PRESTO INTERNATIONAL UK LTD

TRAINING MANUAL

Part 4

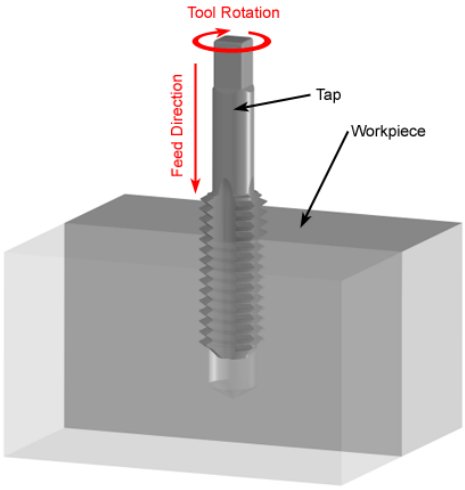
TAPS & DIES

Definition of a tap:-

" a rotary cutting tool having two or more cutting teeth and having two or more helical (spiral) or straight flutes for the passage of chips and the admission of cutting fluid"

The function of a tap

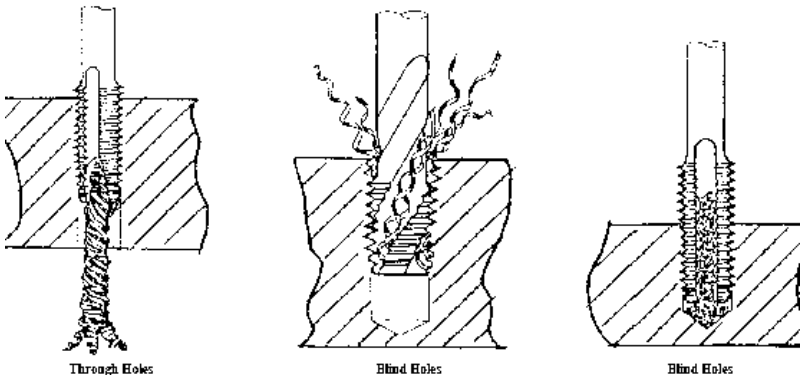
A tap removes material from a pre-drilled hole, that has been drilled to the correct size in relation to the tap, to produce a thread. Tapping drill sizes are stated in the "PRESTO COUNSELLOR)
The threads are used in conjunction with screws or bolts to hold two pieces of material together.



How taps are used

When tapping, the tap usually rotates and the workpiece stays stationary. This is not always the case as in some production environments, the workpiece rotates and the tap is stationary.
Tapping is performed by a combination of forward and rotary movement.
When the threaded hole is complete, the tap is removed by reversing the direction of rotation, preventing the thread from being damaged or broken.

How taps cut



The cutting edges, which can be found at the front of the tap, remove the material. The material, or chips, are stored in the flute of the tap, or are pushed forward in front of the tap, or are drawn up along the flute, removing it from the pre-drilled hole.

Tap Materials

Taps are made from Carbon Steel, High Speed Steel or now from Solid Carbide, for both hand and machine use.

Tap Specifications

When determining the specification of a tap, the following information is required.

DIAMETER	e.g. Metric or Imperial (inch)
THREAD FORM	e.g. UNC or UNF or MM
STYLE	e.g. Straight or Spiral Point or Spiral Flute
LEAD (Where applicable)	e.g. Taper or Second or Bottom (Plug)

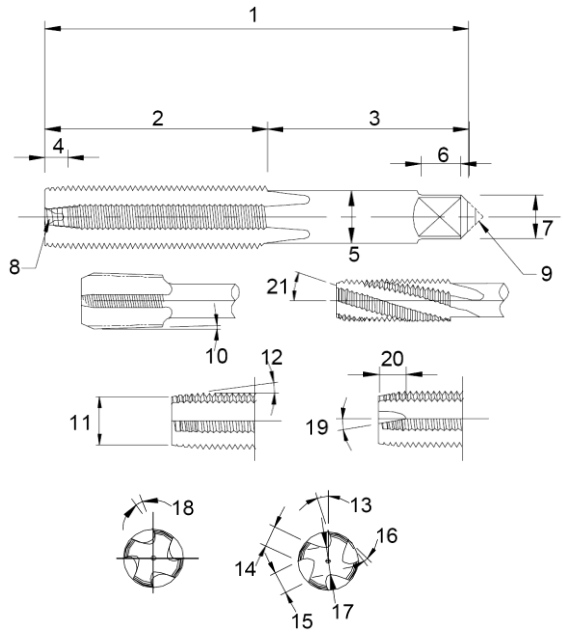
Thread Forms

The most common thread forms are:-

Metric Coarse	M
Metric Fine	MF
Unified National Coarse	UNC
Unified National Fine	UNF
British Standard Whitworth	BSW
British Standard Fine	BSF
British Association	BA
British Standard Pipe Taper	BSPT Rc
British Standard Pipe Straight	BSPF G

Other Less common thread forms are available.
DIN taps are almost all Metric or Metric Fine threads with some Pipe threads

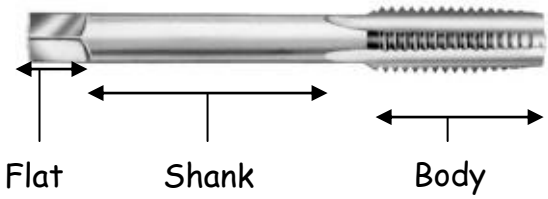
Tap Elements

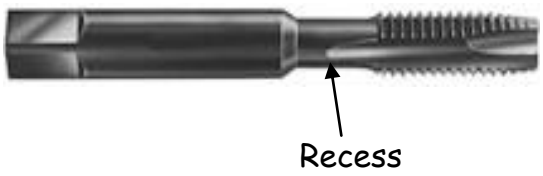


1. Overall Length
2. Thread Length (Including Chamfer)
3. Shank Length (Including Square)
4. Chamfer Length
5. Shank Diameter
6. Length of Driving Square
7. Size across flats of square
8. Internal Centre (Female)
9. External Centre
10. Back Taper
11. Point Diameter (Chamfer)
12. Chamfer Angle
13. Rake Angle
14. Width of Land
15. Width of Flute
16. Radial Thread Relief
17. Web Diameter
18. Spiral Point Rake Angle
19. Spiral Point Angle
20. Spiral Point Length
21. Angle of Spiral

The diagram shows the basic elements of a standard tap.
Taps are made up of two basic parts, the body(thread) (2), and the shank (3).

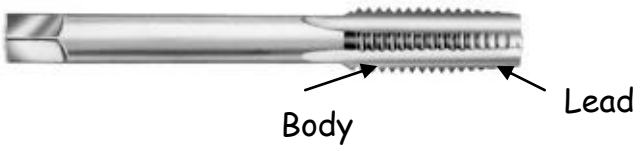
Tap Elements – Shank

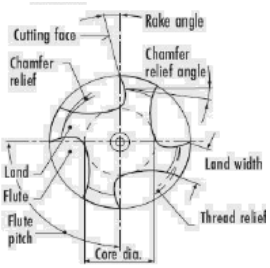




The shank is the part of the tap that fits in to the tap holder. The end of the shank is made square for driving and rotating the tap. The surfaces of the square are known as the "flats"
The part of the shank above the flats can be manufactured straight or incorporate a recess which would be visible just before the flutes. This design generally provides better lubrication and makes tapping easier in deeper holes.

Tap Elements – Body

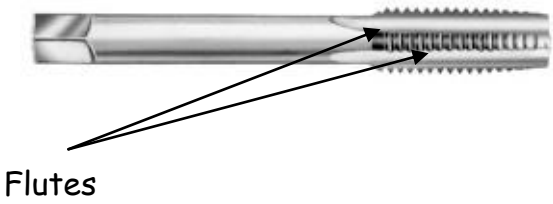


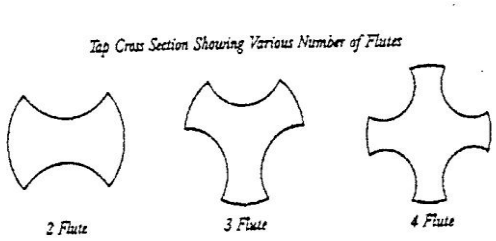


End View of 4 Flute Tap

The body of the tap is made up of flutes, land, core, diameter, thread lengths and lead. These elements of the body portion produce the threaded hole.

Tap Elements – Flute



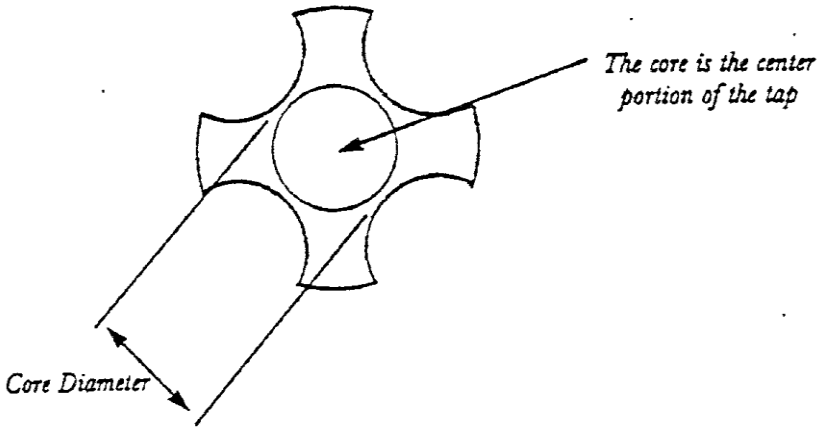


The flutes are grooves which run along the body of a tap. These flutes can be milled (as in carbon steel taps) or more generally ground (as in High Speed Steel). They provide a path for chip removal and also to carry cutting fluid to the front of the tap.
Increasing the number of flute increases the strength of the tap but reduces the space for chip flow, whereas a decrease in the number of flutes will increase the space for chips but weaken the tap.

Tap Elements - Land

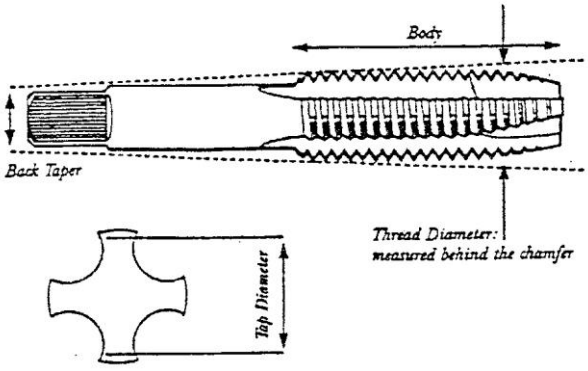
The material remaining after the flutes have been removed is the land. The land is the area between the flutes that contains the threads.

Tap Elements – Core



The core is the centre portion of the tap that separates the flutes. This provides the strength of the tap. As the number of flutes increases, the core becomes larger, increasing the strength of the tap.

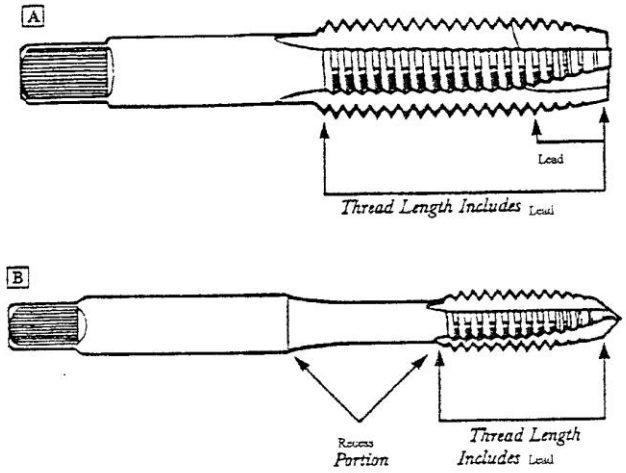
Tap Elements – Diameter



The diameters of the thread on a tap are largest at the front of the tap, behind the lead. Unlike drills or end mills. The nominal diameter cannot be determined by measurement over the top of the lands. Behind the front of the tap, the thread diameter decreases slightly towards the back of the shank. This is known as back taper, and creates clearance between the tap and the workpiece.

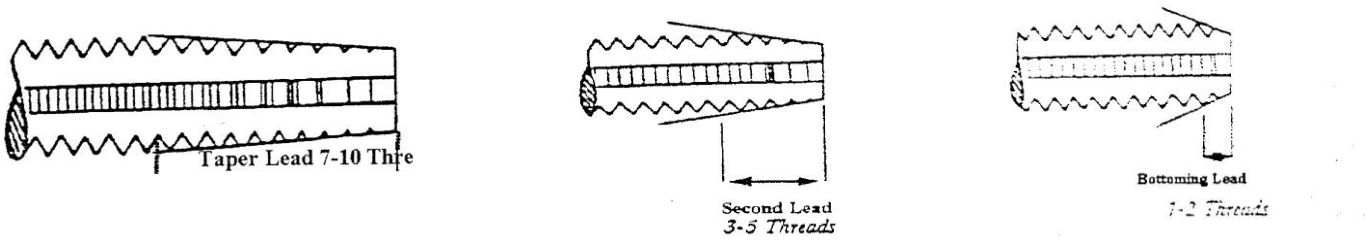
Tap Elements – Thread Length

Thread length is the part of the body containing the threads. Taps are usually available in 2 styles – one with threads over the whole of the body, and the other with shortened threads after a recess in the body. These taps can be used to tap deeper holes (fig B).



Tap Elements – Lead

The lead is the tapered portion at the front of the tap. The lead portion of the tap and the first full thread after the lead produce the finished thread in the workpiece.



There are three standard leads used on taps:- Taper, Second & Bottom.

Taper Lead – 7/10 threads in length and often used for starting threads. They are the easiest to use because of their long lead.

Second Lead – 3/5 threads in length and are the most common of leads. They are used when tapping holes all the way through the workpiece.

Bottom Lead (Plug) –1 to 2 threads and generally used in blind or bottoming holes, where the hole is not all the way through the workpiece but the thread must go as far down the workpiece as possible. These taps work the hardest because of their short lead.

Tap Elements – Flute Forms

Spiral Point or Gun Nose

These taps are designed to ease chip clearance and promote free cutting action. They are recommended for tapping through holes as the chips are pushed ahead of the tap to prevent clogging up the flutes. They are NOT suitable for blind holes unless there is clearance at the bottom of the hole to accommodate the chips.

Spiral Flute Taps

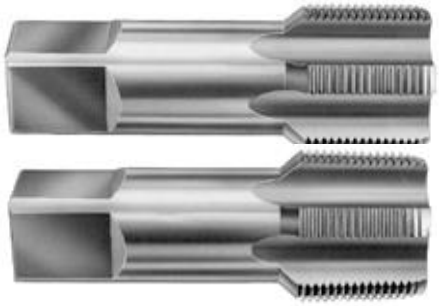
These taps are recommended for tapping in blind holes as the chips are evacuated back up the flutes. They can thread to the bottom of a blind hole. They can be supplied with different helix angles depending on the material to be threaded.

Straight Flute Taps

These taps are the most common, and are used as machine taps or as a set of three hand taps.
Today the hand tap is used both by hand and in machines of all types. This is the basic tap design: four straight flutes, in taper, plug, or bottoming types. The small, numbered machine screw sizes are standard in two and three flutes depending on the size.

Pipe Taps

Pipe taps are available in two styles:-



Parallel (G) – Cuts a parallel thread
Taper (Rc) - Cuts a tapered thread

There is some confusion when one is asked for a "Taper Pipe Tap"
Pipe fittings are often made with a slightly tapered threaded portion to create a close fit when the parts are screwed together.
A Taper Pipe Tap would be used to thread the component in to which the thread component is threaded.
The correct reference is as follows:-

BSPT (Rc) giving a tapered thread
BSPT (G) giving a straight thread

Ideally the hole should be reamed first before using a tapered tap but often is not. The result is that only the first 3 threads are formed to full profile.

American Pipe Threads are similar in that:-

Taper thread is NPT (National Pipe Taper)
Straight thread is NPS (National Pipe Straight)

Forming or Fluteless Taps

Forming or fluteless taps produce a more accurate thread than a normal ground tap in soft materials such as copper and aluminium. This is because a fluteless tap will displace material rather than cut the material. A regular tap would tear small sections of soft material and lead a weak thread whereas the fluteless tap produces a smooth unbroken strong thread.
The hole which is to be tapped must be slightly larger than that when using a regular tap to allow the displaced material to flow inward and outward.

Fluteless taps need power and plenty of lubrication in use and the hole should be countersunk if possible.

Dies & Dienuts

HSS Dies & Dienuts are manufactured to the following standards.

SPLIT	BS1127 (1951)
SOLID	DIN223 (BS1127 1981)

They are manufactured in High Speed Steel for use in production environments and in Carbon Steel for use in maintenance.

Use of Dies & Dienuts

Dies (referred to as button dies, because of their appearance) are used to cut an external thread on solid round bar or tubing by hand or machine. Typical end products are Machine Screws, Studs, Water Pipes and Electrical Conduit.

Threading by hand involves the use of a diestock, and the die should be turned clockwise in relation to the workpiece. A single die is used to form the thread from solid.

Dienuts are used solely for cleaning existing and damaged threads, and not for making new threads.

Die Elements

Dies have a taper lead over the first 2 or 3 threads to enable the thread to be formed. The outer diameter may be split or solid. Split dies allow a small adjustment on the cutting diameter by means of a dimple on the outer edge.

Die Specifications

Essential information for ordering Dies & Dienuts is as follows:-

Thread Form	e.g. Metric/UNC/UNF
Split or Solid	
Outside Diameter (for dies)	mm or Imperial (inch)
Material	HSS or Carbon

Note. The outer diameter of a DIN 223 solid die, is always in mm's. This may not fit a fractional size Die stock.

Diestocks

Diestocks are used in hand threading operations. They are available in dimensions to fit the outside diameter of the die in use.