James Walker RotaBolt

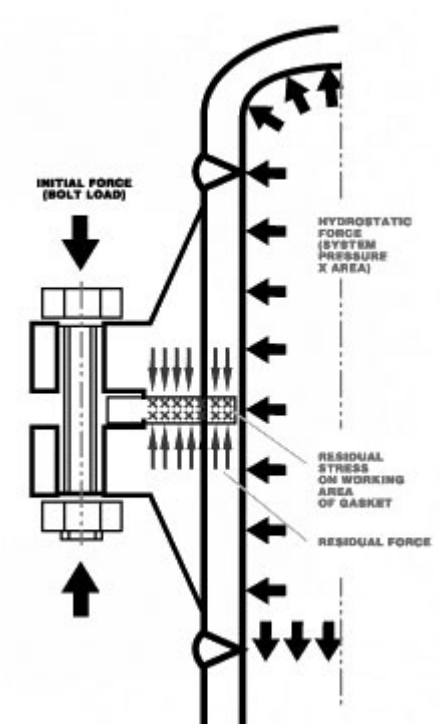
Where RotaBolt works

Over 90% of all bolted joint failures can be attributed to low bolt tension on installation tightening. During traditional tightening, the tension being achieved is unmeasured - it is the tightening force being applied (torque) that is measured. There is no reliable correlation between the equipment tightening power and the residual bolt tension achieved. Achieving and maintaining the correct installed design tension will eliminate failures from fatigue, vibration loosening, structural slip and pressure containment.

The behaviour of a bolted joint, whether it is in an aircraft, car, pressure vessel or a wind turbine assembly, is governed by the same science. Its reliability is dependent on three major parameters…

- Joint design
- Component quality
- Installing bolts to the design bolt tension objective

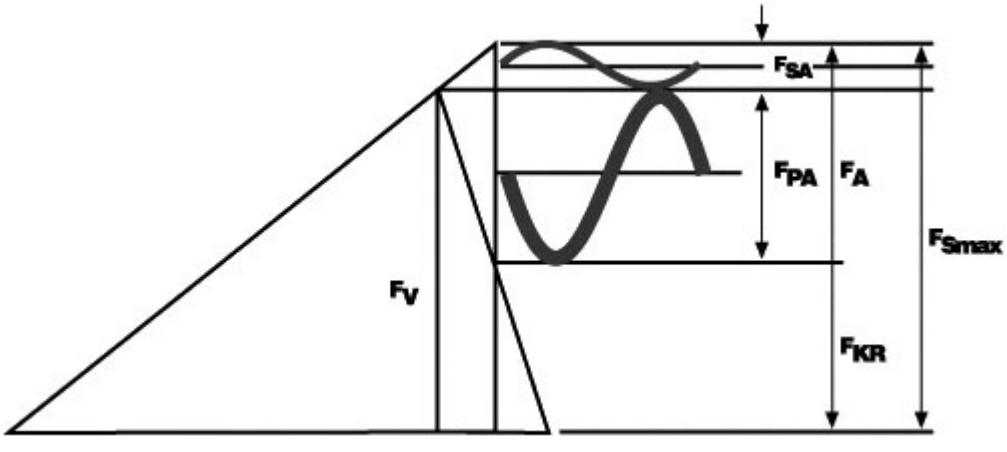
By measuring and assuring all three factors, bolted joint reliability is guaranteed. The investment in assured design, fastener procurement and associated quality is substantial. It has one objective - to deliver the level of bolt tension/joint compression on installation tightening that will assure joint reliability. There is a direct relationship between installed bolt tension and the four common bolt failure mechanisms



Pressure containment leaks

Bolted flanged joints are used to contain internal pressure in pipeline or pressure vessels. The bolt tension developed on tightening creates an equal and opposite compression in the joint which has to withstand the internal pressure trying to open the flanges.

This compression also develops the required gasket seating stress enabling the gasket to seal effectively. With insufficient bolt tension and low joint compression, the internal pressure finds a leak path.



Fatigue

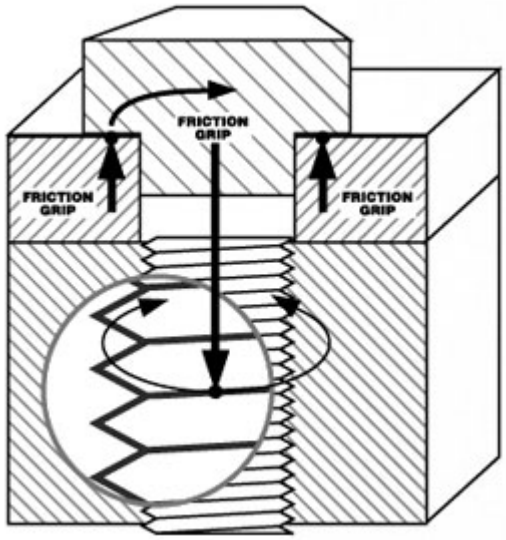
The diagram on the left illustrates the effect of a cyclic, fatigue working load, FA, on a correctly loaded joint, bolt tension FV. The bolt feels only a small proportion of this fatigue load, FSA. If the design is correct, FSA should be lower than the bolts endurance fatigue limit. With a lower bolt tension, the bolt feels more of the fatigue loading thereby increasing the risk of fatigue failure.

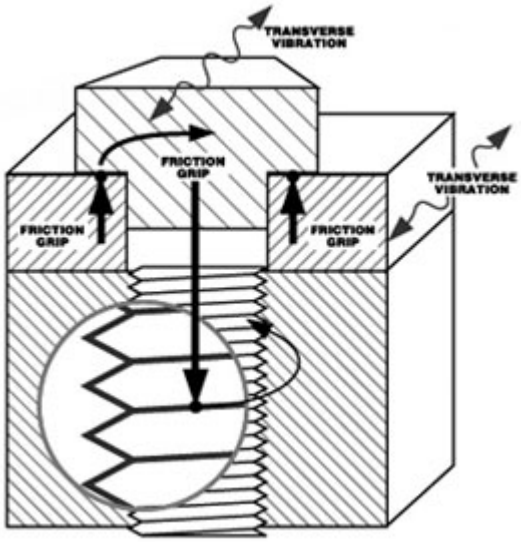
Structural slip

The explanation for this mechanism is the same as in friction grip. Bolt tension develops friction grip in connecting structural members, preventing slippage under service loadings be it static or dynamic.

The bolting type used for this type of connection is commonly called High Strength Friction Grip (HSFG) bolting. Insufficient bolt tension/friction grip increases the risk of structural slippage/failure where the structure slips on to the bolt shank putting it in shear.

Any measuring system needs to utilise Hooke's Law - Stress is proportional to Strain. The system needs to measure stress or strain; bolt load or bolt extension.





Vibration loosening

Bolts can self-loosen when subjected to transverse vibration. Bolt tension creates friction grip in fastener mating surfaces under the bolt head or nut and in the male and female thread interfaces.

In the diagram on the left, with low bolt tension, low levels of friction grip are generated in the bearing interfaces. Transverse vibration overcomes the grip and the bolt will self-loosen.

The loosening process is accelerated by the bolts internal 'off-torque'; the bolt is like a wound spring that wants to get back to its unstressed position. At the correct bolt tension, the developed friction grip resists the transverse shake, it cannot self-loosen and the joint remains reliable.