Award-Winning Bolt Locking System

Jozef Dominik
Ferodom s.r.o..
www.ferodom.com

Bolted joints can loosen when transverse repeated loadings or vibration from internal and external sources are applied to the joints after they are tightened.

The loosening process is accompanied by a gradual reduction of bolt tension and in extreme cases can result in the failure of an important joint. There are many cases, loosened bolts and fasteners have resulted in road accidents involving vehicles, damage to steel structures, equipment failures, etc., all with tragic consequences. One way to effectively prevent the loosening of bolts and fasteners, and related joint failures, is the patented locking system IstLock (IL) from **Ferodom Ltd.**, Žilina, Slovakia. The IL nut received the third place award in the Innovative Product of the Year competition at *Fastener Fair Stuttgart*, in Stuttgart, Germany in 2009.

System Fundamentals

At the heart of the IL nut is a variable locking ring (VLR) made from plastic material (**Figure 1**) or made from soft metal, e.g., copper (**Figure 2**), on the assembling side of the nut, for higher temperatures.

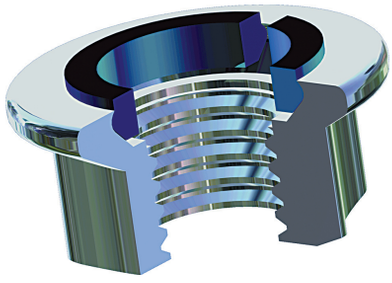


Fig. 1 — Cross section of the IL nut with a plastic locking ring.

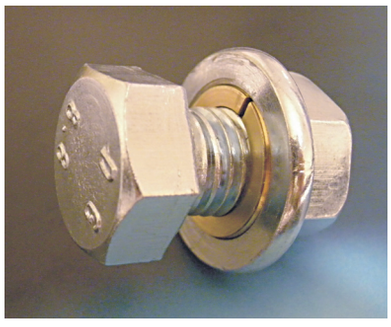
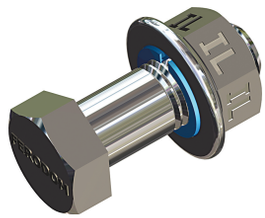


Fig. 2 — IL nut with locking ring made from copper.



IstLock (IL) nut assembly from Ferodom s.r.o.

The VLR overhangs the contact face of the nut by $\Delta k \sim 1$ mm (0.03937").

During assembly, the VLR is forced to reduce its diameter as it is pushed by the radial force F_P to the opposite thread of the screw (**Figure 3**), which provides protection against self-acting release. After disassembly, the VLR automatically returns back to the initial location and is ready to be used again in the assembly. The VLR is capable of repeated use at least five times.

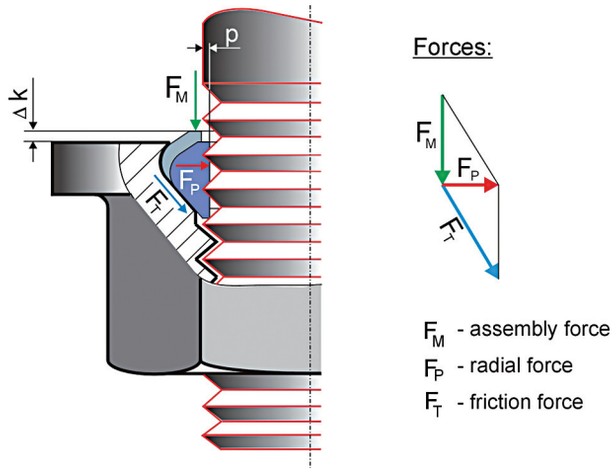


Fig. 3 — IL fundamentals.

Vibration Test

Stability against loosening was monitored by means of the Junker vibration test instrument under following specifications: frequency 12.5 Hz, amplitude ±1 mm on IL zinc-coated flanged nuts *DIN 6923* M16 and compared with self protected nuts with nylon ring *DIN 985*, with standard nuts *DIN 934* and with spring washers *DIN 127*. All tested nuts had tensile strength of 800 N/mm^2. The results of the vibration test are shown in **Figure 4**.

From the information in **Figure 4**, it is seen that during testing, the preload of screw fasteners with IL nuts does not drop below 20%, which is generally considered as the safety threshold. Popular safety nuts with

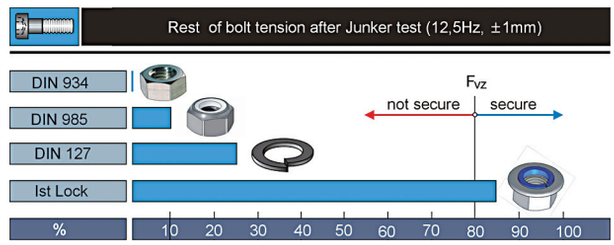


Fig. 4 — Reduction of bolt tension after the Junker vibration test.

nylon rings, *DIN 985*, were found to be unsuitable for maintaining the preload. They prevent the total falling apart of the bolted connection after loosening only. As assumed, standard *DIN 934* nuts showed practically no stability against vibrations and consequently were found to not be suitable for dynamically stressed structural elements. The same is valid for *DIN 127* spring washers. At this point, it should be added that the use of any washers is disadvantageous, because they increase the number of dividing planes with negative effects and also complicate the assembly

Comparison

In a comparison of *DIN 985* nuts versus IL Nuts, the *DIN 985* indicated the following problems:

- *DIN 985* joints are protected against disintegration only, not against decrease of preload.
- Tendency toward limited turn-over of the nut during assembly and disassembly.
- Danger of damage to the nylon plug due to high velocity of assembly and friction coefficient change.
- Temperature dependence.

In the same comparisons, the IL nut indicated:

- Reliable protection of the bolted fasteners against decrease in preload.
- Free turn-over capability during assembly and disassembly.
- Simple disassembling.
- Independence of the whole metallic type from temperature.
- Repeatability a minimum of five times.
- Performance regardless of tightening velocity.
- Contact planes protected from damage.

Nut Types & Materials

The IstLock system can be utilized for all types of standardized (ISO, UNC, BSW, Tr) as well as for nonstandard nuts (**Figure 5**).

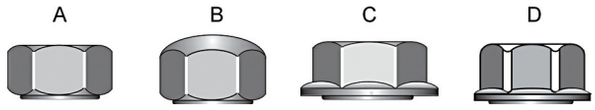


Fig. 5 — Typical types of IL nuts include A - hexagonal nut 0.8 d and 1.5 d; B-hexagonal domed cup nut; C-hexagonal nut with flange; and D-nut with external torx and flange.

Materials include steel grade 5.6, 8.8 and 10.9 stainless steel A2, color metal (Cu, Al, brass) and plastics. Surface treatment is Zn, hot-dip coating with Zn, black. Temperature of VLR made from plastic is 140°C and for VLR made from copper is over 1000°C.

Applications

IL nut applications include dynamically stressed components with bolted joints such as those found in machine tools, grinders, presses, rolling-mills, conveyers, cranes, railway carriages and locomotives, combustion engines, bolt-on fixing of electric motors, pick hammers, road vehicles, aviation and military, structural construction, wind power plants, petrochemical plants, agricultural engineering, sanitary equipment, etc.

More applications include rotating aggregates subjected to vibrations such as compressors and pumps as well as cases where the use of *DIN 985* (*DIN 982*) nuts is insufficient, or where protection methods such as serrated bolts, nuts, washers, wedged safety washers, counternuts and chemical methods are not usable.

Typical examples of IL system applications include flange connections (**Figure 6**), or wind power stations where vital bolt connections (fixing of the rotor and main shaft hub, or bolt fastening of the tower to the concrete foundation base) have to be tested every 500 operational hours. Additional uses include the devices

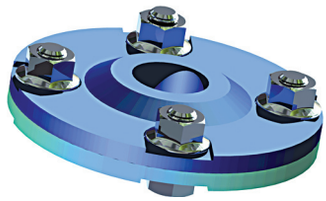


Fig. 6 — Flange connection with IL nuts.

Fig. 7 — Skyline cableway.

for tourist and sports activities such as ski lifts (**Figure 7**). There are many ways of using IL nuts for protection of bolt connections in important structural elements. It is the task of the Designer to select the best solution for his or her structure. *www.ferodom.com*

About the Author...

Jozef Dominik is a Certified Engineer, PhD, who was educated at the **Technical University VŠB Ostrava (CZ)** and achieved an academic degree at **Technical University Žilina (SK)**, with specialization in physics of solids and ultimate state of materials. His career includes the position of Metallurgist at **ZTS Martin**, 25 years at the **Research Institute of Antifriction Bearings Parts VURAL Žilina** as the Heat Treatment Department Chief and 10 years at **Bossard AG Schrauben, Swiss**. Currently, Dominik manages his own company, **FERODOM, s.r.o.** and together with Technical University Žilina, he is participating in the development of new fastening elements with higher utility features. **www.ferodom.com**