Thread Depth of Engagement is Crucial to Joint Safety

By Joe Greenslade

Much emphasis has been placed on thread quality in recent years. Most discussions and much controversy focuses on the measurement of the pitch diameter. A few contend that the pitch diameter is "all important" in determining the quality of a thread. The experience of many thread experts, though, suggests that the accuracy of the major diameter of the external thread and the minor diameter of the internal thread has more to do with fastener safety than does their pitch diameters.

In mating threads, the over-lapping of the major diameter of the external thread and the minor diameter of the internal thread is called the "depth of engagement". The proper sizes of the major diameter of external threads and the minor diameter of internal threads are essential to assure the most critical aspect of product quality, which is the assurance of safety. All other thread characteristics can be perfect, but if either one of these two is out of tolerance, the joint made by these threads may be unsafe.

It is a rule that when a joint has been properly designed, the external thread should always break in tensile when the joint is placed under stress instead of either the external or internal thread shearing or stripping out. Many mathematical and performance studies on standard commercial fasteners have shown that the external thread tensile failure will occur provided the major diameter of the external thread and the mating minor diameter of the internal thread are within their proper limits of size. The actual pitch diameters of the mating threads seem to have little, if any effect on occurrence of the desired mode of failure.

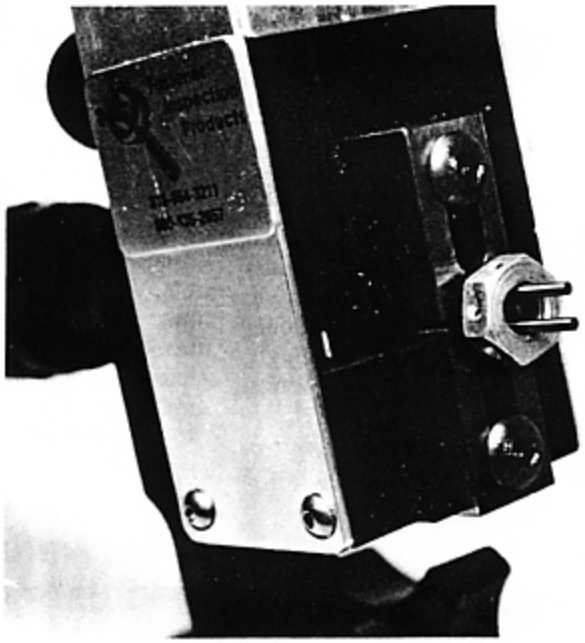

Figure 2. *Measuring internal thread minor diameter with "VARIMINOR" fingers on a variable thread gage.*

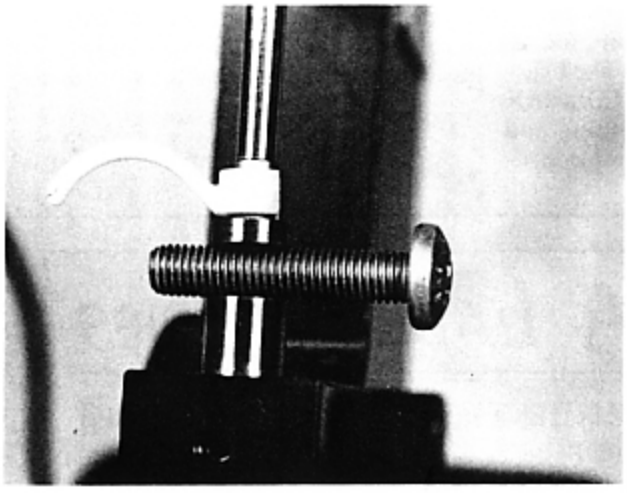

Figure 1. *Measuring external thread major diameter with a "MAJORGAGE."*

The accurate measurements of these two thread characteristics are easy to measure with very little cause for disagreement. The major diameter of external threads can be measured with simple instruments such as micrometers or variable gages such as the "MAJORGAGE." (See Figure 1.) These instruments should read in .0001 inch increments because all thread specifications for this characteristic are taken to four decimal places. In thread and gage standards, ANSI/ASME B1.3M-1986 and ANSI/ASME B1.2-1983, these types of gages are designated "Gage 5.1 for external threads".

The minor diameter of an internal thread is easy to measure with inside diameter micrometers or with "VARIMINOR" fingers mounted on variable inter-

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Joe is an inventor, author, and lecturer. He holds eleven U.S. Patents, has written over 80 technical articles for industrial trade journals, and has spoken frequently at trade association meetings and technical conferences on issues related to industrial quality for the past ten years.

He is an Associate Member of the Industrial Fastener Institute and a member of the American Society of Mechanical Engineers B1 Thread Specification Committee. In 1992, Joe was recognized for his technical and innovative contributions to the fastener industry when, at age 44, he became the youngest person to be inducted into the National Industrial Fastener Show "Hall of Fame."

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nal thread gages. (See Figure 2. on page 78) The ANSI/ASME illustration (See Figure 3.) for "Gage 5.2 for internal threads" shows the contact members of the measuring instrument must be round. This is required for the gage to provide accurate measurements. These gages should read in .0001 inch increments because the minor diameter of internal threads is also specified to four decimal places.

The ANSI/ASME thread committees have recognized the importance of controlling these two characteristics by making their inspection a requirement in all three designated inspection systems: Systems 21, 22, and 23. The only other thread characteristic requiring inspection in all three systems is the functional diameter. The military thread specifications MIL-S-7742 and MIL-S-8879 also require the inspection of these characteristics in all designated levels of inspection.

The importance of the major diameter of the external thread and the minor diameter of the internal thread should not be ignored or under valued in any fastener quality program. These characteristics, above all others, are essential to product safety. ❑

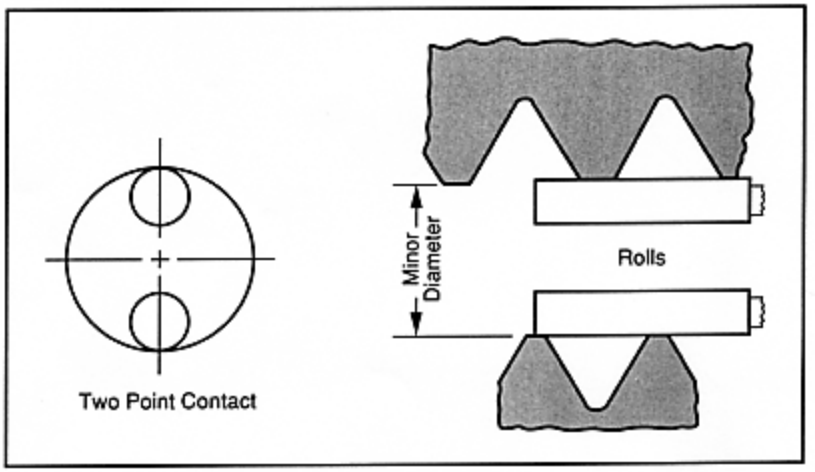

Figure 3. *ANSI/ASME B1.2-1983, an American National Standard.*

Meet the Author

Joe Greenslade will be moderating a panel discussion on P.L. 101-592 at the National Industrial Fastener Show and Conference in Columbus, Ohio on Monday, May 24 from 10:00 - 12 noon, in Rooms 110 and 112.

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