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## Bolting Guidelines

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To achieve a trouble free joint, one of the most important aspects to consider is the bolts or studs. Reliability depends on achieving and maintaining an acceptable level of tension in each bolt. The target tension level for most applications can be calculated using Klinger's gasket design system.

However, the method employed to tighten the bolts is very important and can result in significant variations from those anticipated. As a guide the following table shows the variation of bolt tension with the tightening method.

<b>Method Used</b>	<b>Tools Required</b>	<b>Variation of tension from mean value</b>
Wrench (No Torque Control)	Spanner or Wrench	±50%
Wrench (With Torque Control)	Calibrated Torque Wrench	±30%
Hydraulic Tensioner	Multiple Stud Tensioners	±10% to ±30%
Direct Strain Measurement	Rotabolt pre-set Studs	±5%

If the initial bolt stress is too low the total amount of strain (stretch in the bolt) is low and under these circumstances any subsequent reduction in thickness of the gasket due to creep will quickly result in loss of bolt strain and subsequent leakage.

Within reason, it is better to approach the maximum bolt stress recommended by the manufacturer. This is often 80% of the yield strength at the operating temperature.

Other points to consider are:

- The crushing strength of the gasket.
- That the hydrostatic end thrust will increase the bolt tension at the operating internal pressure.
- Using a bolt stress which represents less than 50% of the yield strength will cause problems and should only be considered under certain circumstances.

- Most flanges are tightened with ordinary wrenching methods and it is often advantageous to have design bolt stresses which require no more than this. The probable bolt stress developed manually is often expressed as

$$S_b = \frac{1560}{\sqrt{d_b}} \text{ N/mm}^2$$

Where:

$S_b$  = bolt stress achieved on assembly

$d_b$  = bolt diameter in mm

For smaller bolts this results in excessive stress unless care is exercised. For larger bolts, however, it is often impossible to develop the required stress by hand.

REMINDER: As the temperature increases, the yield strength of the bolt material decreases.

The ability of a gasket material to make and maintain a seal depends not only on the quality of the gasket material, but also on medium being sealed, the flange design, the amount of pressure applied to the gasket by the bolts and how the gasket is assembled into the flanges and tightened.

For product safety information, warranty and damage limitations, refer to the Material Safety Data Sheet (MSDS).