



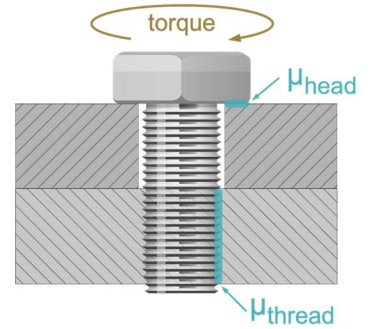
# Lubrication of Bolts

## Background

Friction stands between the tightening torque ( $M_D$ ) and the bolt preload force ( $F_A$ ) generated from it. It occurs at the thread and under the bolt head in every bolted joint.

The tightening torque is calculated from the yield strength of the bolt material and bolt size with the coefficients of friction for the thread ( $\mu_t$ ) and bolt head contact ( $\mu_h$ ).

A torque specification for a bolt of a certain size and material is incorrect without specifying the underlying friction coefficients.



## Lubricate: yes or no?

The assembly of a bolt - particularly the determination of the tightening torque - must consider all boundary conditions (size, yield strength and coefficients of friction).

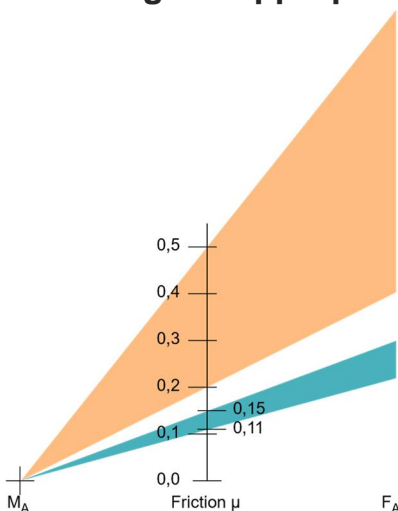
Example calculation acc. to VDI Directive 2230 (VDI = German Association of Engineers)		
Bolt: M16, Material: 25CrMo4 (440 MPa yield point), 70% utilization of yield point		
Lubrication	yes	no
$\mu_t$ friction coefficient thread	0.13	0.24
$\mu_h$ friction coefficient bolt head	0.13	0.20
Tightening torque	119 Nm / 88 lbf ft	162 Nm / 120 lbf ft
Precision and repeatability	++	--

Lubricating the bolts with a suitable paste (e.g., OKS 250) results in a lower coefficient of friction than is possible with non-lubricated bolts. Using special bolt pastes is strongly recommended. Oils and greases should never be used on bolts.



## Advantage of appropriate lubrication

The greatest advantage of bolt lubrication is that the scattering range of friction is significantly reduced. With correct lubrication, the coefficients of friction are usually in the range of 0.11 to 0.15. Without lubrication, experience has shown that coefficients of friction can vary between 0.2 and 0.5. Correct lubrication of the bolt connection ensures greater precision and repeatability.



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## What else should be considered?

In order to control the friction coefficient, hardened washers should be used (e.g. DIN ISO 7089 200HV or 300HV), as prescribed in the VCI guidelines for flange mounting (VCI = German Chemical Industry Association).

Nuts should always be mounted with the marking on the head contact surface visible to the outside so that any burrs present do not affect friction.



## Myth: Lubrication leads to loose bolts

The best way to secure bolts against loosening, e.g., due to vibration, is to apply as high a bolt pre-tensioning force as possible. The presence of suitable bolt lubrication does not have a detrimental effect on 'bolt locking'.

The use of serrated lock washers is usually a disadvantage, as the friction coefficient of the head contact are massively increased, but tightening torque is often not increased in response.

## Further Information

Other FlatSeal™ Guides deal with the following basic topics:

- FlatSeal™ Guide 1 – Fundamentals of Flat Gasket Technology
- FlatSeal™ Guide 2 – Choice of Sealing Material
- FlatSeal™ Guide 3 – Installation Instructions
- FlatSeal™ Guide 4 – Optimized Gasket Geometry
- FlatSeal™ Guide 5 – Lubrication of Bolts
- FlatSeal™ Guide 6 – Roughness of Sealing Surfaces
- FlatSeal™ Guide 7 – Service Life of Sealing Systems
- FlatSeal™ Guide 8 – Shelf Life of Sealing Materials
- FlatSeal™ Guide 9 – Tolerances Cut Parts
- FlatSeal™ Guide 10 – Temperature Test

