NORD-LOCK GROUP

LOAD-SENSING SOLUTIONS 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.

Superbolt Flexnuts

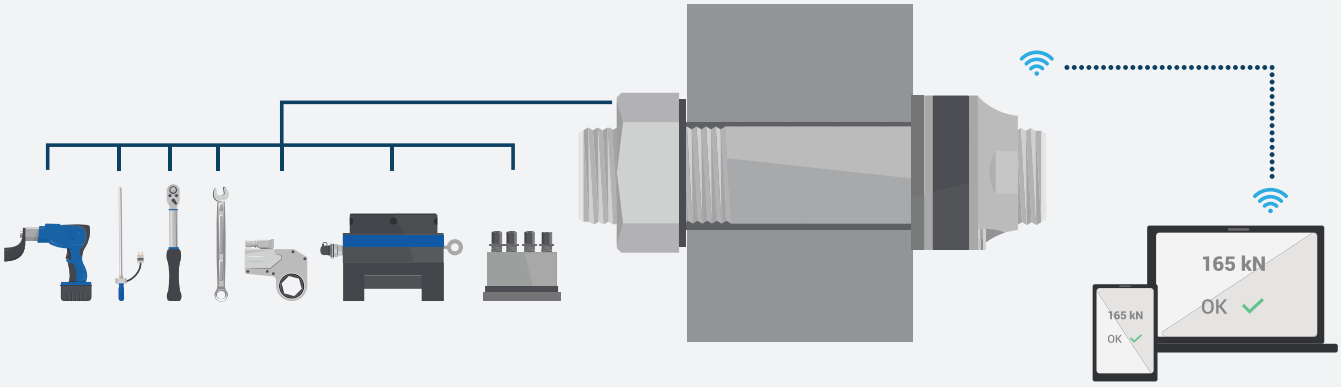
Superbolt developed the Flexnut for through-hole applications. Flexnuts bring the advantages of MJT-type elasticity to the reactive side of the joint.

Flexnuts are designed to flex out at the bottom and flex in toward the top of the nut. This distributes the bolt load along many threads, adds elasticity, and prevents stress concentrations in the first few threads.

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. Regardless, this need for preload verification exists for all tightening methods.



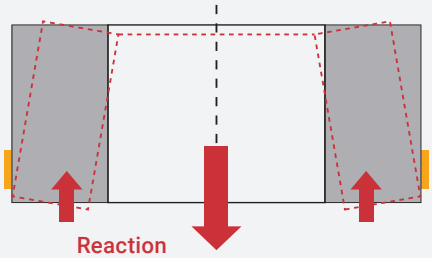
OUTCOME

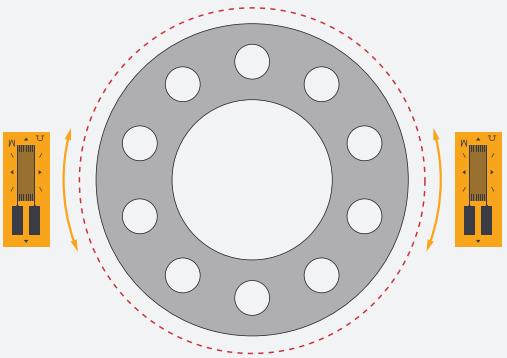
Preload-measuring MJT

The nut bodies of the Superbolt Load-Sensing Tensioner (LST) and the Load-Sensing Flexnut (LSF) are equipped with strain measuring devices that measure the variation of their circumferences, which are proportional to the variation in bolt preload:

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

Patented principle of a smart Superbolt nut

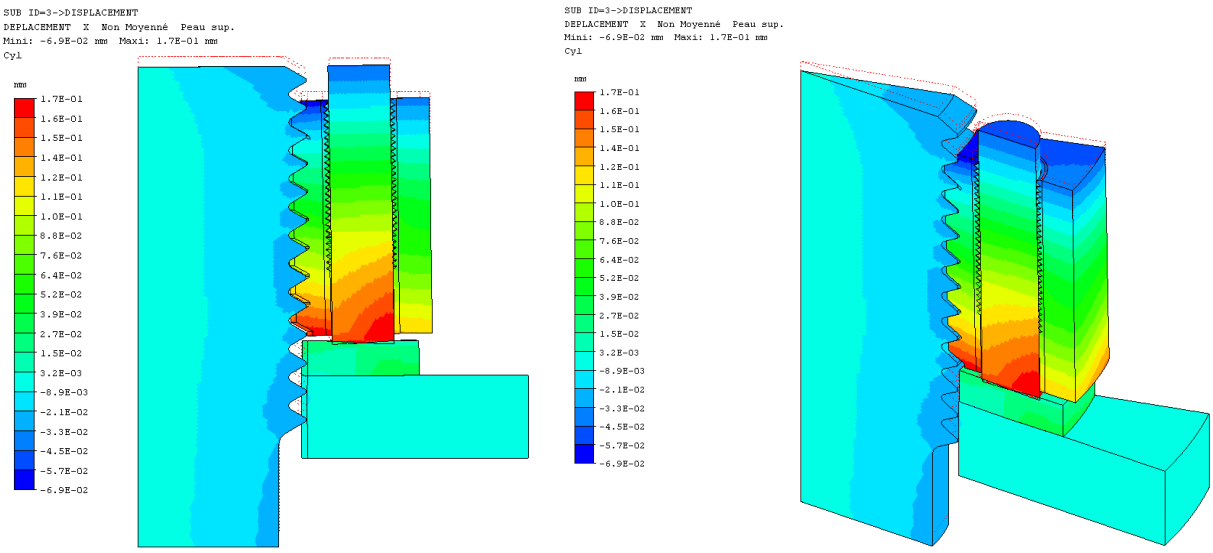




Circumferential deformation is a function of axial bolt load F_b

The principle of a preload monitoring Superbolt MJT or Flexnut 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.

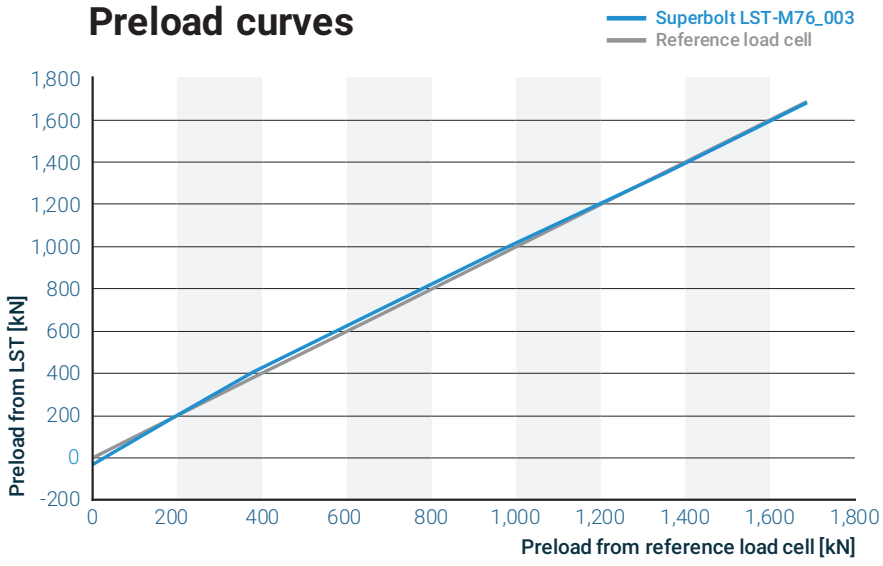


Deflection as shown by finite element simulation to choose optimal location for strain gauges

Note: Superbolt Flexnuts deflect similarly to MJTs.

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:



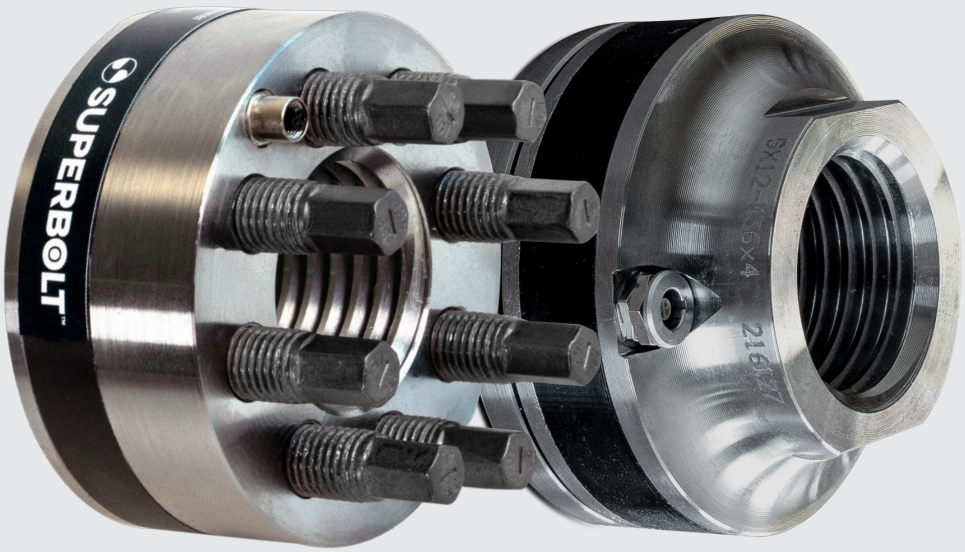
Preload measured by the system versus axial bolt load, example on LST-MT-M76x6/W.

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

Load-Sensing Solutions, both LSTs and LSFs, 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
- Solutions for both active and reactive sides of the joint, allowing for preload monitoring regardless of tightening technique (torque, mechanical tensioning or hydrualic tensioning), preventing stress concentration on the first few threads.



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