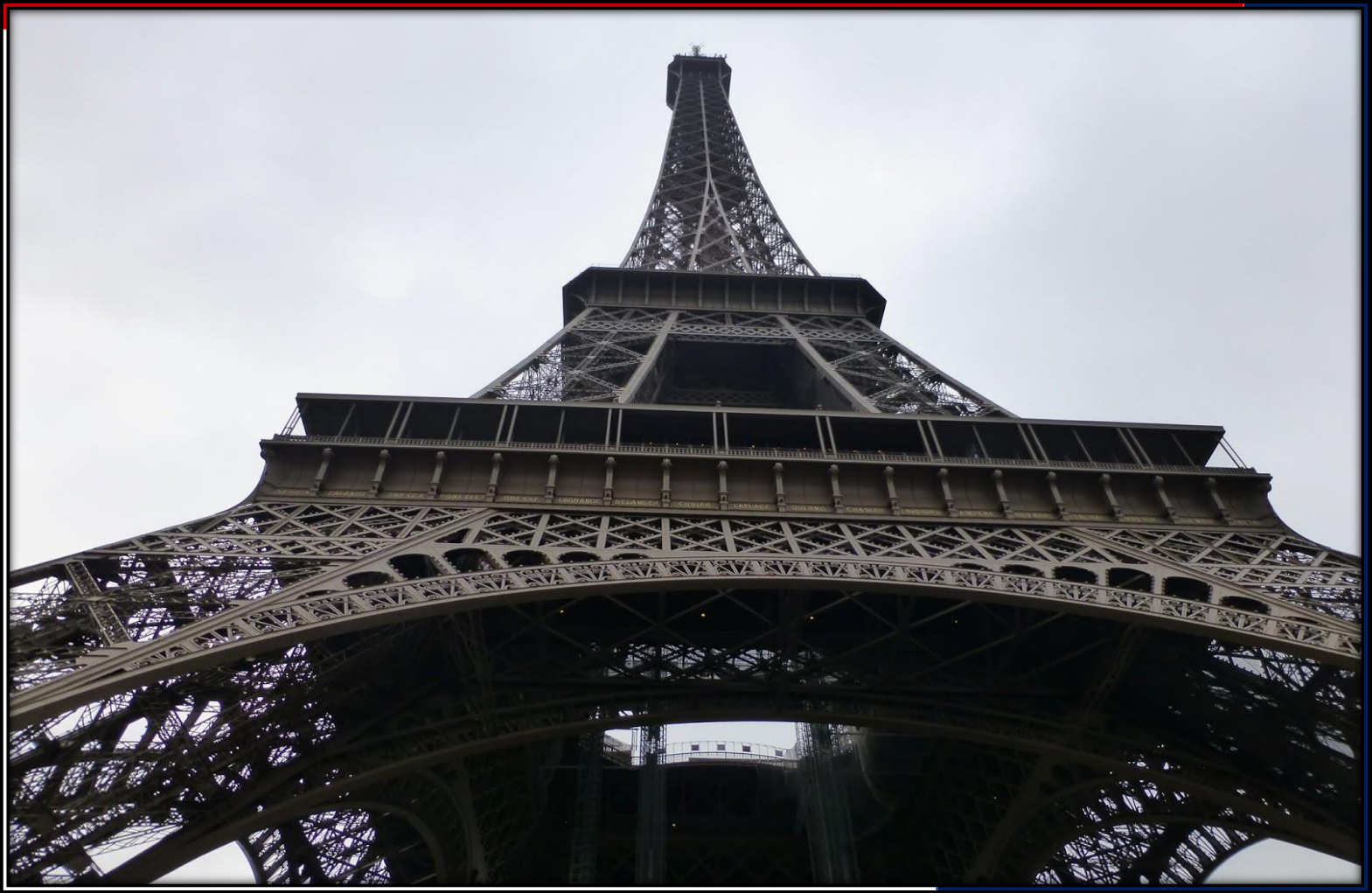
UET LAHORE

FITTING AND FABRICATION WORKSHOP



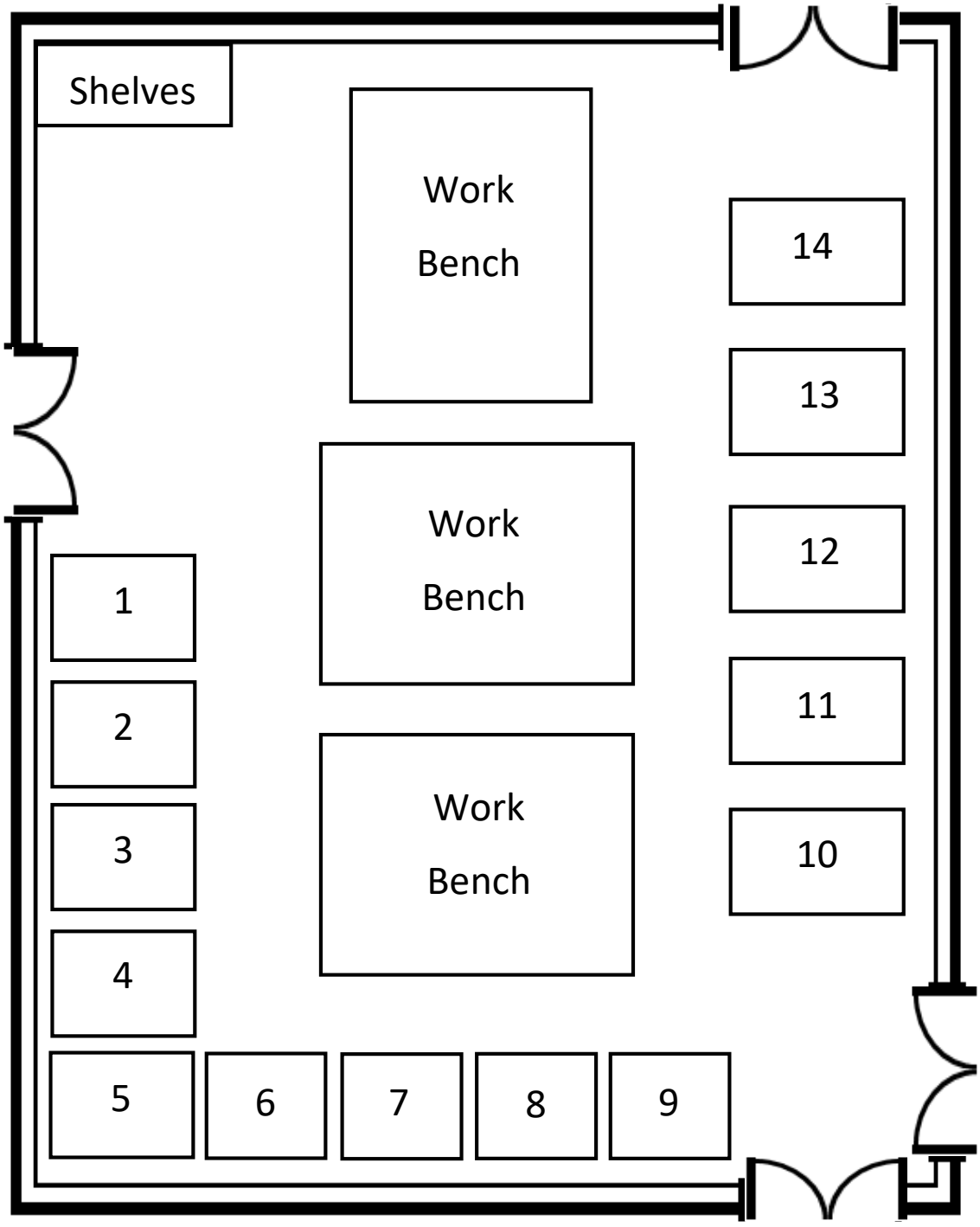
PRECAUTIONS

YOU ALWAYS HAVE TO BE CAREFUL WHILE WORKING IN THE WORKSHOP FAILURE TO FOLLOW PROPER HANDLING PRECAUTIONS CAN RESULT IN SERIOUS INJURY..

FOLLOWING ARE SOME OF THE SAFETY PRECAUTIONS YOU NEED TO TAKE CARE OF IN THE WORKSHOP.

- ALWAYS WEAR LAB COAT WHILE WORKING IN THE LAB.
- WEAR GLOVES WHILE HANDLING THE METAL SHEETS AND SHARP TOOLS.
- USE APPROPRIATE TOOLS AS TOLD BY LAB STAFF.
- AFTER USAGE, SUBMIT THE TOOLS BACK IN THE LAB.
- GET FULL KNOWLEDGE BEFORE OPERATING ANY MACHINE OR USING ANY TOOL.
- FILES MUST HAVE WELL FITTED HANDLES.
- SEE THAT WORK PIECE IS PERFECTLY CLAMPED OR FIXED IN THE VICE.
- NEVER USE HAMMERS WITH LOOSE HEADS.
- NEVER TILT THE HACKSAW BLADE WHILE SAWING.
- DRILL THE HOLES CENTRALIZING ON POP MARKS, GIVE GRADUAL FEED.
- DO NOT USE A SPANNER AS A HAMMER.
- DO NOT USE A STEEL RULE AS A SCREW DRIVER.
- USE THE COOLANT AT THE TIME OF HACK-SAWING AND DRILLING.
- KEEP THE WORK PLACE NEAT AND CLEAN AFTER WORK.
- IN CASE OF EMERGENCY IMMEDIATELY CALL THE ATTENDANT.

Lab Layout



1. Drill Machine no. 1
2. Drill Machine no. 2
3. Power Hacksaw Machine
4. Double and Pedestal Grinder
5. Arbor Press
6. Surface Grinding Machine
7. Air Compressor
8. Pneumatic press
9. Pneumatic Metal Sheet Shearing Machine
10. Sheet Bending Machine
11. Sheet Shearing Machine
12. Surface plate no. 1
13. Surface plate no. 2
14. Surface plate no. 3

Introduction to Fitting and Fabrication Lab

Introduction:

The fitting and fabrication shop offers series of practical for students where students have to manufacture machine elements while using elementary hand tools. **Fitting jobs** involves the removal of excess / unwanted material from a blanks with the help of hand tools so that they could be assembled as specified in drawing. It is done for the assembly practice by mating surfaces/edges of components leading to assembly. **Metal fabrication** is the building of metal structures by cutting, bending, and assembling processes. It is a value added process that involves the construction of machines and structures from various raw materials.

Purpose:

The purpose of this workshop was to understand the working procedure being done on metals using different mechanical techniques. These mechanical techniques consist of filling, drilling, cutting, threading and finishing of metal piece.

Why use hand tools?

We may consider the efficiency of any hand processes to be low and that the outcome quality depends highly upon the skill of individuals. Perhaps it is fair to consider the following points before a definite answer is given to the above question: -

1. Accuracy

Although the machines can give a higher degree of dimensional accuracy however the extreme high degree of flatness required for a surface table or a machine slideway is usually obtained by hand scraping only.

2. Flexibility

Hand processes are very flexible and can be carried out at any place where necessary while machining processes are not. In addition, machining usually require a rigid setting up, while fitting is simple.

3. Quantity

For large batch size, advanced production machines are commonly employed in order to maintain the accuracy as well as the efficiency but it would be uneconomic to use these advanced machine tools for single component designing. So it is conventional to use machining and followed by hand fitting where necessary.

4. Final Assembly

In the assembly of precise component parts, no matter how accurate they are being produced, a skilled fitter is often required to give the necessary "finishing touch" on them to ensure that everything goes together correctly.

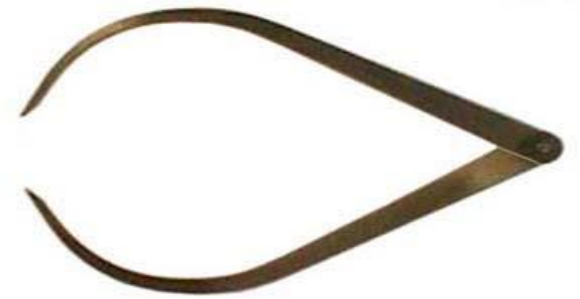
Measuring Tools in Workshop

Calipers

Calipers are the very simple tools used together with a steel rule for the measurement or comparison of linear dimensions. An experienced worker can achieve +/-0.05mm in the measurement. Calipers are classified into two types:

Outside Calipers

Outside calipers are used for measuring external dimensions such as the length, diameter, or even the thickness of a solid.



Outside Calipers

Inside Calipers

Inside calipers are used for measuring internal dimensions such as the diameter of a hole, or the width of a slot etc.

Inside Calipers

Vernier Calipers

Vernier Calipers are more precise tools capable for measuring external dimensions, internal dimensions, and depths. Besides the two pairs of measuring jaws and the depth gauge, its main features also include a main scale and a vernier scale.

Vernier Calipers

Micrometer

A micrometer is a more precise measuring instrument than the vernier calipers. The accuracy is come from the fine thread on the screw spindle. The ratchet prevents excess force from being applied. Generally, the screw spindle has a pitch of 0.5mm. The thimble is divided into 50 equal divisions.

Common types of micrometers used in the workshops are: -

Outside Micrometer

An outside micrometer is used for measuring external dimensions. The work to be measured is placed between the anvil and the tip of the spindle.

Outside Micrometer

Inside Micrometer

This is similar in structure to an outside micrometer and is used for measuring internal dimensions..

Inside Micrometer

Protractor

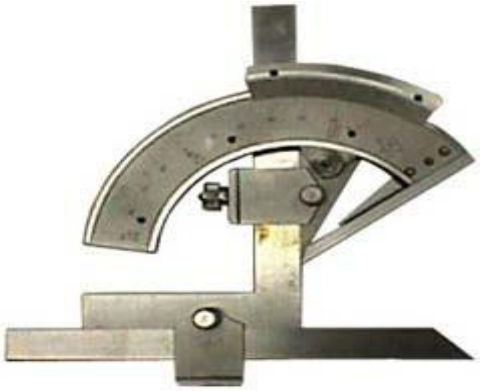
Engineer's Protractor

Engineer's protractor is a general purpose tool used for the measuring / checking of angles e.g. the angle of drill head, angle of cutting tool, and even for the marking out of angles on a component part.

Engineer's protractor

Vernier Protractor

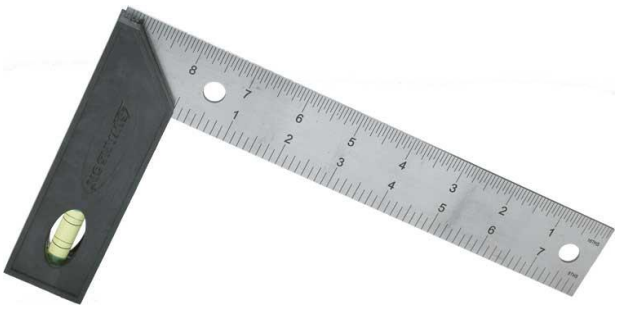
This is a precision measuring tool that the accuracy of measurement can reach ¡Ó5 minutes of an angle through the vernier scale.



Vernier Protractor

Try Square

A **try square** is a woodworking or a metalworking tool used for marking and measuring a piece of wood. The **square** refers to the tool's primary use of measuring the accuracy of a right angle (90 degrees); to **try** a surface is to check its straightness or correspondence to an adjoining surface.



Try square

Marking Out Tools in Workshop

Marking out is the preliminary work of providing guidance lines and centres before cutting and machining. The lines are in 3-D and full-scale. The workpiece can then be cut or machined to the required shapes and sizes. The common tools used for marking out are as follow:

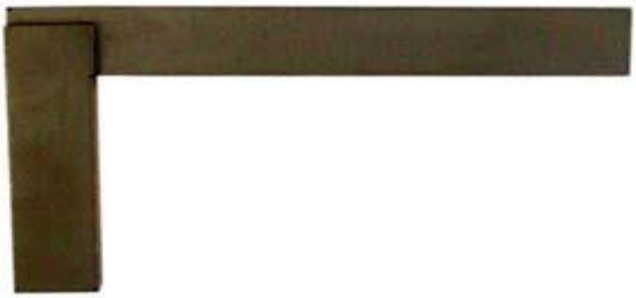
Scriber

A scriber is used for scratching lines onto the workpiece. It is made of hardened tool steel.

Scriber

Engineer's square

Engineer's square is made of hardened tool steel. It is used for checking the straightness and the squareness of a workpiece. It can also be used for marking perpendicular lines onto a workpiece.



Engineer's square

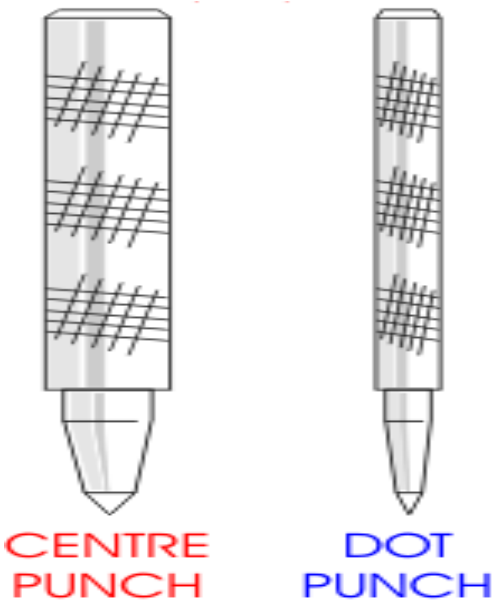
Spring dividers

Spring dividers are made of hardened tool steel. The legs are used for scribing arcs or circles onto a workpiece.

Spring dividers

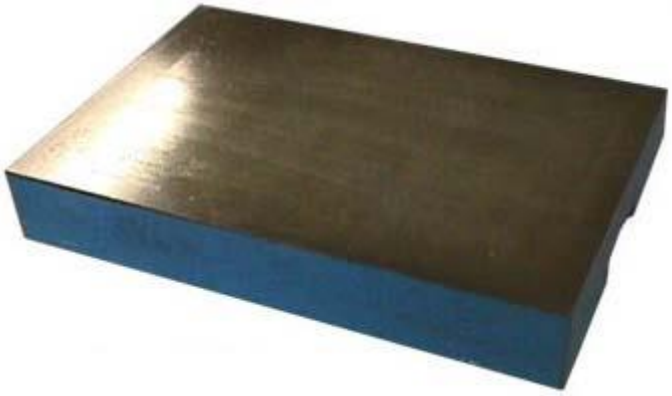
Punch

There are two types of punch namely the Centre Punch and the Dot Punch. A dot punch has a point angle of 60¢X and it is used for making of small dots on the reference line. The centre punch has a point angle of 90º and it is used for making a large indent on a workpiece for drilling. Both punches are made of hardened tool steel.



Surface plate

Surface plate is made of malleable cast iron. It has been machined and scraped to a high degree of flatness. The flat surface is being used as a datum surface for marking out and for measuring purposes. If it can stand on the floor, it is called surface table.



Surface plate

Angle plate

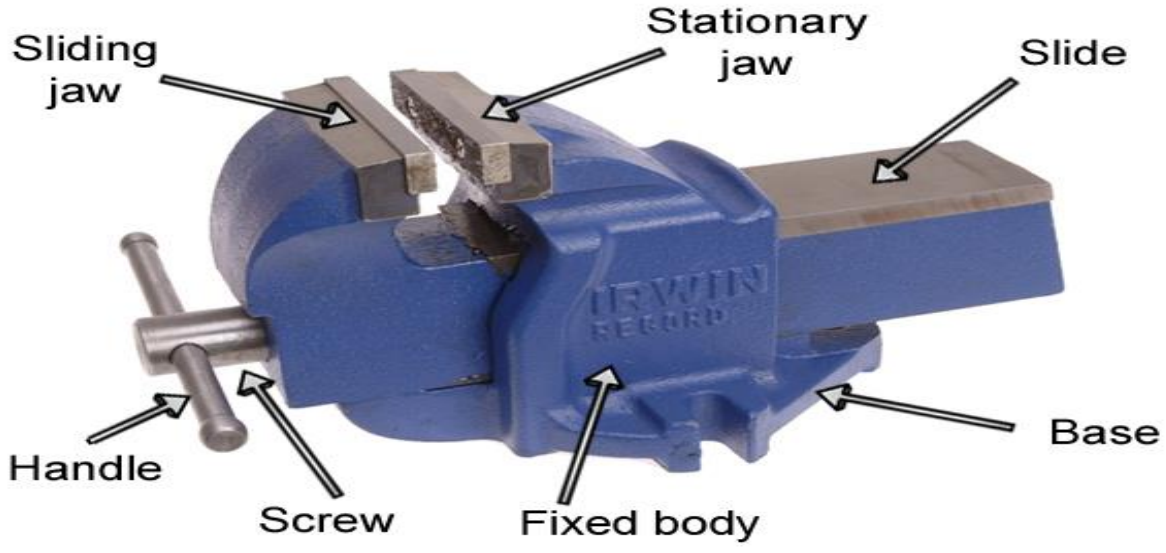
An angle plate are used for supporting or setting up work vertically, and are provided with holes and slots through which securing bolts can be located. It is made of cast iron and ground to a high degree of accuracy.

Angle plate

Hand Tools for Workshop

Bench Vice

A bench vice is the device for holding the workpiece where most hand processes to be carried out. The body of the vice is made of cast iron while the two clamping jaws are made of hardened tool steel. Some bench vice has a swivel base, which can set the workpiece at an angle to the table. The vice height should be correct ergonomically. Vice clamps, made of copper are fitted over the vice jaws when holding finished work to avoid damage to the finish surfaces.



Bench vice

Care of Vices

a) Do not direct impact the vice body by the hammer.
b) Light hammering can be done on and only on the anvil of the vice.
c) To avoid over clamping, the handle of the vice should be tightened by hand only.

Files

Files are the most important hand tools used for the removal of materials. They are made of hardened high carbon steel with a soft 'tang'. to which a handle can be fixed. Files are categorised as follows:-

File

Length - measured from the shoulder to the tip.
Shape - the cross-sectional profile.
Grade - the spacing and pitch of the teeth.
Cut - the patterns of cutting edge.

Types of Files

Save Edge

There are no cutting edges on one side of the hand file. The purposes for the save edge is to avoid the worker damage the work, when he is filing a shoulder position. Shape of files.

Hand File

The common file used for roughing and finishing. It is a rectangular in section and parallel in width. It has double cut teeth on two faces, single cut teeth on one edge, and one save edge.

Flat File

It is similar to a hand file rectangular in section, tapered slightly in width and thickness towards the tip. It has Double Cut teeth on two faces and Single Cut teeth on two sides.

Half-round File

The section is a chord of a circle with its taper towards the tip. It is used for forming radii, grooves, etc. and the flat side is used for finishing flat surfaces.

Round File

This is of round section tapering toward the end. It is used for enlarging holes, producing internal round corners. Usually double cut in the larger sizes, and single cut for the smaller sizes.

Square File

This is square in section, with tapered towards the tip, and usually double cut on all four faces. It is used for filing rectangular slots or grooves.

Three Square File

It is also known as triangular file. This is a triangular in section, with tapered towards the tip with double cut on both faces. It is used for filing corners or angles less than 90°

Needle Files

Needle files are a set of small files with their shapes made in a way similar to the large ones. They are generally used for small and delicate works such as the repair of small instruments.

Grade

This refers to the pitch (spacing) of the teeth that spread throughout the whole length of the file. Files with a rougher grade of cut give a faster metal removal rate but a poorer surface finish or the vice versa. It should be noted that, for the same grade of cut, a longer file would have a coarser pitch than a shorter one.

The grades are as follows:

Bastard cut - medium teeth for general purposes, especially suitable for mild steel.

Second cut - finer teeth for cutting hard metals.

Smooth cut - fine teeth for finishing.

Three grades of cut are in common in use.

Cut Pattern

Single Cut - There is only one set of cutting teeth to one edge. It gives a less efficient cutting but a better finish. It is suitable for the soft metal.

Double Cut - A double cut file has one set of teeth cut at 70 degrees to one edge, and another set of grooves cut at 45 degrees to the other edge. It is thus more efficient in cutting. It is easy to clog the teeth when it is work on the soft metal.

Rasp - Very coarse teeth, like the nail, it is commonly used for the cutting off soft materials such as rubber, PVC, or wood etc.

File Card

When filing the soft metals, the small pieces of metal will tend to clog the teeth. If the file is not cleaned, this small piece of metal will scratch on the surface of the work. We call it pinning. This case is frequently appeared when applying a new smooth file on the soft metals. The pinning can be removed with a File Card, which is a wire brush mounted on a block of wood. Sweep the file card along the grooves on the file until the pinning is removed.

File card

Hacksaw

A hacksaw is generally used for cutting a metal into pieces.

It consists of a frame and a saw blade as shown below. It is a "U" shaped steel frame with a pistol handgrip and a saw blade. The frame may be of fixed type to take only one length of blade, or adjustable to take different blade lengths. It has a wing nut to adjust the tension of the blade.

Hacksaw

Saw Blade

Saw blades are made of high carbon steel, alloy steel or High Speed Steel. They are supplied according to material, hardening, length and pitch.

1. Hardening - Usually the saw blade is supplied with all hard or flexible grade. The all hard is very brittle, and it is suitable for the skillful user only. The flexible grade is tough, so it can twist an angle. It is suitable for cutting a curve or for the beginner to use.

2. Material - Usually the saw blade is supplied with High Carbon Steel (HCS) and High Speed Steel (HSS). The HCS will annealed from the heat generated by fraction of cutting. The HCS, saw blade will lost its hardness when cutting the hard metal. The HSS can keep its hardness unless improper use.

3. Pitch - It is grading according to the number of teeth per 25mm.
Coarse blade (18T) is most suitable for soft material and thick workpiece.
Medium blade (24T) is suitable for steel pipe.
Fine blade (32T) is suitable for the thin metal sheet and thin copper pipe.

For safety, it is advice that to keep at least 3 teeth of the blade, stand on the workpiece.

Pitches of Saw Blade

4. Length - The length of the blade is determined by the distance between the outside edges of the holes, which fit over the pegs.

5. Set - The teeth have a "set" to either side alternately, which causes the blade to cut a slit wider than the thickness of the blade, to prevent jamming.

Safety and Care of Hacksaw

The cutting action is carried on the forward action only. So the blade must be mounted with its teeth pointing forward.

Suitable tension should be applied on the blade to avoid breakage or loosen.

Change the blade if some teeth are broken.

Avoid rapid and erratic strokes of cut.

Avoid too much pressure.

Workpiece must be hold firmly.

Hammer

The type most commonly used is the ball pein hammer, which has a flat striking face and a ball-shaped end (call the pein). Hammer heads are made from medium carbon steel. The two ends must be hardened and tempered, the centre of the head with the eye being left soft. It is specified according to its weight.

Hammer

Safety and Care of Hammer

The hammer head is firmly fixed to the shaft by a wedge.

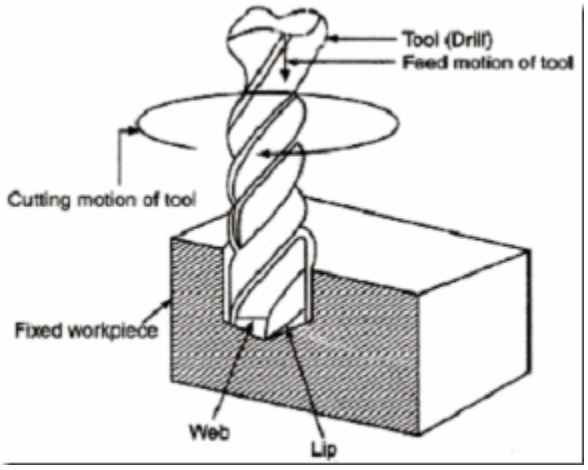
The striking face of the hammer head does not wear.

Drill and Drilling

The drilling machine or drill press is one of the most common and useful machine employed in industry for producing forming and finishing holes in a workpiece. The unit essentially consists of:

- A spindle which turns the tool (called drill) which can be advanced in the workpiece either automatically or by hand.
- A work table which holds the workpiece rigidly in position.

Drilling machine



Drilling

Twist Drill

The twist drill is made from High Speed Steel, tempered to give maximum hardness throughout the parallel cutting portion. Flutes are incorporated to carry away the chips of metal and the outside surface is relieved to produce a cutting edge along the leading side of each flute.

Twist Drill

Reamer and Threading Tools

Functions of reamer are

- to control the diameter of a hole
- to improve the internal surface finish
- to improve the roundness of the hole

Reamer is made of hardened High Carbon Steel or High Speed Steel. It is classified into hand reamer and machine reamer

Types of Reamer

1: Hand Reamer:

These reamers are operated by hand with a tap wrench fitted on the sequence of the reamer. The work is hold in a vice. The flutes may be straight or helical. Shank is straight with a square tang for the wrench.

2: Machine Reamer;

These are similar to hand reamer, except that the shank is tapered.

3: Chucking Reamers:

These are machine reamers with shorter flutes. These may be either of the type known as rose reamers or fluted reamers. These are using for heavy roughing cuts.

4: Fluting Reamers:

There the holder are not rigid but are fluting this permits the reamer. To flow the previously made hole naturally and without restrained resulting in a better hole.

5: Expanding Reamers:

These reamers allow slight increase in their size to allow for wear to remove an extra amount of material. For this the body of the reamers is bored tapered and is slitted. A taper plug runs through the hole end is operated by a screw so that it acts as the expander.

6: Adjustable Reamers:

In these reamers separate blades are inserted in the grooves provided in the body of the reamer. The blades can be moved up or down of the reamer.

Types Of Reamers

Taps

Taps are used to cut the internal screw threads. Taps are made of hardened High Carbon Steel or High Speed Steel. The ends of the shank are square to fit a wrench. Usually taps are provided in set of three -- taper, second and plug tap

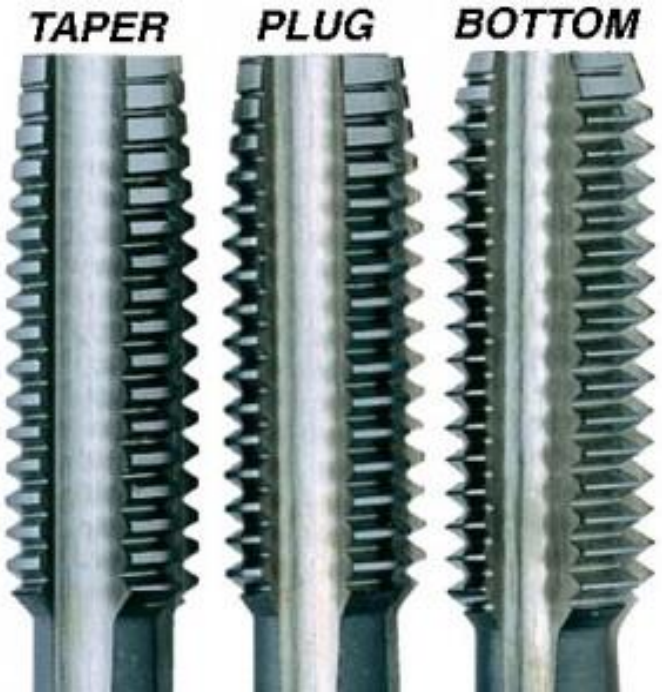
The tap is tapered off for a length of 8 to 10 threads and is the first tap to be used in a hole to start the thread form.

Types of Taps

There are three most common types of taps

1. Taper tap

TAPER taps have the first 7 – 10 threads at the tip ground flatter than the main body of the tap to enable easy starting of the threads in the hole. Sometimes called a starter tap, taper taps can be be used to start the thread in a blind hole for another tap to finish or used to cut threads all the way on a through hole.



2. Bottom taps

PLUG taps are like taper taps in that they have tapered threads at the starting end of the tap, the difference is there are fewer of them, usually the first 3-5 threads, so you get to cutting a full thread sooner. Although not as easy to start as a taper tap, they can be used to start a thread. If you can only buy one type of tap, and you're a patient user, plug taps can be a good choice because they are still easy to start, but they can also form complete threads deeper into a blind hole than a taper tap.

3. Bottom taps

BOTTOMING taps have no ground threads at the starting end and are generally used after, and in conjunction with a taper or plug tap. Bottom taps can cut threads to the bottom of blind holes although they do not do well at starting threads.

Tap wrench is used to hold the taps in its jaws

Tap wrench

Die

Dies are used for cutting external threads on round bar or tubes. Dies are made of Hardened High Carbon Steel or High Speed Steel.

Types of Dies:

Split Die or Button Die

Split die is held in place in the stock. The split permits a small amount of adjustment in the size of the die by adjusting the screws in the stock. Since split dies cut their thread complete in one cut, the die thread are tapered and back off for one third of their length.

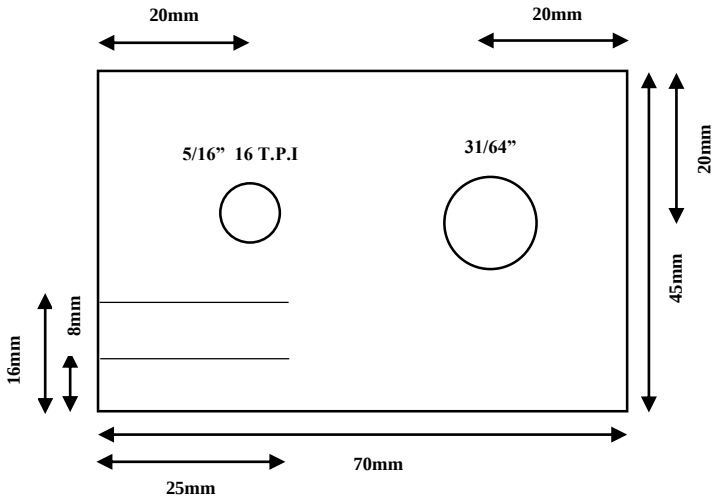
Split die and stock

Die nuts

Die nuts are not capable of any adjustment. They are not usually employed for cutting threads from the bar, but for rectifying damage to existing threads. They are externally formed to hexagonal shape for use with a spanner.

Die nut

Work piece Dimensions:



Final Workpiece