Tightening Methods

Principally there are two modes of tightening: "Uncontrolled" and "Controlled".

**Uncontrolled tightening**
Uses equipment and/or procedures that cannot be measured. Preload is applied to a bolt and nut assembly using a hammer and spanner or other types of impact tools.

**Controlled tightening**
Employs calibrated and measurable equipment, follows prescribed procedures and is carried out by trained personnel.

Advantages of Controlled Tightening

**Known, controllable and accurate bolt loads**
Employs tooling with controllable outputs and adopts calculation to determine the required tool settings.

**Uniformity of bolt loading**
Especially important on gasketed joints as an even and consistent compression is required for the gasket to be effective.

**Safe operation following prescribed procedures**
Eliminates the dangerous activities of manual uncontrolled tightening and requires that the operators be skilled and follow procedures.

**Reduces operational time resulting in increased productivity**
Reduces tightening time and operator fatigue by replacing manual effort with the use of controlled tooling.

**Reliable and repeatable results**
Using calibrated, tested equipment, following procedures and employing skilled operators achieves known results consistently.

**The right results first time**
Many of the uncertainties surrounding in-service joint failures are removed by ensuring the correct assembly and tightening of the joint are carried out the first time.

What is Torque?

It is a measure of how much force acting on an object which causes that object to rotate.

What is Torque Tightening?

The application of preload to a fastener by the turning of the fastener’s nut.

Torque Tightening and Preload

The amount of preload created when torqueing is largely dependent on the effects of friction.

Principally there are three different “torque components”:

- torque to stretch the bolt
- torque to overcome the friction in bolt and nut threads
- torque to overcome friction at the nut spot face (bearing contact surface).

Visit www.enerpac.com to access our free on-line bolting software application and obtain information on tool selection, bolt load calculations and tool pressure settings. A combined application data sheet and joint completion report is also available.
Friction points should always be lubricated when using the torque tightening method.

Friction Reductions Friction

Lubrication reduces the friction during tightening, decreases bolt failure during installation and increases bolt service life. Variation in friction coefficients affect the amount of preload achieved at a specified torque. Higher friction results in less conversion of torque to preload. The value for the friction coefficient provided by the lubricant manufacturer must be known to accurately establish the required torque value.

Lubricant or anti-seizure compounds should be applied to both the nut bearing surface and the male threads.

Torque Procedure

When torquing it is common to tighten only one bolt at a time, this can result in Point Loading and Load Scatter. To avoid this, torque is applied in stages following a prescribed pattern:

**Torque Sequence**

- **Step 1**: Spanner tight ensuring that 2 - 3 threads extend above nut
- **Step 2**: Tighten each bolt to one-third of the final required torque following the pattern as shown above.
- **Step 3**: Increase the torque to two-thirds following the pattern shown above.
- **Step 4**: Increase the torque to full torque following the pattern shown above.
- **Step 5**: Perform one final pass on each bolt working clockwise from bolt 1, at the full final torque.

Breakout Torque

When loosening bolts a torque value higher than the tightening torque is normally required. This is mainly due to corrosion and deformations in the bolt and nut threads.

Breakout torque cannot be accurately calculated, however, depending on conditions it can take up to 2½ times the input torque to breakout.