TALKING TORQUE

THE RELATIONSHIP BETWEEN NUTS AND BOLTS

Torque, by definition, is a force caused by turning. The greater the resistance to turning, the greater the torque or force required to turn the item.

To quantify the importance of torque on a nut/bolt combination it must first be understood what operation the combination is designed to perform.

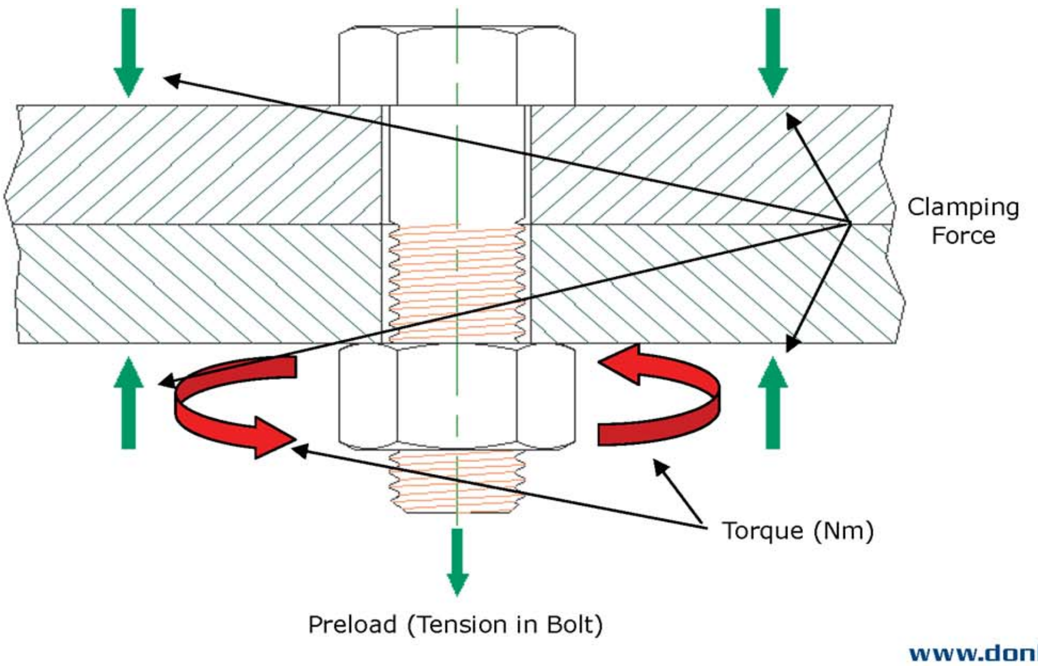
- Bolts and nuts are designed to hold individual components together. To achieve this the bolt shank must be able to stretch and therefore exert a clamping force that exceeds the force trying to pull the individual components apart.
- When the nut is loosened the bolt shank should return to its' original length unless the force used to stretch the bolt exceeded the yield strength of the bolt. In this case the bolt will have been permanently stretched and therefore unsuitable for re-use.

Theoretically you would get the greatest clamping force from a given bolt by stretching it exactly to the yield point and locking the free end. This operation requires a high degree of accuracy, is time consuming, and therefore expensive, and generally only a requirement where precision components are used and a high degree of uniformity is essential.

The most economical and conventional method of obtaining the required tension in a bolt and therefore clamping force is by using a bolt and nut combination. As the nut tightens against the bolted component it stretches the bolt to the desired tension.

As stated above, the force used to turn the nut is called torque. As the tension in the bolt increases and therefore the clamping force exerted by the bolt increases so to does the amount of torque required to turn the nut increase.

There is therefore a direct relationship between torque, bolt preload (tension) and clamping force.



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Theory versus Practice

Theoretically installing bolts and nuts sounds very simple, however, there are several variables that need to be taken into account when determining the required torque. In simple terms they are:

1. Property Class (Metric) or Grade (Imperial) and diameter of bolt and nut combination. Tensile strength and diameter of the items determines how much pre-load is required.

2. Type of Lubrication used. Different types of lubricants have varying coefficients of friction. The lower the co-efficient of friction, the lower the amount of torque required to achieve the required preload. The amount of friction may also vary dependent on which surfaces the lubricant is applied to.

3. Condition of Threads and Bearing Faces. The thread condition and bearing face condition oboth the bolt and nut can affect the amount of friction between the mating parts. A clean rolled thread would create much less resistance than a lightly corroded cut thread and therefore the torque required to achieve the required preload would be significantly lower. A damaged, corroded or galled bearing face on a nut, bolt or washer face (depending which is the moving component) would create much more resistance than a clean, smooth bearing face.

These are the major variables that need to be considered when determining a torque value to achieve a required preload. It must be recognised that approximately only 10% of torque is converted into preload.

TABLE 1: Illustrates the approximate torque requirements in Nm (at 75% of Safe Bolt Load) for an M36 x 4P bolt of various property classes when different lubricants are applied to threads and bearing faces that are in good condition.

TABLE 1:

Lubricant	Property Class	4.6	5.8	8.8	10.9	12.9
Dry Steel on Steel		2580	4360	6880	9520	11130
Light Oil		990	1680	2650	3660	4282
Neverseez		740	1260	1990	2750	3210
Moly Kote		450	750	1190	1650	1930

NOTE: Incorrectly tightened bolts can lead to premature failure.

- Under-tightened bolts can fail due to fatigue.
- Over-tightened bolts can fail due to tensile overload.