEALTH AND SAFETY INSTRUCTIONS FOR LUBRICANT USED FOR DETAILS OF PROTECTIVE MEASURES.

IX Seal Ring Installation

Before installation, inspect the seal ring for mechanical damage.

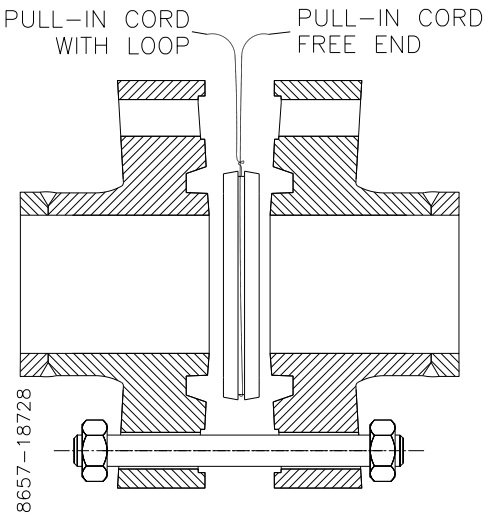
Damaged seal rings must be replaced.

Norsok Compact Flange for IX Seal



IX Seal Ring installation

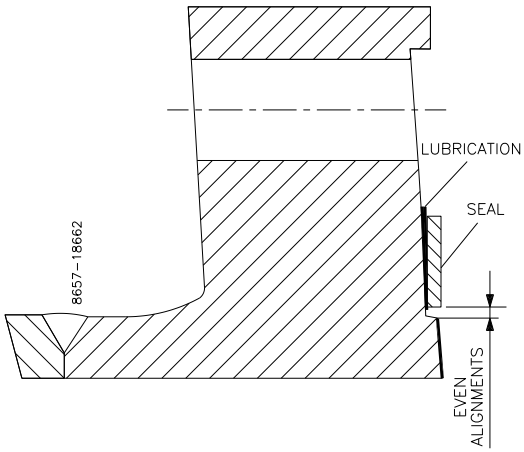
Installation of IX seal using a pull-up cord – one end with a loop and one free end.



Norsok Compact Flange for Plate Seal

Plate Seal Installation

Apply a thin layer of grease in the flange grove and press the seal into place so it sticks to the flange.

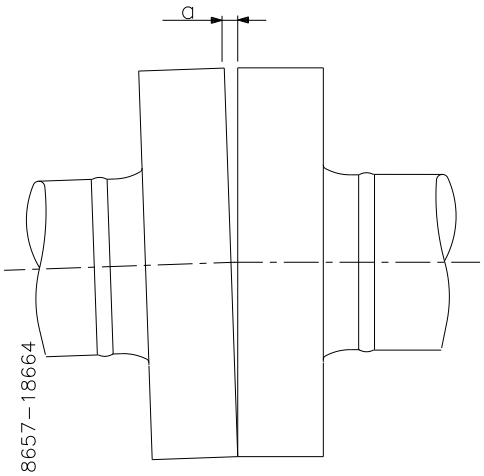


Alignment

With the seal ring in the flange bring the other flange into alignment. Bolt holes to be positioned to allow bolts to be easily moved.

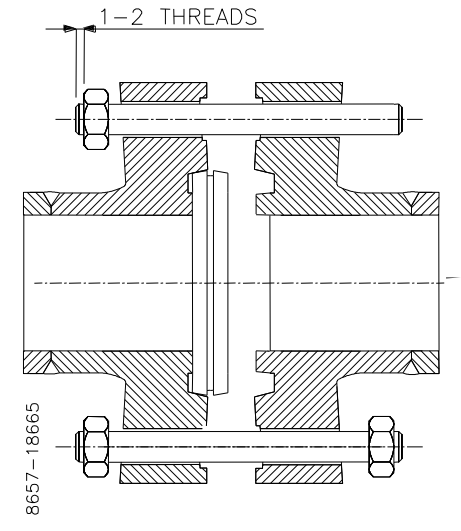
Alignment of facings:

- flange diameter ≤ Ø300 mm: “α” max. 3 mm
- flange diameter > Ø300 mm: “α” max. 10 mm per 1000 mm



Fitting

The stud bolts must protrude 1 – 2 threads from the nut at the opposite side where the tool is used.



Partly load the Bolts

Tighten the bolts with 10% of final applied bolt preload, see Table 1.
Use a criss-cross pattern when tightening, see the illustrated examples. Start with the bolt where the flanges have the largest gap.

If the flanges are not finally tightened at this stage, seal the gap between the flange faces with adhesive tape.

Final Preloading

Personnel shall be skilled and qualified.
Bolt preloading procedures must be qualified in tests.
Tools, equipment and personnel must be the same as in the calibration tests.
Please refer to qualification procedure(s) see page 14.
Use relevant criss-cross pattern during make-up operation.

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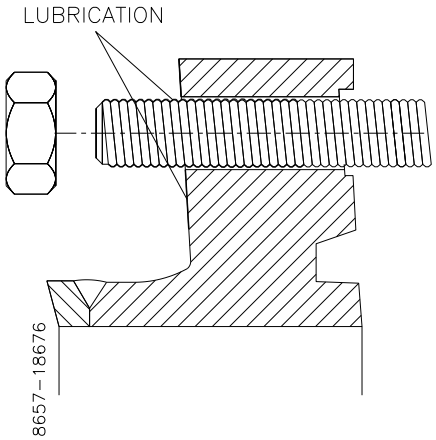
Nuts shall be turned until no further movement is possible on last pre-tension cycle
Gap between the flanges at the wedge shall be fully closed to indicate correct pre-tension.



Lubricate bolt and nut bearing area .

Table 1. Final bolt tension and torque values [1)]

Stud bolt size	Target residual preload [2) 4)]		Applied torque, torque tool	
			μ = 0.10	μ = 0.12
in	kN		Nm	Nm
½-UNC	44		84	98
⅝-UNC	71		164	192
¾-UNC	106		291	341
⅞-UNC	147		465	544
1-UNC	193		697	816
1 ⅛-8UN	255		1016	1194
1 ¼-8UN	325		1420	1671
1 ⅜-8UN	405		1918	2261
1 ½-8UN	492		2532	2989
1 ⅝-8UN	589		3249	3840
1 ¾-8UN	693		4108	4859
1 ⅞-8UN	807		5084	6020
2-8UN	929		6204	7351
2 ¼-8UN	1199		8942	10610
2 ½-8UN	1503		12347	14665
2 ¾-8UN	1667		14945	17766
3-8UN	2004		19536	23240
3 ¼-8UN	2373		24980	29736
3 ½-8UN	2773		31282	37258
3 ¾-8UN	3204		38642	46046
4-8UN	3666		46982	56008

NOTES

1) Bolting material: A193 B7, B16 and A320 L7.

2) Target minimum pre-stress is 75% of yield such that a minimum of 70% is secured taking into account uncertainty in the make-up procedure. Bolt root diameter used.

3)

4) Washers may be necessary for some CL2500 and CL4500i flanges as well as for Rigid Interface (RI) flanges to ensure minimum required bolt length to achieve sufficient residual preload.

Flange Disassembly

1) De-pressurise the line in compliance with standing instructions.

   Always proceed with caution. Never take it for granted that the line has been de-pressurised.

   Re-pressurisation of the line prior to or during disassembly is possible for many reasons

   REFER TO THE RELEVANT HEALTH AND SAFETY INSTRUCTIONS FOR PROTECTIVE MEASURES.

2) Loosen bolts gradually in relevant criss-cross pattern.

3) Continue loosening the bolts in this pattern until you are able to verify that the seal is broken and the seal ring is loose.

4) When you are satisfied that the seal is broken:
   a) Proceed to loosen bolts further and remove bolts necessary to remove seal ring, clean flange faces and replace with new seal ring.
   b) Proceed to loosen bolts further and remove completely for disassemble

Maintenance

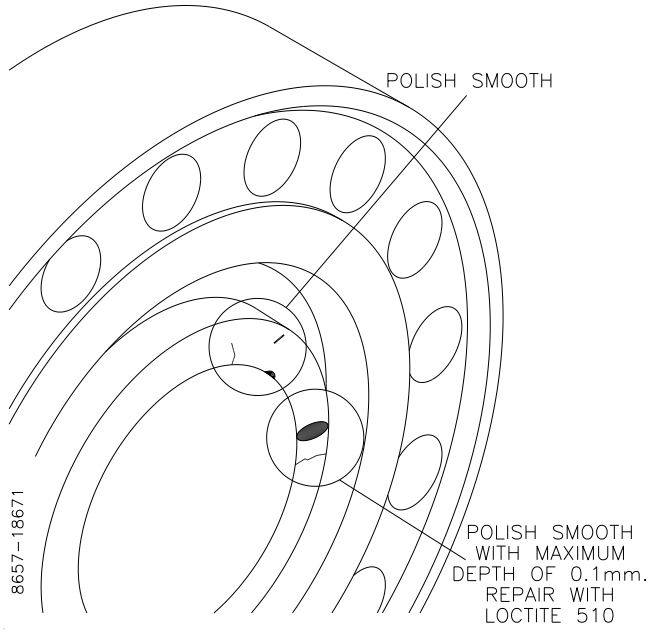
The Norsok Compact Flange does not require special maintenance if correctly assembled. An IX seal ring may be reused if it has sufficient stand-off and is free from defects – a plate seal must be replaced. Minor rust, burrs or scratches must be repaired, see section *Repair* on page 13.

Repair

Polish off any small scratches on the heel and seal ring seat area using fine emery cloth in the circumferential direction only. Polish at least one third of the circumference to ensure a uniform blending of the re-work area.
Damaged seal rings must be replaced.

Do not polish radially or axially.

Larger damages may require re-machining of flange face.



Damage Identification	Action
Scratch or dent at the heel, covering less than ¾.	Hard polish with block and fine emery paper to the required depth. Finish with emery paper grade 240.
Scratch or dent at the heel, covering ¾ or more of the heel width.	Grind with fine emery paper to the required depth. Finish with emery paper grade 240. The depth after grinding should be maximum 0.1 mm. 'Repair' with Loctite 510.
Small damage in seal ring seat location	Grind with fine emery paper. Finish with emery paper grade 240.
Outer wedge	Remove any burr standing proud of the surface by grinding/filing.
Seal ring sealing faces	Replace seal ring.

BOLT TENSIONING QUALIFICATION PROCEDURE

General

This is a qualification procedure for bolt preloading using torque tool or hydraulic tensioner. The target minimum pre-stress should be 75% of yield so that a minimum of 70% pre-stress is achieved after losses due to time dependent strains (relaxation).

Personnel

The requirement for skilled operators is a very important aspect often neglected. The complete assembly of tool and torque/tension measurement instrument must be calibrated together and have a calibration traceable to a recognized international standard. In order to achieve good accuracy and repeatability, operators must be technically qualified and experienced in surface condition assessment, lubricant application and tool performance.

TORQUE PRELOADING

Background

Preloading by torque is achieved by applying a measured torque to a bolt and nut with a controlled lubrication. For bolts of moderate length the required torque is with good accuracy given by the following expression:

$$T = \frac{F_P}{2}(\mu_n d_n + 1.155\mu_t d_t + p/\pi)$$

Where
- T = Torque applied to the bolt
- F_P = Required bolt preload
- μ_n = Coefficient of friction of nut bearing surface
- d_n = Effective contact diameter of nut face
- μ_t = Coefficient of friction of threads
- d_t = Effective contact diameter of threads
- p = Thread pitch

The nut and thread friction is set equal to μ in Table 1, i.e. $\mu = \mu_n = \mu_t$. It is seen that the coefficients of friction are of dominant importance to the achieved preload. The coefficients of friction are affected by a number of factors:

- bolt/nut material
- bolt surface coating
- type, amount, condition and/or method of application, contamination and temperature of the lubrication of the bolt threads and nut bearing surface.
- hardness of all parts
- surface finish
- speed with which the nut is tightened
- the fit between threads and thread tolerances.

Consistent application of bolt lubrication is vital to maintain the consistency of induced bolt stresses at assembly with torque methods. Change of lubrication will change friction coefficient and hence the required torque.

Equipment

Use the following equipment:

- A torque wrench with a current calibration certificate or a hydraulic torque tool with a pressure gauge of class 1.6 or better accuracy and with a calibration certificate.
- A hollow load cell with a capacity at least equal to the yield strength of the bolt. The capacity should desirably not exceed twice the yield capacity of the bolt. The load cell must have a valid (not more than 12 month old) calibration certificate traceable to a recognised national standard from an accredited laboratory.
- Two solid steel reaction plates each with a hole to suit the bolts.
- Suitable bolt lubricant, such as a MoS2 lubricant, supplied in a closed container, i.e. aerosol, tube or box.
- Five sets of bolts with nuts for calibration test.

Calibration and qualification

1. Place load cell between reaction plates, enter bolt and nuts and pull hand tight after lubricating according to lubrication procedure. Centralise the bolt on the load cell.
2. Apply specified torque value.
3. Record bolt force achieved.
4. Repeat step 2 and 3 with the remaining bolt sets.
5. Calculate the mean tensile load achieved.
6. Calculate the standard deviation of the tensile load achieved.
7. Calculate the minimum bolt tension as the mean value less one standard deviation and check if this exceeds the minimum bolt load specified.
8. Calculate the maximum bolt load as the mean plus one standard deviations and the corresponding axial bolt stress as well as the shear stress due to the applied torque. Check that the equivalent von Mises stress does not exceed the yield strength of the bolts.
9. If the results achieved in step 7 or 8 are not satisfactory revise the specified bolt torque or the lubrication procedure or chose a new lubricant and repeat the same procedure using new bolts and nuts.

Lubrication procedure

Apply bolt lubrication as consistently as possible without contaminating the lubricant. Apply lubricant in a manner that can easily be repeated and that gives a consistent amount of lubricant. To achieve this it is recommended that the threads are filled with lubricant.