Manual screwcutting: the ins and outs

To help with the process of screwcutting threads on or into metal while working on practical metalwork coursework, we have put together this quick "one stop shop" guide. It contains need to know information on cutting internal threads using taps. In a future bulletin, we will look at how external threads are made.

As with most metalwork or engineering processes, whole books can be written on the subject, but let's look at the basics...

The screwthread is a very important aspect of engineering. It is used to hold parts together (e.g. bolt and nut) and to transmit power (e.g. vice screw). A screwthread is really a helical spiral which is specified by:

1) The name or type of thread system;
2) The size of thread major diameter;
3) The series. (coarse pitch, fine pitch, etc.)

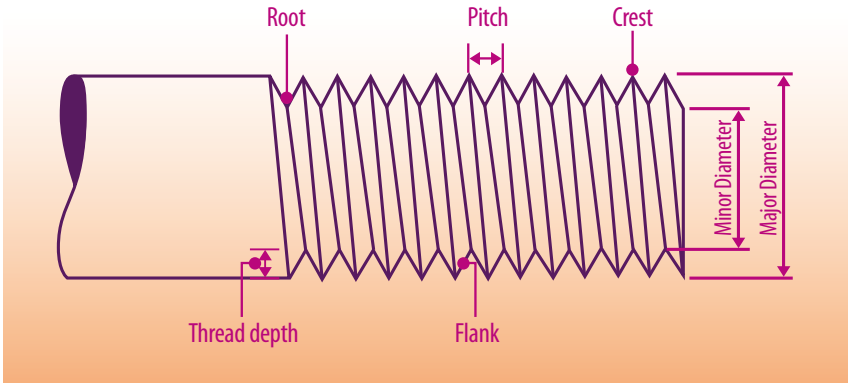

Figure 1 *- Screwcutting terminology.*

Thread forms - ISO Metric screwthreads

International Standards Organisation (ISO) metric screwthreads are a range of threads that have been approved by the British Standards Institution. ISO metric threads may be either Coarse or Fine series (or pitch). The ISO metric coarse range of threads covers most of the work undertaken in industrial and school workshops and, as such, is called "ISO Metric". This range is designated by the letter M followed by the nominal diameter and the pitch (both in millimetres):

e.g. M6 x 0.75
i.e. nominal diameter 6 mm and pitch, 0.75 mm.

e.g. M6 x 1
i.e. nominal diameter 6 mm and pitch, 1 mm.

when a coarse thread is intended it is usual for the pitch not to be indicated. Thus M6 x 1 can be shown simply as M6.

Other thread forms

There are a number of other thread forms available. ISO Unified Threads are also recognised by the British Standards Institution and like ISO Metric threads, have a range of both coarse and fine pitches. Unified threads are based on imperial dimensions and are designated by a fraction of an inch followed by UNF (Unified Fine) or UNC (Unified Coarse). For example, 1/4" UNF or 3/8" UNC. Older thread forms such as BSW (British Standard Whitworth, BSF (British Standard Fine) and BA (British Association) have been superseded by the ISO Metric and ISO Unified threads. However, as many of these threads exist on various equipment and machinery, they are still available.

Taps

An internal screwthread is cut, in a previously drilled hole, using a tap. Taps are made from high speed steel screwthreaded and fluted to form cutting edges. The ends of their shanks are square to enable the tap to be held securely in a tap wrench.

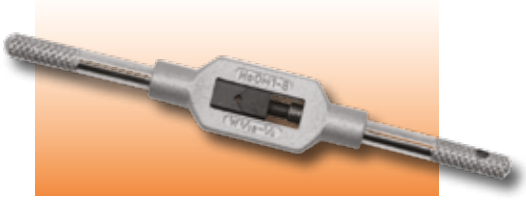

Figure 2 *- Tap wrench.*

Taps are available in sets of three and are used in the following order:

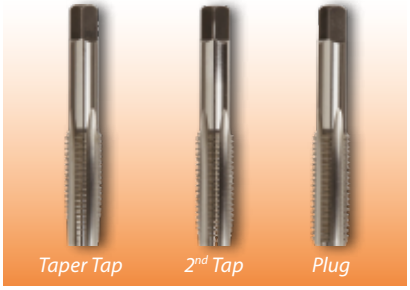

Figure 3 *- Threading taps set,*

Tapping an internal thread

For example, to tap an M8 thread a core hole must be drilled using a 6.8 or 6.9 mm diameter tapping drill. The taper tap must then be started with its axis parallel to the centre line of the hole; if not a "drunken" thread will result (see Figure 4 and 5).

Figure 4 *- To cut an internal thread the taper tap must be used first.*

Figure 5 *- Even and square pressure must be applied to initially start the cut.*

As soon as the tap cuts it should be checked for alignment with an engineer's square.

The tap should be turned clockwise half a revolution to cut the thread and back a quarter turn to clear the swarf (see Figure 6 and 7) This is followed by a second or intermediate tap which is tapered for the first few threads only.

Figure 6 *- Tap wrench is turned clockwise half a revolution.*

Figure 7 *- Tap wrench turned back quarter of a turn to break and clear the swarf.*

Finally, the plug or bottoming tap is used to cut the full thread (see Figure 8). A cutting oil or compound should be used to lubricate the work as the thread is being cut. This will prolong the life of the tap and allow for an efficient cutting action which in turn produces better quality threads.

Tapping sizes

Table 1 gives all the information required when tapping a metric hole from M2 to M12.

Broken taps

Broken taps always present a problem as there is rarely enough tap left protruding for easy extraction with pliers.

A tap extractor (see Figure 9) could be used. However if this fails then other means must be found. For example, it is sometimes possible to punch the tap out from the other side, or it may become loose enough for extraction when heated. The tap could be annealed by heating after which it might be possible to drill it out.

Figure 8 *- Once complete, the 2nd and plug tap should be used to fully cut the thread.*

ISO Metric Coarse Pitch Threads		
Diameter	**Tapping Drill Size**	**Clearance Drill Size**
2	1.6	2.2
2.5	2.1	2.7
3	2.5	3.2
3.5	2.9	3.7
4	3.1	4.3
4.5	3.8	4.8
5	4.2	5.3
6	5.0	6.4
8	6.8	8.4
10	8.5	10.5
12	10.2	13

Table 1 *- Tapping & clearance sizes.*

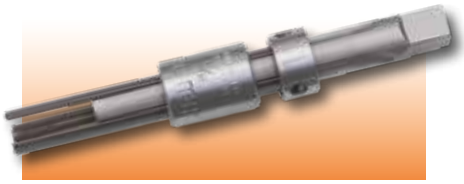

Figure 9 *- Tap extractor.*

Check out the video link!

http://www.sserc.org.uk/images/Technology/Video clips/General Bench Skills/internal threading.mp4