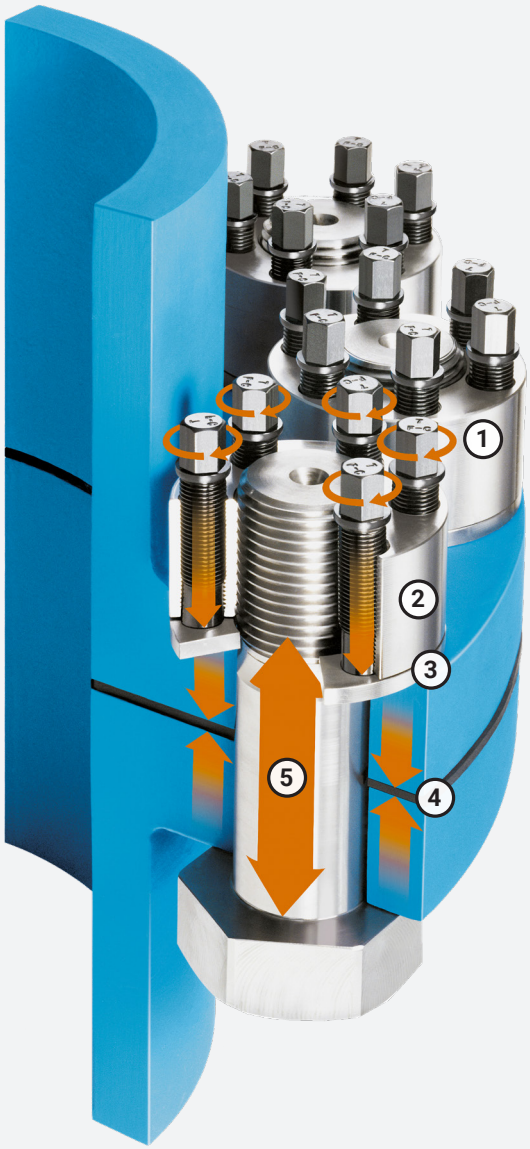
NORD-LOCK GROUP

LOAD-SENSING TENSIONER BY SUPERBOLT

THE NEXT LEVEL OF SMART

SUPERBOLT™



BACKGROUND

Superbolt multi-jackbolt tensioners (MJTs)

Superbolt multi-jackbolt tensioners are used in industries for applications where tightening large bolts (over M30) becomes very challenging. MJTs solve this problem by breaking down the necessary tensioning energy into a sum of small input torques, following a certain procedure.

1. By tightening the jackbolts, a strong thrust (axial) force is generated. This thrust force is directed against a hardened washer. Jackbolts have a small friction diameter and can therefore create a high thrust force with relatively little torque input.
2. The loads are transferred through the nut body which is positioned on the main thread by hand.
3. A hardened washer is used to transfer the force while protecting the flange face.
4. The thrust (axial) force of jackbolts and the opposite reaction force of the main bolt head create a strong clamping force on the flange.
5. The thrust (axial) force from the jackbolt creates an equally strong reaction force in the main bolt.

OBJECTIVE

Easy preload measurement

Experience has proven that MJTs generate very accurate preload (usually within less than ±10% scatter). Since MJTs are used in numerous critical bolted joints where control of the preload is crucial, a need exists for a preload measuring function in the MJT itself to ensure the conformity of their installation, either for easier verification of the initial preload or to monitor the residual preload in service, or both.

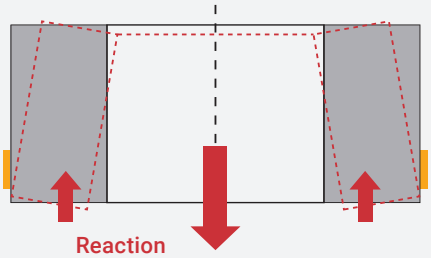
OUTCOME

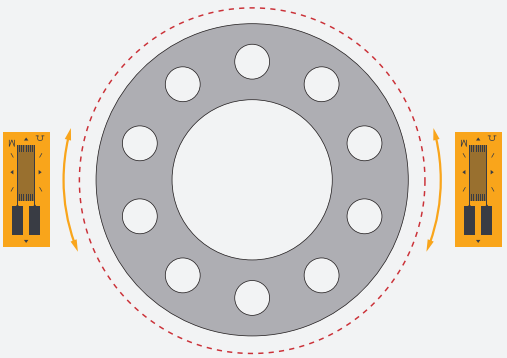
Preload-measuring MJT

The nut body of the Superbolt Load-Sensing Tensioner (LST) is equipped with a strain measuring device that measures the variation of its circumference which is proportional to the variation in bolt preload. This unique method has been patented:

The innovation here is that the measurement of the axial bolt load utilizes the unique deformation mode of MJTs unlike traditional techniques that rely on the bolt stretch or on the compression of clamped parts.

Patented principle of a smart Superbolt nut

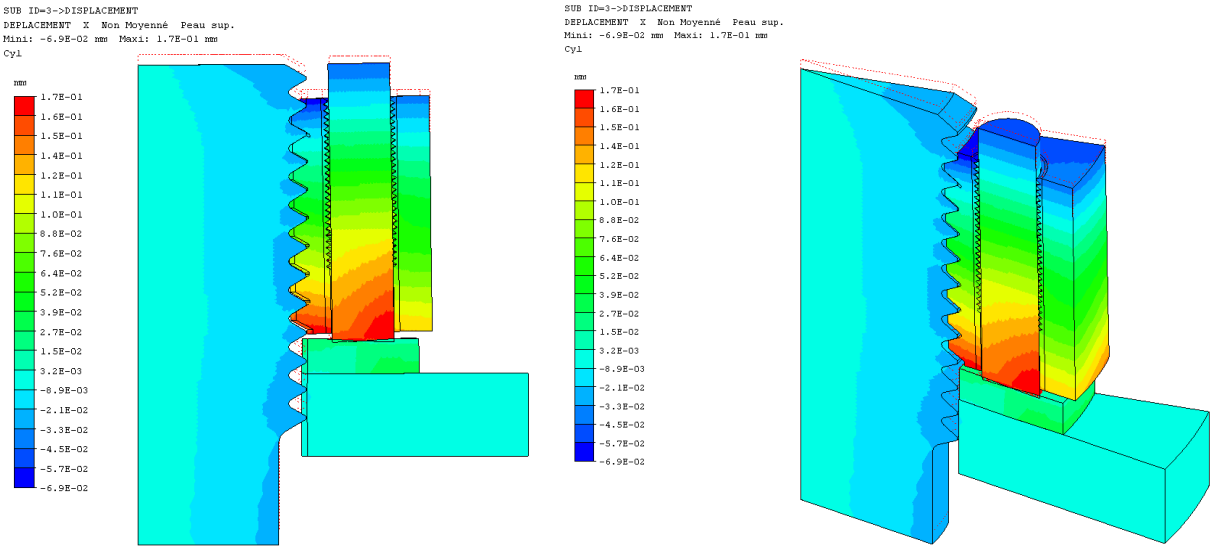




Circumferential deformation is a function of axial bolt load F_b

The principle of a preload monitoring MJT relies on the ability to measure accurately the circumferential expansion of the nut body and to link it back to the preload level F_b in the main bolt.

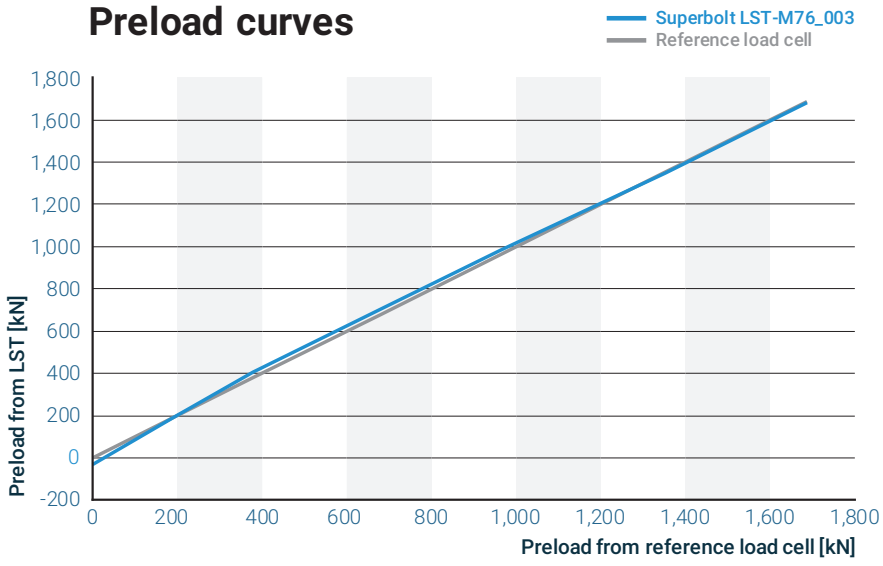
In order to optimize the location of the strain gauges, the Technical Center of the Nord-Lock Group has used FE simulations to quantify the magnitude of the stresses at several locations around the nut body.



Deflection as shown by finite element simulation to choose optimal location for strain gauges

Calibration and accuracy

Based on the strain-stress relationship determined during early tightening tests, a “load factor” can be set to calibrate the smart Superbolt preload measuring system:



Preload measured by the system versus axial bolt load, example on LST-MT-M76x6/W.

The value given by the smart Superbolt nut matched the preload measured by the calibrated load cell (reference cell). This performance matches the best accurate preload (± 2%) monitoring systems available commercially.

CONCLUSIONS

Superbolt LSTs are a true innovation in the field of preload monitoring:

Developed, tested and proven to address both needs for a live preload reading during installation phase, and for remote preload monitoring

Eliminates the need for modifications of the bolt, unlike conventional methods

Reliable solution for all joints that require accurate preload verification without modification or preparation of the fasteners or clamped parts

Eliminates high costs (both equipment and labor) involved with other options, including external measurement devices and periodic verification by maintenance crews

Accurate and repeatable preload reading

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