Fastenal's engineering team is available to help you with your joint designs and fastening needs around the world. We are here to educate, trouble shoot, and provide general support to our current and future customers. This and other fastener related articles can be found at www.fastenal.com. Email engineer@fastenal.com for further assistance or to schedule a meeting.

Nylon Insert Lock Nuts – Nylon Pushing Out or Fracturing

Complaints about nylon fasteners (including cable ties and nylon insert locking nuts) are common in the fastener industry. These complaints primarily occur in winter when the climate is cold and dry. The focus of this article will be nylon insert lock nuts.

Why does nylon's mechanical properties change in cold and dry climates?

Nylon is *hygroscopic*; this is the technical term for being moisture sensitive. Functionally, this means the water content in nylon influences its mechanical properties. As water content increases, the flexibility and toughness of the nylon increases. Additionally, as water content increases, the glass transition temperature decreases, i.e., the nylon will still have good ductility at lower temperatures. As the water content decreases the nylon will be stronger and stiffer and the glass transition temperature will rise. Nylon will change geometry based on the water content; as water content increases the nylon will swell. More can be learned about conditioning nylon in BASF Corporation's published paper titled *Effects of Moisture Conditioning Methods on Mechanical Properties of Injection Molded Nylon 6*.

What happens to a cold and dry nylon insert lock nut when installed?

Dry nylon will act more brittle, have smaller dimensions, be harder and stronger, be less malleable, and have a higher glass transition temperature. These factors combined with cold temperatures decrease the ease of assembly. While some dry nylon insert lock nuts are simply difficult to install, others experience nylon rings extruding/pushing out (Fig 1), or chipping after installation (Fig 2). Sometimes the nylon will simply be displaced or ejected as the nut is run down the external threads (Fig 3).

Figure 1: Temperatures hovered just under freezing when these 7/16"-20 stainless steel nylon insert lock nuts were installed. Date & location: January 2017, Ohio.

Figure 2: The nylon rings in these 1”-14 Grade N2 nylon insert jam nuts cracked and split when engaging the external threads. Date & location: January 2018, Washington.

Figure 3: Ejected nylon rings from a 1/2"-13 stainless steel fastener. Date & location: January 2018, Maryland.

In a typical installation of a nylon insert lock nut, some amount of nylon displacement is expected (see Figure 4). The amount of nylon that is displaced depends on nylon ring geometry, thread tolerance of the external threads, size of cavity holding the nylon ring, and more.

Figure 4: Nylon completely fills the cavity and fully engages the threads. Excess nylon flows out the top of the nut.

Even conforming fasteners can have problems with nylon

Inch series nylon insert lock nuts are produced in accordance with ASME B18.16.6. This specification defines performance requirements and mechanical properties for these types of nuts at room temperature. ASME B18.16.6 also defines the geometry and finish required on the *external threads* used for nut performance testing. Perhaps the most unique aspect is the external threads required finish, which is zinc phosphate and oil according to Grade D of ASTM F1137. When nuts are submitted to a laboratory for testing, samples are tested in a room temperature environment, with special external threads, and installed with hand tools or other slow speed tools. Nylon insert lock nuts that experience field issues, most often, pass all tests in accordance with ASME B18.16.6.

How can you prevent displacing the nylon?

Relative to the quantity of nylon insert lock nuts used, the amount that have problems during the cold and dry winter months is quite low. Nonetheless, if problems are taking place then there are a few things that can be done to help prevent reoccurrences:

1. *Slow down the installation speed*. Impact tools should be avoided. Variable speed drills or hand tools could be used to permit the nylon more time to plastically flow against the external threads.
2. *Keep parts warm*. There is a glass transition temperature for all nylons. If parts are warmer, the less glassy they will act, i.e. the more ductile they will be.
3. *In certain instances*, it may be worth employing preservation tactics such as FIFO inventory systems, sealed packaging, etc.

If the nylon related issue simply cannot be prevented, or, the application will be in dry and/or cold environments, please contact Fastenal Engineering (engineer@fastenal.com) and ask what alternative lock nut solutions are available.