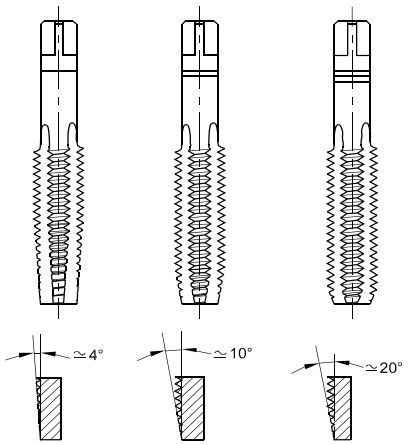
Fig 2

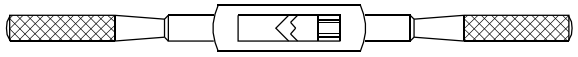


Tap wrenches: Tap wrenches are used to align and drive the hand taps correctly into the hole to be threaded.

Tap wrenches are of different types, such as double-ended adjustable wrench, T-handle tap wrench, solid type tap wrench etc.

Double-ended adjustable tap wrench or bar type tap wrench (Fig 3)**:** This is the most commonly used type of tap wrench. It is available in various sizes - 175, 250, 350 mm long. These tap wrenches are more suitable for large diameter taps, and can be used in open places where there is no obstruction to turn the tap.

Fig 3

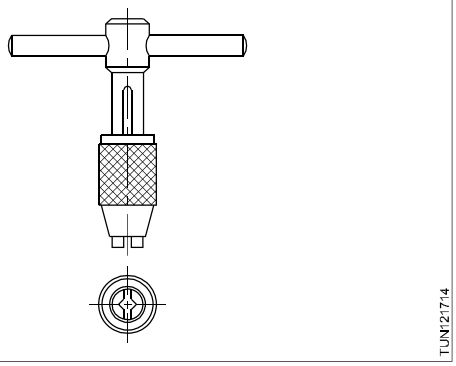


It is important to select the correct size of wrench.

T-handle tap wrench (Fig 4)**:** These are small, adjustable chucks with two jaws and a handle to turn the wrench.

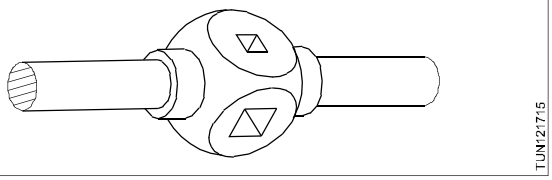
This tap wrench is useful to work in restricted places, and is turned with one hand only. Most suitable for smaller sizes of taps.

Fig 4



Solid type tap wrench (Fig 5)**:** These wrenches are not adjustable.

Fig 5



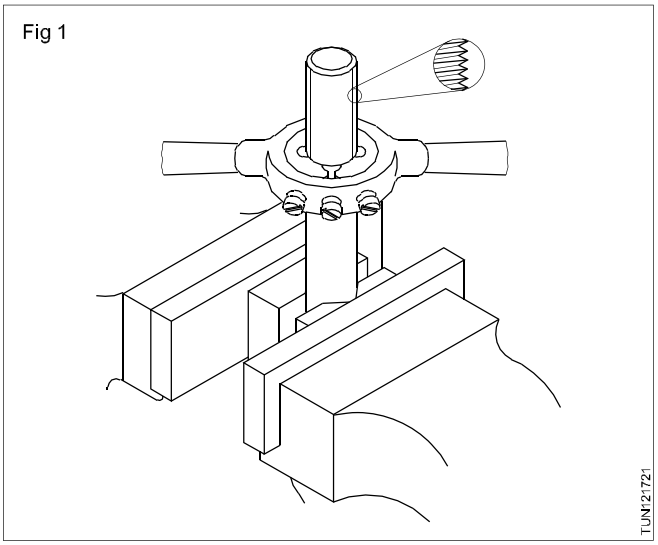
They can take only certain sizes of taps. This eliminates the use of wrong length of the tap wrenches, and thus prevents damage to the taps.

Die and die stock

Objectives: At the end of this lesson you shall be able to
- **list the different types of dies**
- **state the features of each type of die**
- **state the uses of each type of die**
- **name the type of the stock for each type of die**
- **determine the diameter of blank size for external thread cutting.**

Threading dies are used to cut external threads on cylindrical workpieces. (Fig 1)

Fig 1



Types of dies: The following are the different types of dies.

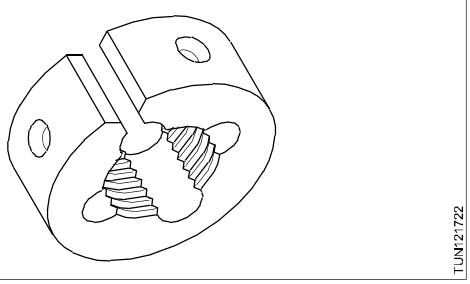
– Circular split die (Button die)

– Half die

– Adjustable screw plate die.

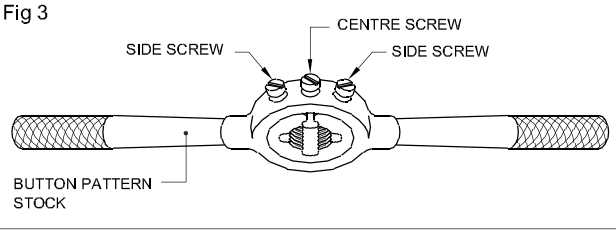
Circular split die/button die (Fig 2): This has a slot cut to permit slight variation in size.

Fig 2



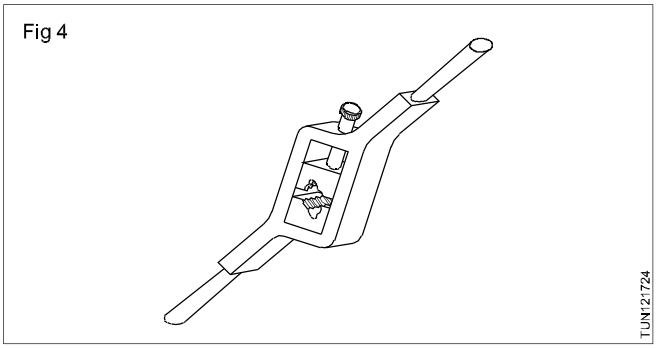
When held in the die stock, variation in the size can be made by using the adjusting screws. This permits increasing or decreasing of the depth of cut. When the side screws are tightened the die will close slightly. (Fig 3) For adjusting the depth of cut, the centre screw is advanced and locked in the groove. This type of die is called the button die.

Fig 3



Half die (Fig 4)**:** Half dies are stronger in construction.

Fig 4



Adjustments can be made easily to increase or decrease the depth of cut.

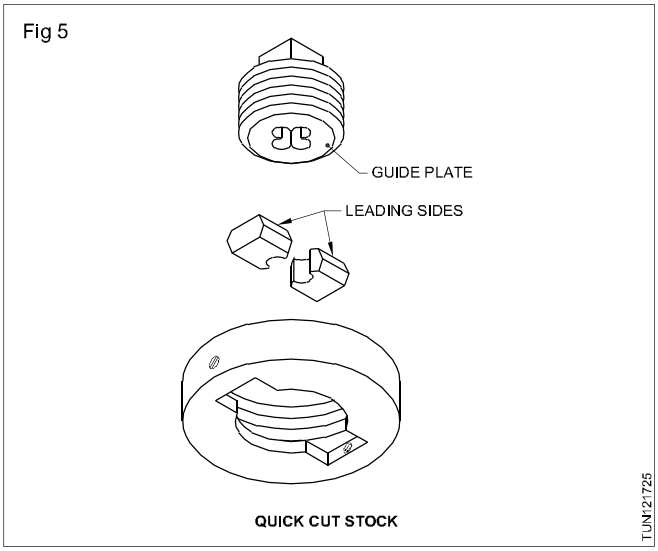
These dies are available in matching pairs and should be used together.

By adjusting the screw of the die, the die pieces can be brought close together or can be moved apart.

They need a special die-holder.

Adjustable screw plate die (Fig 5)

Fig 5



This is another type of a two-piece die similar to the half die.

This provides greater adjustment than the split die.

The two die halves are held securely in a collar by means of a threaded plate (guide plate) which also acts as a guide while threading.

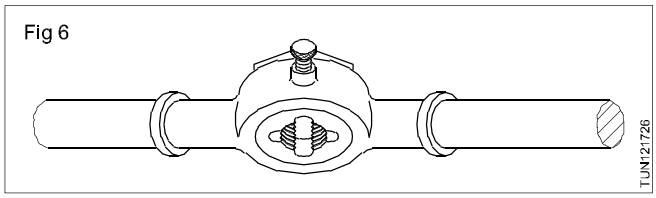
When the guide plate is tightened after placing the die pieces in the collar, the die pieces are correctly located and rigidly held.

The die pieces can be adjusted, using the adjusting screws on the collar.

The bottom of the die halves is tapered to provide the lead for starting the thread. On one side of each die head, the serial number is stamped. Both pieces should have the same serial numbers.

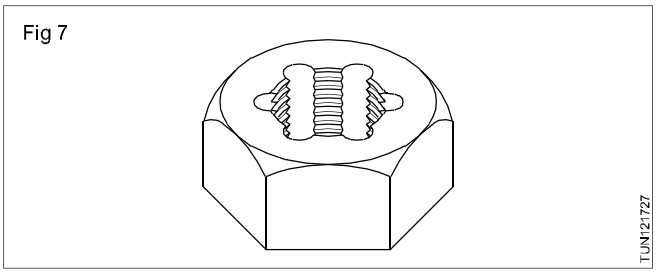
This type of die stock is called quick cut die stock. (Fig 6)

Fig 6



Die nut (Solid die) (Fig 7)**:** The die nut is used for chasing or reconditioning the damaged threads.

Fig 7



Die nuts are not to be used for cutting new threads.

The die nuts are available for different standards and sizes of threads.

The die nut is turned with a spanner.

Determining the diameter of blank size for external thread cutting

Why should the blank size be less?

It has been observed from practice that the threaded diameters of steel blanks show a slight increase in diameter. Such increase in the diameter will make the assembly of external and internal threaded components very difficult. To overcome this, the diameter of the blank is slightly reduced equal to 0.1 x pitch of the thread before commencing the threading.

Tap extractor

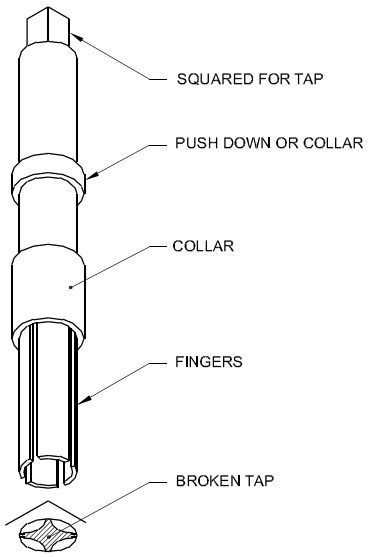
Objectives: At the end of this lesson you shall be able to
- **name the different methods of removing broken taps**
- **state the methods of removing broken taps.**

A tap broken above the surface of the workpiece can be removed using gripping tools like pliers.

Taps broken below the surface pose a problem for removing. Any one of the several methods given below can be used.

Use of tap extractor (Fig 1)

Fig 1



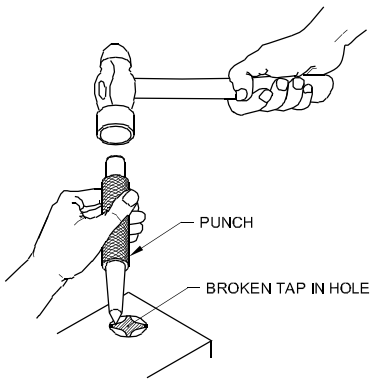
This is a very delicate tool and needs very careful handling.

This extractor has fingers which can be inserted on the flutes of the broken tap. The sliding collar is then brought to the surface of the work and the extractor turned anticlockwise to take out the broken tap.

A light blow on the broken tap with a punch will help to relieve the tap if it is jammed inside the hole.

Use of punch (Fig 2)

Fig 2

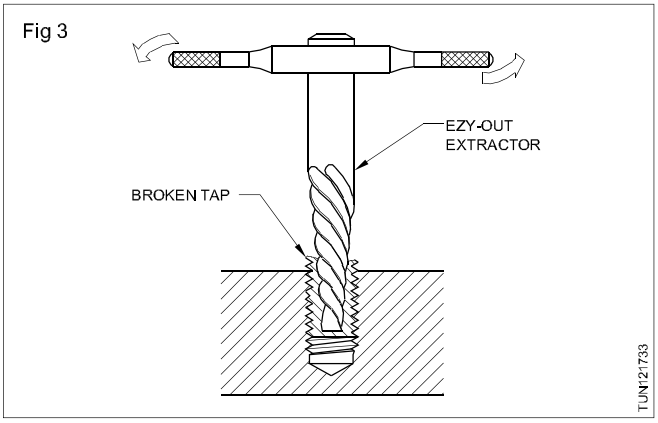


In this method the point of the punch is placed in the flute of the broken tap in an inclination and struck with a hammer. The positioning of the punch should be such that the broken tap is rotated anticlockwise when struck.

Annealing and drilling the tap

This is a method adopted when other methods fail. In this process the broken tap is heated by flame or by other methods for annealing. A hole is then drilled on the annealed tap. The remaining piece can be removed either by using a drift or using an EZY-OUT (extractor). This method is not suitable for workpieces with low melting temperatures such as aluminium, copper etc.(Fig 3)

Fig 3



Use of arc welding

This is a suitable method when a small tap is broken at the bottom of materials like copper, aluminium etc. In this method the electrode is brought in contact with the broken tap and stuck so that it is attached with the broken tap. The tap may be removed by rotating the electrode.

Use of nitric acid

In this method nitric acid diluted in a proportion of about one part acid to five parts of water is injected inside. The action of the acid loosens the tap and then it is removed with an extractor or with a nose plier. The workpiece should be thoroughly cleaned for preventing further action of the acid.

While diluting acid mix acid to water.

Use of spark erosion

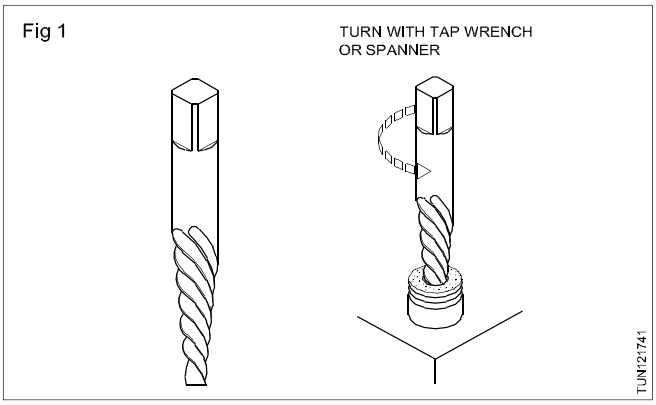
For salvaging certain precision components damaged due to breakage of taps, spark erosion can be used. In this process, the metal (broken tap) is removed by means of repetitive spark discharges. The electrical discharge occurs between an electrode and the electro-conductive workpiece (tap) and the minute particles are eroded both from the electrode and the workpiece. In many cases it may not be necessary to remove the broken tap completely. (After a small portion has been eroded, a screwdriver or punch can be used to remove the remaining portion of the tap.) The shape of the electrode also need not be round. It can be square or in the form of a slot on the workpiece for assisting the tools for rotating the broken tap.

Methods of removing broken studs

Objectives: At the end of this lesson you shall be able to
- **name the different methods used for removing broken studs**
- **state the situations in which each of the above methods is applied.**

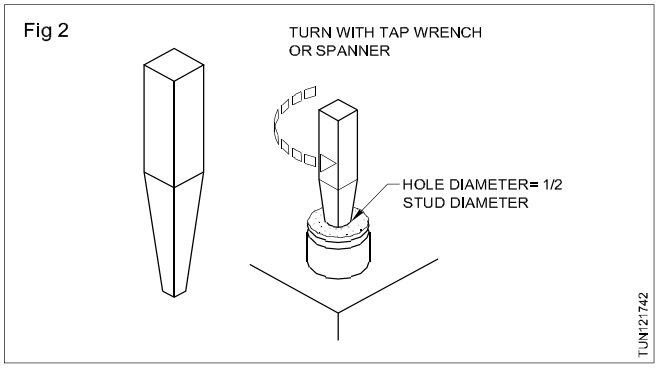
When studs or screws are broken the following methods are used for removing them.

Screw extractor (Fig 1)



Screw extractors are available in different sizes. Depending on the size of the broken stud a hole is first drilled. A screw extractor is then inserted into the hole and turned anticlockwise until it is tight. Turning further will loosen the stud.

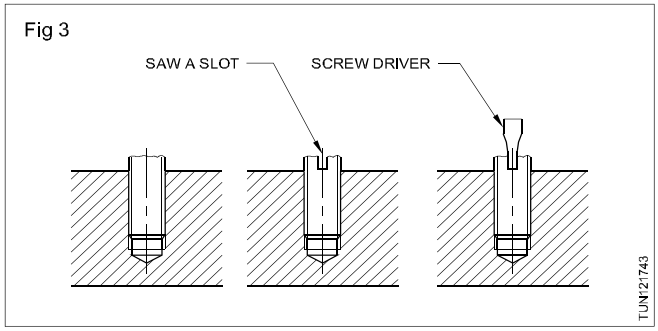
Tapered square drift (Fig 2)



First a hole approximately to half the diameter and to about half the length of the broken stud may be drilled. A tapered drift with a square head is then driven into the hole.

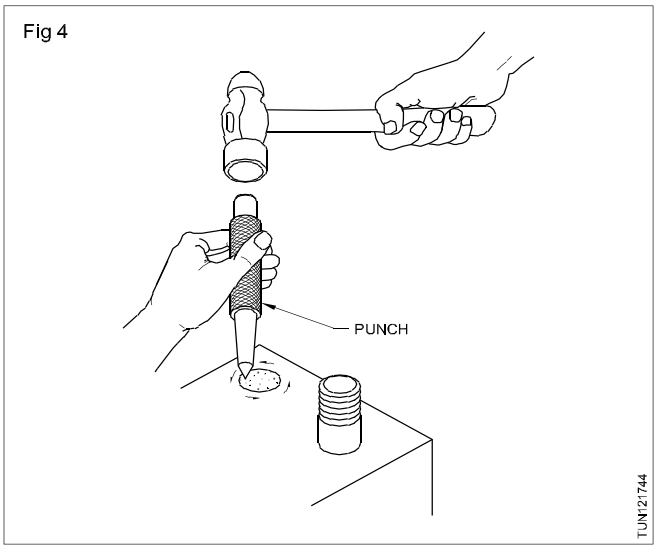
Use a tap wrench or spanner and rotate the drift for unscrewing the stud.

Using a screwdriver (Fig 3)



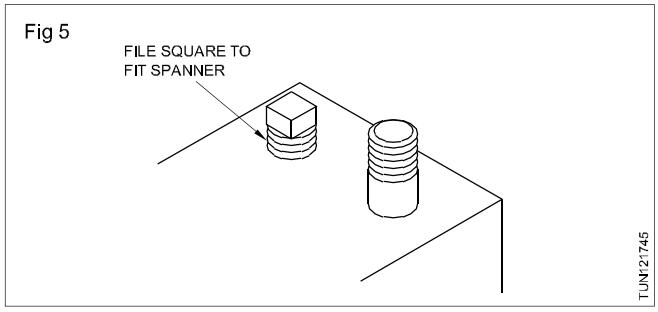
If there is sufficient projection of the broken stud, cut a slot with a saw and unscrew it with a screwdriver. This method is suitable only for small diameter studs.

Punch and hammer (Fig 4)



If the breakage of the stud is near the surface, sometimes it can be removed by using a punch. The punch is used to direct blows at different points to loosen the stud. Be sure the punch is used in the direction of unscrewing.

Using spanner (Fig 5)

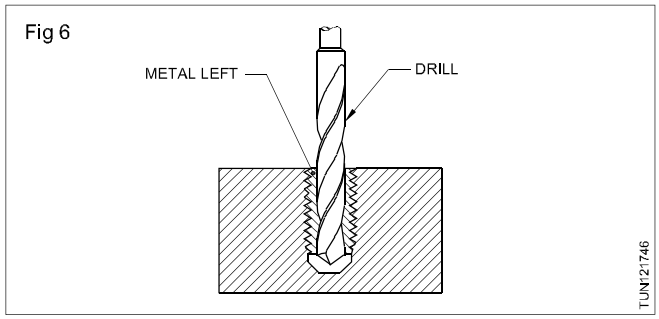


Large diameter studs which are broken above the surface can be removed by shaping a square head and then removing by a spanner.

By drilling (Fig 6)

Broken studs which are very stubborn can be drilled through. The remaining metal can be removed using a tap or a scriber point.

Sometimes it may be necessary to remove the stud completely by drilling and re-threading for oversize stud.



Calculation involved in finding out drill size (metric and inch)

Objectives: At the end of this lesson you shall be able to
- **state what is tap drill size**
- **choose the tap drill size for metric and BSW thread from the tables**
- **calculate the tap drill size for metric ISO threads.**

Calculation involved in finding out drill size (metric and inch)

What is tap drill size?

Before a tap is used for cutting internal threads, a hole is to be drilled. The diameter of the hole should be such that it should have sufficient material in the hole for the tap to cut the thread.

Tap drill sizes for different threads

ISO metric thread

Tap drill size for M10 x 1.5 thread

Minor diameter	= Major diameter - (2 x depth)
Depth of thread	= 0.6134 x pitch of a screw
2 depth of thread	= 0.6134 x 2 x pitch
	= 1.226 x 1.5 mm
	= 1.839 mm
Minor dia.	= 10 mm - 1.839 mm
	= 8.161 mm or 8.2 mm.

This tap drill will produce 100% thread because this is equal to the minor diameter of the tap. For most fastening purposes a 100% formed thread is not required.

A standard nut with 60% thread is strong enough to be tightened until the bolt breaks without stripping the thread. Further it also requires a greater force for turning the tap if a higher percentage formation of thread is required.

Considering this aspect, a more practical approach for determining the tap drill sizes is

Tap drill size	= major diameter minus pitch
	= 10 mm - 1.5 mm
	= 8.5 mm.

Compare this with the table of tap drill sizes for ISO metric threads.

BSW inch (1") threads formula 1" = 8 T.P.I

Tap drill size =

$$\text{Major diameter} - \frac{1 \text{ inch}}{\text{No.of threads per inch}}$$

$$= 1'' - \frac{1}{8}'' = \frac{8-1}{8}'' = \frac{7}{8}''$$

$$= \frac{7}{8}''$$

Compare this with the table of drill sizes for unified inch threads.

What will be the tap size for the following threads?

a) M20

b) BSW 3/8

Refer to the chart for determining the pitches of the thread.

Table for tap drill size

Nominal diameter M.M	ISO Metric (60°)		B.S.W. (55°)		Tap drill sizes
	Pitch	Tap drill sizes	Nominal diameter (inch)	Threads per inch (mm)	
3	0.5	2.50	1/8	40	2.5
4	0.7	3.30	5/32	32	3.2
5	0.8	4.20	3/16	24	4.0
6	1.0	5.00	1/4	20	5.0
8	1.25	6.80	5/16	18	6.5
10	1.50	8.0	3/8	16	8.0
12	1.75	10.20	1/2	12	10.5
14	2.00	12.00	9/16	12	12.5
16	2.00	14.00	5/8	11	14.00
18	2.50	15.50	3/4	10	16.00
20	2.50	17.50	13/16	10	18.00
22	2.50	19.50	7/8	9	19.5
24	3.00	21.00	1	8	22.2