Thread Nicking

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Occasionally the customer will find problems assembling the nut onto his bolt no matter how careful the manufacturer is with trying to avoid this problem. Fasteners used for manufacturing assembly are less likely to be rejected for thread nicks than the MRO (Maintenance and Repair Operations) user. It's not only how the fasteners are made but their expectation of how easily they should be assembled.

Manufacturing assembly needs only to have the bolt or nut start so the power wrench can continue the tightening operation. A maintenance mechanic would like to spin the nut to the work surface by hand so he may finish the installation with a hand wrench. Neither of these conditions is practical. However, **there are several factors that affect their ease of use during assembly or disassembly: thread nicks and coating thickness.**

Depending upon processes, procedures and handling, I have counted as few as 12 to over 20 opportunities to create a thread nick during the manufacturing, handling and transportation of the fasteners. Additional factors include the size and weight of the fastener and, of course, **fine threads are the most susceptible to nicking and flattening of the thread crest with large diameter products. Packaging and shipping add other opportunities for creating thread nicks.**

Many fastener manufacturers employ a spring-loaded platform under their tote bins to minimize the drop distance from where the bolts are ejected from the thread rollers. Others use shallow bins. Either way, the soft, non-hardened bolts are still dumped from the bolt making machine's container into other containers to be delivered to the heat treating ovens.

There are two common types of heat treating methods, batch and conveyor. Both have their advantages and disadvantages. I conducted a study at one facility that operated both types and found that for our purposes, **Grade 5 bolts had fewer thread nicks processed through the batch ovens. The fasteners travel through the long heat treating ovens in a single large wire container for the batch method and never move against each other. The conveyor method will dump the soft fasteners onto a conveyor where the parts will strike against each other again.**

Heavy equipment manufacturers will commonly use black, non-coated fasteners because the finished product is painted in corporate colors that will afford the corrosion protection needed. Due to normal thread tolerances, most minor thread nicking will go unnoticed during assembly.

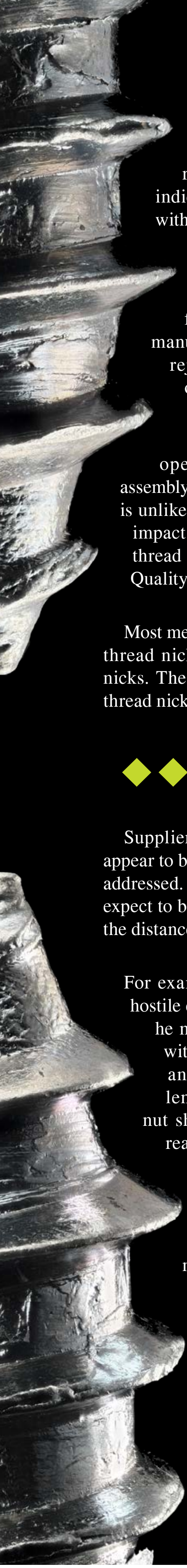
However, unplated bolts do not store well unless heavily oiled. Too much oil makes it unsuitable for handling, but bolts used in manufacturing do not sit idle for very long.

Phosphate coatings will facilitate painting and provide modest corrosion protection in humid environments. The buildup is minimal and produces negligible interference between threads. The lubricating effect of the coating will aid assembly and decrease any galling from heat treat scale.

The automotive industry has specified more organic dip and spin coatings for their applications than electroplating. Virtually all MRO fasteners are zinc plated. Regardless of the coating type, the extra thickness has the potential to create an interference fit with its mating part. This will cause inconsistent assembly torque and result in lower clamp loads.

Nut over tapping and the design of other mating joint components have increased the use of organic coatings. The coatings are pliable enough that thread nicks have not been a problem. Electrodeposits can make minor nicks worse. This is because of the thread crest's proximity to the anode; it receives more metal deposit than the thread root. The amount of fasteners dumped into a plating barrel and whether it rotates or rocks will also determine if the thread crests are left rounded or will be abraded to a truncated form.

Quality personnel will check either the plating thickness or thread tolerance with gauges. Thickness can only be measured on large surface areas, like the hex flat of a nut or bolt head or the bolt's shank. It does not give any indication about the intended functionability of being able to be threaded into a mating finished component.



In this case, ring and plug gauges are effective. Tri-roll thread gauges will provide more useful data and indicate any thread anomalies. However, the litmus test is with the end user.

Few manufacturers or distributors employ any method of testing for torque, yet this is the condition for which the fasteners will be used. All automotive manufacturers and the IFI have developed acceptance and rejection criteria for the amount of torque required to overcome any thread nicking.

Manufacturers, and those performing mass assembly operations, use a variety of automatic tools to speed assembly. The most common is a low torque speed wrench, which is unlike the high speed and high torque of its larger brother, the impact wrench. The small wrench would stall if the nicks or thread interference is sufficient. If a certain AQL (Acceptable Quality Level) is exceeded, the lot is rejected.

Most mechanics will find it impossible to overcome an acceptable thread nick by hand using the IFI or automotive guidelines for nicks. The main difference is perception, usability and excessive thread nicking, or power tool assembly verses MRO hand assembly.

◆◆ Customer Expectations ◆◆

Suppliers must realize that while some customer complaints appear to be nit picking, many have genuine concerns that should be addressed. As many value-added distributors have found, customers expect to be able to thread the nut onto the fastener by hand at least the distance equivalent to the nut thickness, plus one or two threads.

For example, if a customer is working high overhead or in a hostile environment, he expects the parts to assemble quickly so he may finish as quickly as possible and not have to return with another hand full of fasteners. It is unreasonable for any customer to expect to thread a nut along the entire length of the bolt. Outside of a shear application, the nut should never be that close to the thread run-out. It is reasonable to expect to fully engage the entire threads of the nut.

What becomes frustrating to users is that some nuts will engage on the fasteners while others will not. Much of this is caused by the electroplating. The first thread of the nut is an incomplete thread and receives a larger amount of plating than the inside. This is due to the 'throwing power' of the plating chemicals in relation with the current density and geometry of the part.

Many times, if the nut was reversed and threaded onto the fastener again, the nut will thread on easier.

These thread nicks and the inability to easily engage a nut onto a bolt will continue to plague a distributor because the nuts and bolts are all made by and plated by different manufacturers. Then, the customer continually replenishes his fastener bins with new products from different batches which may be of differing coating thicknesses, and then the problem begins again.

This is where a good understanding of product expectations and practical reality needs to be communicated and agreed upon between purchaser and seller.

In 1968 the Industrial Fasteners Institute (IFI) issued the 'Recommended Practice' IFI-105. Paragraph 4.10 stated; "Nicks and gouges located in the threaded length are permissible discontinuities providing the proper GO thread gage will assemble on the thread with the application of not more than 12 times D in.-lbs. of torque, where D is the nominal bolt or screw size in inches. Nicks and gouges in other locations are permissible discontinuities. The manufacturer shall exercise due care during the manufacture and handling of bolts and screws to minimize the number and magnitude of nicks and gouges."

The Society of Automotive Engineers (SAE) issued the 'Recommended Practices' SAE J1061 and J123 in 1973. Both of these SAE documents contain paragraphs on thread nicks which are essentially the same as the IFI-105.

In reality, the industry has never been able to comply with the 12 x D in.-lbs. criteria. The torque values for rejection are so low that even very slight and clearly insignificant thread nicks could make a perfectly usable screw rejectable.

Tests have been conducted to prove that if a manufacturer's lot of large sized cap screws did happen to make it through thread rolling, heat treatment and plating with no more than 12 x D nicks, it would not be in that condition after shipping to the customer, unless each fastener had its threads individually protected.

The ASTM (American Society for Testing and Materials) issued the standard practice F788 in 1982. It states: "Nicks, gouges, dents and scrapes are permitted, provided that the functionability of the product is not impaired."

This statement was a major step towards product acceptability as it regarded the user and his ability to engage enough threads to sufficiently start and hold the nut until the assembly could be completed with either a hand or power wrench until the proper preload could be achieved.

In the 6th edition of the Fastener Standards Handbook, published by the IFI in 1988, the IFI-105 was withdrawn. It was superseded by SAE J123 and J1061, as well as, the ASTM F788. ■