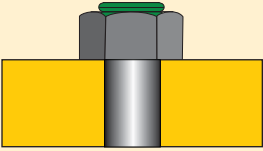




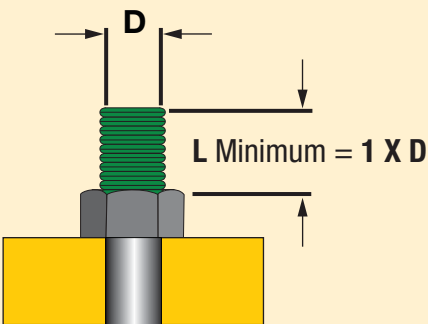
## Tensioning requires longer bolts



**INCORRECT**



**CORRECT**



## What is Bolt Tensioning

Tensioning is the direct axial stretching of the bolt to achieve **preload**. Inaccuracies created through friction are eliminated. Massive mechanical effort to create torque is replaced with simple hydraulic pressure. A uniform load can be applied by tensioning multiple studs simultaneously.

Tensioning requires longer bolts, and a seating area on the assembly around the nut. Tensioning can be done using detachable Bolt Tensioners or Hydraulic Nuts.



**Preload (residual load) = Applied Load *minus* Load Losses**

## What is Load Loss

**Load loss** is a loss of bolt elongation depending on factors such as thread deflections, radial expansion of the nut, and embedding of the nut into the contact area of the joint. Load loss is accounted for in calculation and is added to the preload value to determine the initial **Applied Load**.

**The preload depends on Applied Load and Load Loss (load loss factor).**



## GLOSSARY OF TERMS

**Applied Load:** The load applied to a bolt during tensioning which includes an allowance for Load Loss.

**Bolt Tensioning:** A method of controlled tightening which applies preload to a bolt by stretching it axially.

**Breakout Torque:** The amount of torque required to loosen a tightened bolt. (Usually more torque is required to loosen a bolt than was used to tighten it.)

**Elastic Range:** The range on a bolt's stress / strain curve where stress is directionally proportional to strain.

**Load Loss:** The losses in a bolt which occur on transfer of load from a tensioning device to the bolt assembly (these may arise from phenomena such as thread deflection and embedding of

the nut to the contact area of the joint, and is calculated as a factor of the length to diameter ratio of the bolt).

**Load Scatter:** The spread of differing loads in a sequence of bolts after they have been loaded. It is mostly due to the elastic interaction of the bolts and the joint member; as subsequently tightened bolts further compress the joint, previously tightened bolts are subject to some relaxation.

**Plastic Range:** The range on a stress/strain curve where the tensile load applied to a bolt results in permanent deformation.

**Preload:** The load in a bolt immediately after it has been tightened.

**Proof Load:** Proof load is often used interchangeably with Yield Strength but is usually measured at 0.2% plastic strain.

**Tensile Point:** The point at which the tensile loading on a bolt causes the bolt to rupture.

**Torque Tightening:** The application of Preload to a bolt by turning of the bolt's nut.

**Ultimate Strength:** The maximum tension which can be created by tensile load on a bolt.

**Yield Strength:** The point at which a bolt begins to plastically deform under tensile loading.

**NOTE:** Bolt is used as a generic term for a threaded fastener.



**Manufacturer's rating of pressure and load are maximum safe limits.  
Good practice encourages using only 80% of these ratings!**

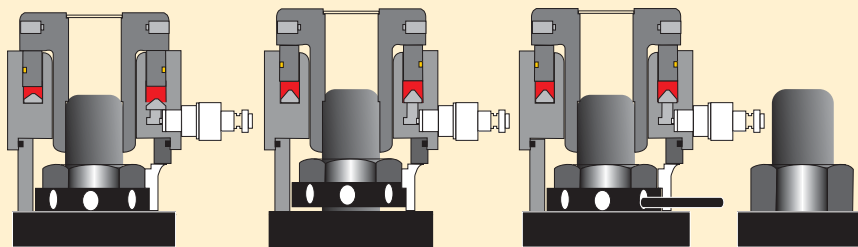
## Tensioning Operation

Tensioning permits the simultaneous tightening of multiple bolts; the tools are connected in sequence via a high-pressure hose assembly to a single pump unit. This ensures each tool develops the exact same load and provides a uniform clamping force across the joint. This is especially important for pressure containing vessels requiring even gasket compression to affect a seal.

## General Procedure

- Step 1:** The bolt Tensioner is fitted over the stud
- Step 2:** Hydraulic pressure is applied to the tensioner which then stretches the stud.
- Step 3:** The Stud's nut is wound down against the joint face
- Step 4:** Pressure is released and the tool removed.

The bolt behaves like a spring, when the pressure is released the bolt is under tension and attempts to contract, creating the required clamping force across the joint.



Step 1

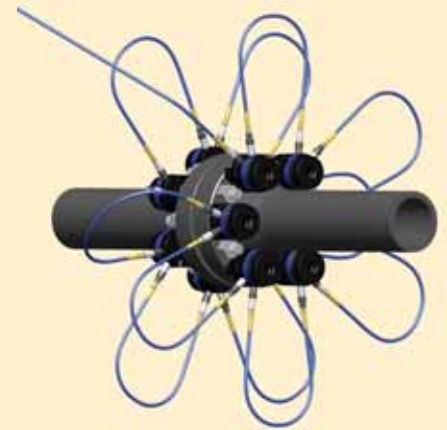
Step 2

Step 3

Step 4

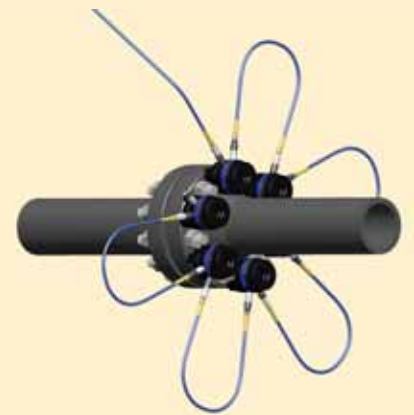
## Less than 100% Tensioning

Not all applications allow for the simultaneous fit of a tensioning device on each bolt, in these cases at least two tensioning pressures are applied. This is to account for a load loss in those bolts already tensioned as the next sets are tightened. The load losses are accounted for in calculation and a higher load is applied to allow the first sets to relax back to the target preload.



### Set-up using a 100% tensioning procedure

All bolts are tensioned simultaneously.



### Set-up using a 50% tensioning procedure

Half the bolts are tensioned simultaneously, the tools are relocated on the remaining bolts and they are subsequently tensioned.



#### Read Instruction Manuals

Please refer to the product Instruction Sheets for safe use guidelines and detail on the correct set up and operation of the equipment.