A New Approach to the Tightness Checking of Bolts

Dr Bill Eccles

A frequent question that is asked relating to bolting is: ‘We’ve just checked a nut that we tightened and it’s well below what we tightened it to just minutes earlier – what’s wrong?’

It’s not widely known that the torque for a newly tightened nut or threaded fastener, in general, is different depending upon whether you attempt to untighten it or tighten it a bit more. Typically the torque needed to untighten a newly tightened fastener is around 10% to 30% less than the torque to tighten it further. When you are tightening a threaded fastener a significant amount of torque is needed to overcome friction in the threads and under the nut face (or the bolt head, if the bolt is rotated). The proportion of the torque that is used to overcome friction depends upon the friction value but is typically in the 85% to 90% region. This is illustrated in Figure one, which shows that when tightening a nut/bolt with a coefficient of friction of 0.12, only about 14% of the torque is used to stretch the fastener producing the clamp load with 86% of the torque being lost overcoming friction. The torque needed to stretch the fastener always acts in the untightening direction and it’s for this reason that the untightening torque is
always acts in the untightening direction and it’s for this reason that the untightening torque is less than the tightening torque.

Figure one

Figure two shows what happens when you tighten, and thenuntighten, a threaded fastener. The tightening torque $T_{On}$ produces a certain clamp force ($F$), it then takes a torque $T_{Off}$ to untighten it. For a newly tightened fastener, $T_{On}$ is greater than $T_{Off}$. If the fastener is left for a prolonged period, changes in friction can result in the untightening torque $T_{Off}$ becoming greater than the original tightening torque $T_{On}$.

Figure two

In many applications the clamping force provided by tightening fasteners is of critical importance in determining the success, or otherwise, of the structural integrity of an assembly.
Importance in determining the success, or otherwise, of the structural integrity of an assembly. A great deal of attention is often placed on ensuring that bolted connections are installed in a controlled manner so that a predictable clamping force is achieved. The most popular controlled method of tightening a threaded fastener is by applying a specific tightening torque. Below the yield point of the fastener, the relationship between the applied torque and the clamp force provided by the fastener, is linear. That is, double the torque and you double the clamp force. Once tightened, the clamp force provided by a bolted connection can decrease. The decrease can occur without any rotation of the thread, as in the case of stress relaxation, embedding, creep and similar effects, or, the bolt or nut may rotate decreasing the clamp force as in the case of self-loosening. Subsequently, concern over the loosening of bolts, in many applications, necessitates quality control measures to check their tightness. Tightness is usually assumed to be the measured torque value but in the majority of applications, it is the clamp force rather than the torque that is the critical factor. The problem is that there is no low cost method of assessing the clamp force provided by a previously tightened fastener. Currently, the tightness of a bolt/nut assembly is usually assessed by a torque based method, the approach is referred to as torque auditing.

From an article featured in Fastener & Fixing Magazine Issue 90 November 2014.

To continue reading this article please head to https://www.boltscience.com/pages/a-new-approach-to-the-tightness-checking-of-bolts.pdf

---

**DID YOU KNOW?**

Stainless steel can unpredictably sustain galling (cold welding). Stainless steel self-generates an oxide surface film for corrosion protection. During fastener tightening, as pressure builds between the contacting and sliding, thread surfaces, protective oxides are broken, possibly wiped off, and interface metal high points shear or lock together. This cumulative clogging-shearing-locking action causes increasing adhesion. In the extreme, galling leads to seizing - the actual freezing together of the threads. If tightening is continued, the fastener can be twisted off or its threads ripped out.
Are you following us on Facebook? Stay in touch with our weekly updates by clicking on the image above.

If you found our newsletter interesting why not share it with your colleagues?
New readers can subscribe using the link here.

Copyright © BOLTSCIENCE 2020

Bolt Science was founded in 1992 by Dr Bill Eccles with the intention of becoming the recognised worldwide quality provider of independent technical expertise in bolted joint technology. Our clients include many of the major engineering organizations of the world. We can help you understand the issues regarding the structural integrity of bolted joints and provide engineering solutions based upon our considerable experience in this field. To this end, we offer analysis software focused on solving bolting problems and online training. For more information please visit our website www.boltscience.com.

Want to change how you receive these emails?
You can update your preferences or unsubscribe from this list.