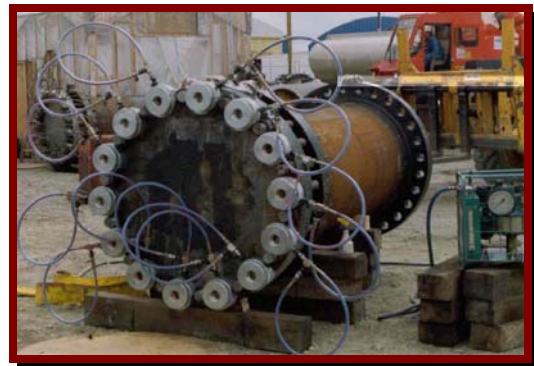
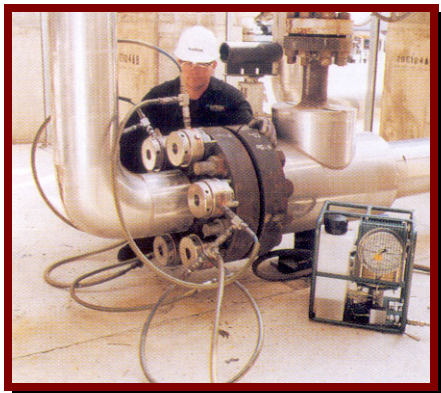




INTEGRA[®]
TECHNOLOGIES

HYDRAULIC BOLT TENSIONING

HOW IT WORKS



Bolting and Machining the World's Critical Joints

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BOLT TIGHTENING

It was the increasing technological demands of the North Sea Offshore Oil & Gas Industry that exposed the limitation of conventional bolt tightening methods as failing to achieve consistently tightened, leak free joints.

It was recognized that critical bolted flanges in all industries around the world had a common problem. There were, and still are, a variety of gasket types available to suit various operating conditions, but in all cases the effectiveness of the gasket depends upon **UNIFORM GASKET COMPRESSION**. The bolt tightening method significantly effects the gasket compression that directly influences the likelihood of a leak.

INTEGRA Technologies has led the way by identifying the role of residual bolt load and its effects on leak free joints. It is essential on critical bolted joints to ensure **ACCURATE** and **UNIFORM RESIDUAL BOLT LOADS**.

Ignoring flogged methods, consider conventional bolt tightening methods. All types of mechanical hydraulic torque wrenches have the capacity to control the applied torque, but torque tightening suffers the inability to accurately translate the applied rotational force into axial bolt load.

Torque tightening, even during the initial loading stages can be unpredictable and torque figures used, even under the most closely monitored site conditions, can vary as much as 40%. Frictional losses between the nut and bolt threads are, at best, substantial and vary considerably with many factors such as lubrication, bolt corrosion and thread damage, reducing the theoretical torque values to worthless numbers. Residual bolt loads achieved using torque equipment can only be reliably identified using a bolt load monitoring system such as ultrasonics, as each bolt is tightened.

Torque wrenches are usually incapable of tightening more than one bolt at a time and because conditions in each bolt are never the same, a consistently applied torque to any number of bolts will inevitably result in inconsistent axial bolt loads. Torque tightening also requires laborious and gradual bolt tightening sequences to avoid damage to the gasket.

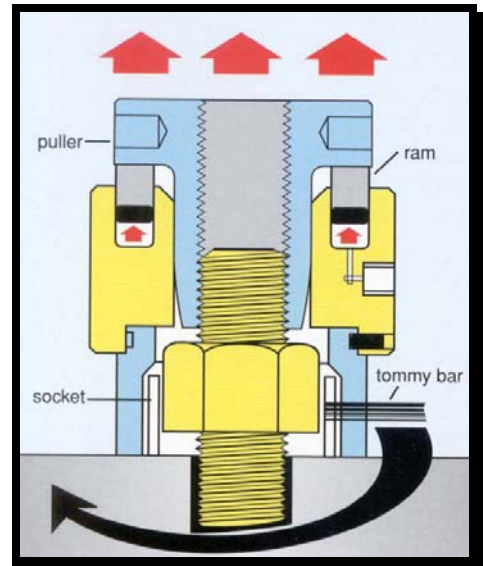
BOLT TENSIONING, however, can achieve accurate and predetermined bolt loading in a single simultaneous operation, providing the uniform gasket compression essential for the integrity of critical bolted connections. Particularly on larger flanges, Bolt Tensioning can also be significantly quicker than torque tightening.

How It Works

Bolt tensioning essentially provides a hydraulic load that acts directly upon the studbolt to retain its specified residual load when the hydraulic pressure in the tensioners is released.

High-pressure oil from a small air operated pump acts upon the ram in the hydraulic head, developing an axial force that is transmitted directly to the bolt by the puller. This force stretches the bolt and tightening down the nut by simply turning the socket with a tommy bar retains the extension.

Known pressure areas of the hydraulic tools ensure direct correlation between the pump pressure gauge reading and the applied load.



It is important to understand exactly what happens when nuts and bolts are tightened.

Apart from some compression of the gasket or joint material, the flange is considered to be incompressible. As a load is applied to a bolt, the effect is similar to the stretching of a spring and the studbolt will elongate. This elongation or spring effect of the bolt is what maintains the load in the joint and the gasket compression. To maintain uniform gasket compression, it is essential that all studbolts in any one joint have the same elongation.

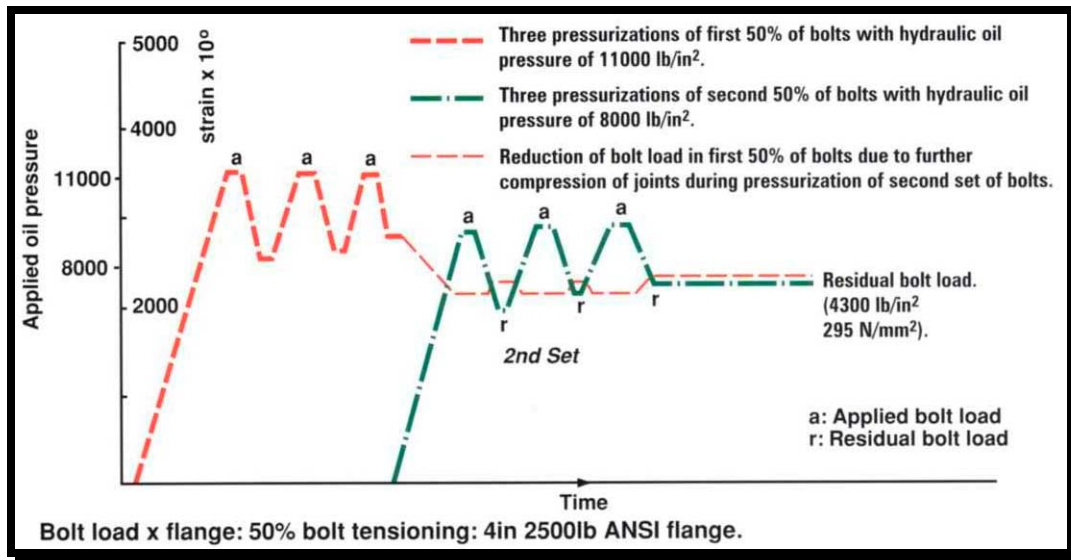
THE BOLT TENSIONER can be applied to a single bolt or any number of bolts, depending upon access and application. However, to give the most accurate residual bolt loading and uniform compression of a joint, the tools are ideally applied in an arrangement where all the bolts can be simultaneously tensioned.

100% Tensioning is achieved where tensioning tools are attached to bolts alternatively on each side of the flange. Hydraulic Hoses connect all of the tools to the air driven hydraulic pump unit enabling every bolt to be tensioned simultaneously. This ensures:

- 1) The gasket is compressed evenly throughout the operation; and
- 2) All bolts have the same accurate residual bolt load.

Accurate bolt loading and uniform gasket compression can still be achieved with 50% tensioning by fitting tensioners to alternate bolts on one side of the flange only. The successive tensioning of the remaining bolts from the same side reduces the residual bolt load in the first 50% of bolts.

INTEGRA Technologies, with our considerable field experience, is able to calculate the applied load of the first 50% of bolts so that the subsequent tightening of the second 50% of bolts results in the required residual load in all of the bolts. Some small loss of applied load, due to thread deformation and bedding-in of mating assembled components takes place and this is incorporated into the bolt load calculation.



Bolt tensioners do need extra length bolts to allow for the engagement of the puller. The extra length studbolt should ideally be specified at the design stage or alternatively standard length studbolts could be changed during a shutdown.

INTEGRA Technologies can advise on all aspects of your flange connections, bolting requirements and gaskets, as well as provide calculations for joint integrity. From your design and test criteria we can provide optimum bolt loading while taking into account the induced flanges stresses.

Ignoring flogging methods, both torque and tensioning have their place in the make-up and break-out of bolt joints. Bolt tensioners are unsuitable for tightening very short bolts or for applications requiring bolt loads very close to yield. The torque wrench is more suited to such application and is the preferred method of breaking out, particularly for the removal of nuts from corroded bolts.

To meet the demands of outages and shutdowns, INTEGRA offers a package of specialized services, including not only torque and tension, but also techniques to assist with all aspects of flange make-up and breakout.

Bolting and Machining the World's Critical Joints