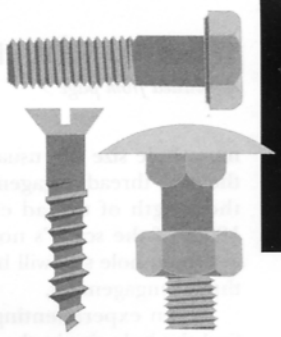
Thread Rolling Screws Must Be Driven Into Properly Sized Holes to Perform Appropriately



by Joe Greenslade

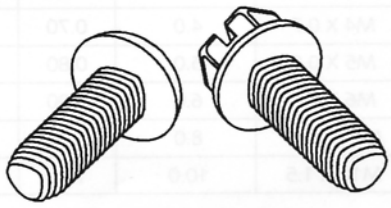
When applying thread rolling screws it is highly critical that the installer use the appropriate hole size in the application. If the hole size is too large, the screws will strip out, and if the hole sizes are too small, the screws may twist in two before they are seated. Only the correct hole size range will provide an effectively assembled joint.

The American Society for Mechanical Engineers (ASME) provides extensive application hole size information for tapping screw types A, AB, B, BF, BT (25), C, D (1), G, and T (23) in Tables 1 through 6 in Appendix B of ASME B18.6.4. Every supplier of these types of screws should familiarize themselves with the content of these tables to help users with proper hole size selection.

Unfortunately, no such information is available from any of the industrial standards and specifications for the application hole sizes for thread forming screws such as LO-DRIV®, TAPTITE®, Swageform®, Rolok®, Tap-R®, etc. When users request information on hole size selection, the supplier must rely on the sales literature from the manufacturers of the specific brand of thread rolling screw they are supplying. In recent years many thread rolling screws have been introduced into the fastener supply chain for which hole size information is not readily available.

THREAD ROLLING SCREW APPLICATION HOLE SIZES CAN BE CALCULATED

The specifications for thread rolling screws can be found in IFI-112, SAE J81, and SAE J1237. The only hole sizes referred to in these documents are those for use in testing the screws. These are NOT application hole sizes. These hole sizes were selected to stress the screw's threads beyond what they will be expected to experience when they are properly installed. Tables 1 and 2 are for guidance in application hole size selection for inch and metric thread rolling screws.



These hole sizes are calculated using a formula developed by the manufacturers of thread rolling taps for the pre-tap hole sizes for the application of their taps. The formula is as follows:

Hole size formula =
major diameter – (.0068 x % thread depth) / TPI
(note: % thread engagement is whole number)

Example: 10-32 at 65% thread engagement:

10-32 hole size =
.190 – (.0068 X 65) / 32 = .176

IDEAL HOLES SIZES SHOULD BE DETERMINED BY EXPERIMENTING

The ideal hole size for a thread rolling screw is that hole size in which the application's mode of failure is the breaking of the screw after it is seated and where the torque required to drive the part down to the point of seating is at its minimum. The way to establish this ideal hole size for a particular application is to perform some experiments by drilling various hole sizes in the exact application and driving screws into them to determine how the screws perform in the various hole sizes. Hole sizes between 65% and 80% thread engagement will usually yield the optimum hole size. Generally speaking, the shorter the length of thread engagement the smaller the hole size that will perform best. If the length of thread engagement is 50% or less of the screw's nominal diameter the opti-

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Table 1.

Inch Thread Size	Major Diameter	TPI	Hole Size (inches) % Thread Depth Engagement			
			65%	70%	75%	80%
2-56	0.086	56	0.078	0.078	0.077	0.076
3-48	0.099	48	0.090	0.089	0.088	0.088
4-40	0.112	40	0.101	0.100	0.099	0.098
5-40	0.125	40	0.114	0.113	0.112	0.111
6-32	0.138	32	0.124	0.123	0.122	0.121
8-32	0.164	32	0.150	0.149	0.148	0.147
10-24	0.190	24	0.172	0.170	0.169	0.167
10-32	0.190	32	0.176	0.175	0.174	0.173
12-24	0.212	24	0.194	0.192	0.191	0.189
1/4-20	0.250	20	0.228	0.226	0.225	0.223
5/16-18	0.312	18	0.287	0.286	0.284	0.282
3/8-16	0.375	16	0.347	0.345	0.343	0.341

Joe Greenslade has been active in the fastener industry since 1970. He has held positions with major fastener producers in sales engineering, marketing, product design, manufacturing management, and research and development management.

Mr. Greenslade holds twelve U.S. patents on various fastener related products. He has authored over 136 trade journal articles on fastener applications, manufacturing and quality issues. He is one of the fastener industry's most frequent speakers at trade association meetings and conferences. He is the youngest person ever inducted to the Fastener Industry Hall of Fame.

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mum hole size will usually be in the area of the 80% thread engagement hole size. When the length of thread engagement reaches 100% of the screw's nominal diameter, the optimum hole size will be in the area of 65% thread engagement.

When experimenting, the objective is to find the hole size in the application that provides the greatest difference between the amount of torque required to generate the thread and the torque required to fail the application. When the length of thread engagement is less than the distance equal to one screw nominal diameter the mode of failure is frequently thread stripping instead of screw breaking. In those applications the objective of testing various hole sizes is to discover the hole size that will result in the greatest difference between the driving torque and the stripping torque.

WAX AND TORQUE-ROBBING NIBS CAN EFFECT SCREW PERFORMANCE

Wax and torque-robber nibs should be considered when a wider spread between drive torque and failure torque is required in a particular application. The addition of wax to the screw's finish will lower driving torque. Caution must be exercised when adding wax because it may also lower the stripping torque. Wax works great when the screw driving torque drops and the length of thread engagement is enough to maintain the mode of failure of screw breaking instead of screw stripping.

When low screw stripping torque values are a problem the addition of torque-robbing nibs can increase the stripping failure value as much as 100% in many applications. The only caution in the use of nibs is that the surface under the screw heads will be marred. If surface marring is objectionable in the application nibs may not be applicable.

Table 2.

Metric Thread Size	Major Diameter	Pitch	Hole Size (mm) % Thread Depth Engagement			
			65%	70%	75%	80%
M2 X 0.4	2.0	0.40	1.83	1.82	1.80	1.79
M3 X 0.5	3.0	0.50	2.78	2.76	2.74	2.73
M3.5 X 0.6	3.5	0.60	3.24	3.22	3.20	3.18
M4 X 0.7	4.0	0.70	3.68	3.65	3.63	3.61
M5 X 0.8	5.0	0.80	4.65	4.62	4.60	4.57
M6 X 1.0	6.0	1.00	5.55	5.52	5.48	5.45
M8 X 1.25	8.0	1.25	7.45	7.41	7.36	7.32
M10 X 1.5	10.0	1.50	9.34	9.29	9.24	9.19

HOLE SIZES FOR THREAD ROLLING SCREWS MUST BE CORRECT TO ACHIEVE EFFECTIVE USE

The use of thread rolling screws is a very effective way to lower assembly costs in many applications, but their application can be a complete failure if the correct hole size is not used in the assembly piece receiving the screw. By using the chart and/or formula shown above thread rolling screws can be very effectively applied in a broad spectrum of industrial applications. ■