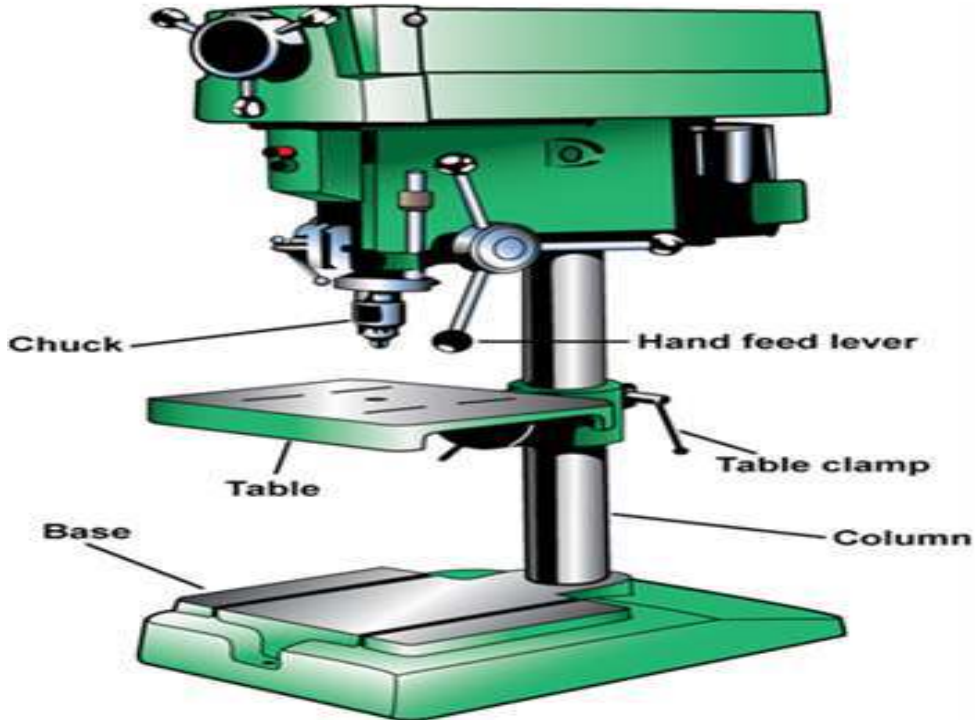
Automotive Body Repair and Paint Work
Level-II

Based on March 2022, Curriculum Version 1



Module Title: - Performing Bench Work

Module code: EIS BRP2 M05 0322

Nominal duration: 120 Hour

Prepared By Ministry of Labor and Skill

September 2022

Addis Ababa Ethiopia

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Table of Content

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Introduction to the Module

Bench work has its own essential position in all engineering works. In the mechanized workshops, where most of the work is carried out on an automatic machine, while bench work has its own importance The jobs can be finished to a fairly good degree of accuracy through machining operation; they often require the hand operations to be done on them to finish to the desired accuracy. A fitter's work is unavoidable when different parts are to be assembled in position after they have been finished. Alignment of machine parts, bearings, engine slide valves and similar other works call for a fitter's work. Reconditioning and refitting of machines and machine parts cannot be done without a skilled fitter. All the above types of works require the use of a large number of hand tools and a fitter must have good working knowledge of all these tools and instruments The module is designed to meet the competencies required to determine job requirements perform basic bench work. The term bench work relates to work performed by the mechanic at the machinist's bench with hand tools rather than machine tools.

Today, work at the bench is not performed as much as formerly; the tendency, with the exception of scraping, is to do more and more bench work with machines work operation like lay out , cutting with hack saw, chiseling, filing ,drilling ,lapping etc and checking components for conformance to the specifications.

This module covers the units:

- Lay-out and mark dimensions/ features on work piece
- Cut, chip and file flat rectangular and / or round blocks
- Drill ,Ream, and, Lap holes.
- Cut threads using tap stock and dies
- Off-hand grind cutting tools
- Scrape and hone holes

Learning Objective of the Module

- To enable Lay-out and mark dimensions/ features on work piece
- To enable Cut, chip and file flat rectangular / or round blocks
- To enable drilling , Rimming and lapping holes
- To enable Cut threads using tap, stock and die
- To enable Off-hand grind cutting tools

- To enable Scrape and hone holes

Module Instruction

For effective use this modules, trainees are expected to follow the following module instruction:

1. Read the information written in each unit
2. Accomplish the Self-checks at the end of each unit
3. Perform Operation Sheets which were provided at the end of units
4. Do the “LAP test” giver at the end of each unit and
5. Read the identified reference book for Examples and exercise

Unit one: Lay-Out and Mark Dimensions and Features

This unit is developed to provide you the necessary information regarding the following content coverage and topics:

- Selecting Materials
- Laying out and marking dimensions
- Performing laying out and marking

This unit will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Select Materials
- Lay out and marking dimensions
- Perform laying out and marking

1.1 Selecting Materials

Metals can initially be divided into two general classifications, and Steelworkers work with both: ferrous and nonferrous metals.

1.1.1. Ferrous metals

Ferrous metals are those composed primarily of iron (atomic symbol Fe) and iron alloys. Ferrous metals include all forms of iron and iron-base alloys, with small percentages of carbon (steel, for example), and/or other elements added to achieve desirable properties. Wrought iron, cast iron, carbon steels, alloy steels, and tool steels are just a few examples. Ferrous metals are typically magnetic.

- **Iron**

Iron is produced by converting iron ore to pig iron using a blast furnace. Pig iron is the intermediate product of melting iron ore with coke, usually with limestone as a flux. Pig iron has very high carbon content, typically 3.5–4.5%, which makes it very brittle and not useful directly as a material except for limited applications.

- **Propertiesof CastIron**

1. It has goodfluidity
2. Itcanbeeasilymachined
3. Itisbrittleinnature
4. Itisresistancetodeformation
5. Itiswearresistant.

Uses of Cast Iron

1. It is used In making pipes
2. It is used for making machinebodies
3. It is used in making automotive industry parts.

- **Steel**

Steel is manufactured from pig iron by decreasing the amount of carbon and other impurities and adding specific and controlled amounts of alloying elements during the molten stage to produce the desired composition.

The metals which contain iron as base are called ferrous metals.Eg.Castiron,Alloysteelsetc.

- **CarbonSteels**

High carbon steels have more than 0.60% carbon i.e. 0.6-0.9% carbon. It is generally used for making parts requiring strength,hardness and wear resistance.

Properties of CarbonSteels

- It has good strength
- It has high toughness
- It has increased wear resistance.

Uses

- It i s used for making Drop hammers
- It is used f or making Screwdrivers
- It is used for making laminated Springs
- It isused formakin ggears.
- It is used fo rmaking pistonrings

A. AlloySteels

Steel is a metal alloy consisting mostly of iron, .The most common alloying elements added to steel are Chromium, Nickel, manganese, silicon, Vanadium etc.

Properties of Alloy Steel

1. **High Strength**
2. High corrosion resistance
3. High wear resistance
4. Good toughness.

Uses

1. It is used formaking Aeroplane parts
2. It is used formaking automobile parts
3. It is used for ailway track work
4. It is used formaking locomotive parts

1.1.2 Nonferrous metals

Nonferrous metals are those composed primarily of some element or elements other than iron, although nonferrous metals or alloys sometimes contain a small amount of iron as an alloying element or as an impurity.

Non-ferrous metals contain either no iron or only insignificant amounts used as an alloy, and are nonmagnetic.

The following list will introduce you to some of the common nonferrous metals that SWs may encounter and/or work with;

Brass: - an alloy of copper and zinc, sometimes with additional alloys for specific properties; sheets and strips are available in several grades.

Bronze:- a combination of 84% copper and 16% tin, and the best metal available before steel-making techniques were developed; the name bronze is currently applied to any copper-based alloy that looks like bronze. It is alloy of copper and tin.

The composition range is5-25% tin and 75 to 95% copper. The corrosion resistance of bronzes are superior than brasses.

Properties of Bronze

1. It is comparativley hard
2. It is resistance to surface wear
3. It can becasted in to wire sand sheets
4. It has highst rength.

Uses

- It is used in hydraulic fittings, pump linings,
- It is used in making tensils,bearings,bushes,sheets,rods,wireetc.

Copper: -is easily identified from all other metals due to red dish in color and is extracted from copper pyrites. One of the most popular commercial metals; used with many alloys; frequently used to give a protective coating to sheets and rods and to make ball floats, containers, and soldering coppers.

Properties of Copper:

1.It is relatively soft.

2.It is very malleable and ductile.

3.It is very good conductor of heat and electricity.

4.It is very flexible.

Uses of Copper

1.It is used for making electrical cables.

2.It is used for making kitchen vessels

3.It is used for making pipes which are used in refrigerators.

4.It is used making for ornaments.

Aluminium

Aluminum is most abundant metal in the earth crust. It is silvery white in color. It make super bout 8% by weight of the earth's solid surface Aluminum is remarkable for it slow density and ability to resist corrosion.

Properties of Aluminium

It is a good conductor of heat and electricity.

It is very light in weight.

In purest is very weak and soft

Uses

1. It is used for making automobile parts
2. It is used or ornamemtal purpose
3. It is used for making aircraft parts
4. It is used for making bars,tubes & rivets

1.2 Laying out and marking dimensions

Layout is the process of making lines, circles, and other marks with a variety of hand tools to represent the features on the blueprint. These marks act as a reference for the operator during machining. They indicate features such as whole locations, dimensions, and other specific areas to be machined. The work piece is coated with a special layout dye.

Marking out and measuring is a critical part of manufacturing and is usually subject to a number of quality control checks. If components are marked out and measured wrongly before being cut out, there is no chance of them fitting together when they are assembled. Always take marking out measurements from a datum as indicated in. A datum edge is a flat face or straight edge from which all measurements are taken. This prevents cumulative errors being made. If you are using timber, choose the face side carefully, before marking it with a small symbol for identification purposes. Then select a face edge that is at right angles to the face side. Take all your measurements from this side and/or edge.

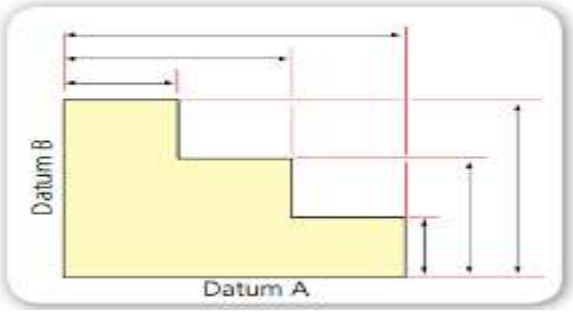

Figure.1.1 Datum edges

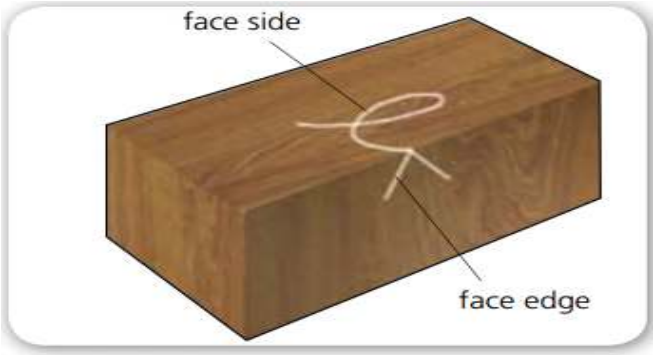

Figure.1.2 Face edges

Common layout and mark dimensions/features

The layout process involves several different types of tools used to accurately scribe the part's Dimensions on its surfaces.

Common layout tools include the following:

- **A steel rule**: is one of the most common hand tools used. Steel rules are often used to make rough measurements and are not extremely precise.
- **Dividers:** are used primarily for spacing distances and scribing circles.
- **A precision steel square:** is used to layout lines as well as to check that two surfaces are squared to each other. It has two sides that form a 90˚ angle. Precision steel squares are extremely accurate.
- **A scriber:** creates fine lines on the surface of a work piece. Some scribers have angled points for scribing the inside of a circular object.

- **A combination set** includes a steel rule, a square head, a center head, and a **protractor head**. The blade and the square head combine to form a combination square. A combination square lays out 45° or 90° angles that are parallel to an edge. To lay out a smaller angle, the blade must be mounted on the protractor head. The protractor head allows the layout of any size angle.

A **prick punch:** marks small, sharp points along layout lines or prepares a part for Center drilling. A **Ball peen hammer** is used to tap the prick punch to make a mark. The types of layout tools necessary will depend on the dimensions specified in the blueprint and their level of accuracy

1.3. Performing laying out and marking

Lay out is the process of making lines, circles, and other marks with a variety of hand tools to represent the features on the blueprint. These marks act as a reference for the operator during machining. They indicate features such as hole locations, dimensions, and other specific areas to be machined. The work piece is coated with a special layout dye.

Marking out and measuring is a critical part of manufacturing and is usually subject to a number of quality control checks. If components are marked out and measured wrongly before being cut out, there is no chance of them fitting together when they are assembled. Always take marking out measurements from a datum as indicated in. A datum edge is a flat face or straight edge from which all measurements are taken. This prevents cumulative errors being made. If you are using timber, choose the face side carefully, before marking it with a small symbol for identification purposes. Then select a face edge that is at right angles to the face side. Take all your measurements from this side and/or edge. Refer the following lay out from the previous;

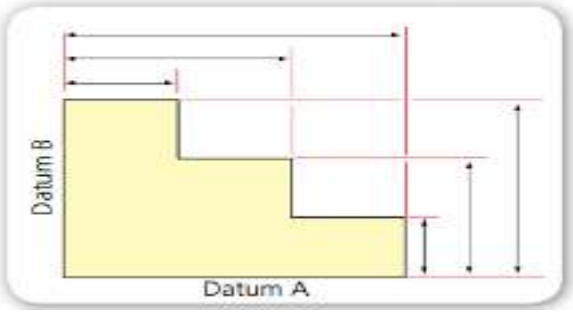

Figure.FIG1.3 Datum edges

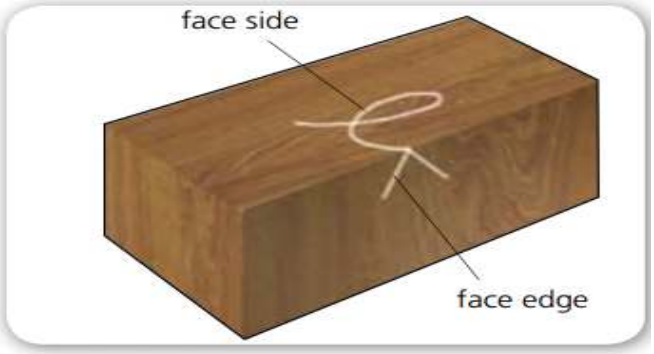

Figure.1.4Face edges

Common layout and mark dimensions/features

The layout process involves several different types of tools used to accurately scribe the part's Dimensions on its surfaces. Common layout tools include the following:

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A **combination set** includes a steel rule, a square head, a center head, and a **protractor head**. The blade and the square head combine to form a combination square. A combination square lays out 45° or 90° angles that are parallel to an edge. To layout a smaller angle, the blade must be mounted on the protractor head. The protractor head allows the layout of any size angle.

A **prick punch:** marks small, sharp points along layout lines or prepares a part for Center drilling. A **ball peen hammer** is used to tap the prick punch to make a mark. The types of layout tools necessary will depend on the dimensions specified in the blueprint and their level of accuracy.

1.3.1 Bench work tools and equipment

Hand tools can be classified into several groups:

- fastening tools
- gripping and clamping tools
- impact tools
- cutting tools
- marking-out tools
- Measuring tools.

A. Drill Press

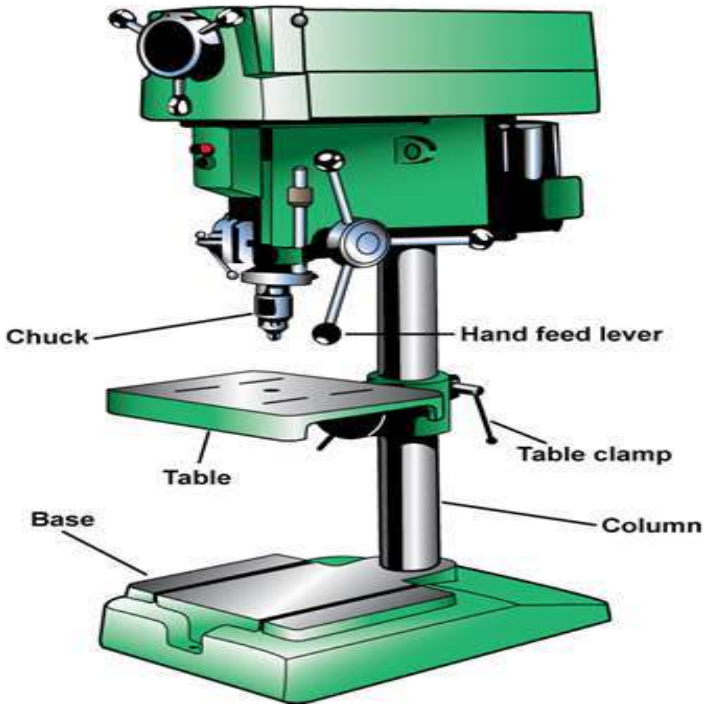


Figure 1.5 - Drill Press

A drill press performs operations similar to those of a portable drill, but it is a large stationary machine capable of heavier work. Common uses for drill presses are drilling or boring holes and countersinking (making a recess where a screw can be driven). Main parts of a drill press include an on/off switch, column, table clamp, hand feed lever, chuck, table, and base. The hand-feed lever lowers and raises the chuck, which holds the drill bit.

B. Pedestal Grinder

Grinding is the process of removing metals by application of abrasives which are bonded to form a rotating wheel .It is a common error to believe that grinding abrasives wheel remove metals by a rubbing action actually the process as much a cutting action as drilling ,milling ,and lathe turning

The grinding machine is used for roughing and finishing flat, cylindrical, and conical surfaces; finishing internal cylinders or bores; forming and sharpening cutting tools; snagging or removing rough projections from castings and stampings; and cleaning, polishing, and buffing surfaces. Once strictly finishing machines, modem production grinding machines are used for complete roughing and finishing of certain classes of work.

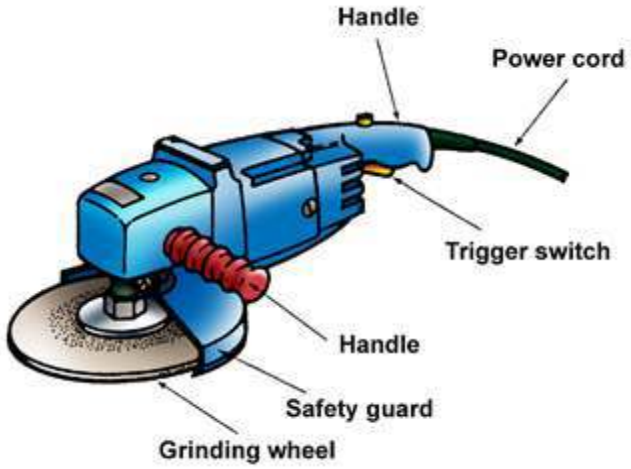


Figure 1.6 : Grinding machine

C. Surface Plate

It is flat horizontal hardened steel plate used to hold work piece along with an angle plate. V-block ,scriber etc. To mark the workpiece.It helps to mark the surface accuretly.It is used for checking theflatness of the workpiece.It is used to mark the workpiece. It is made of cast iron or hardended steel or granite stone.It is specified by the length, breadth, height and grade.

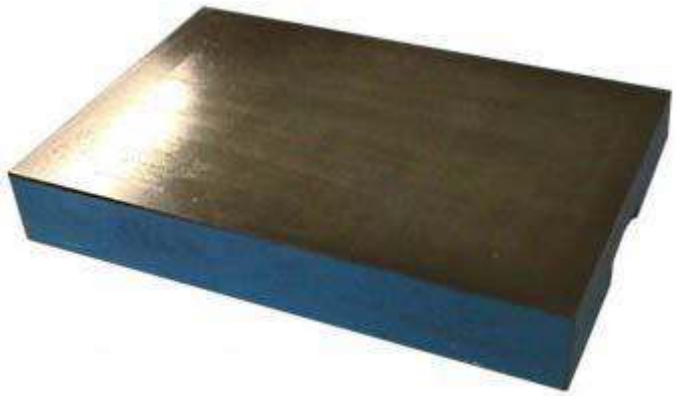


Figure 1.7-surface pate

1.3.2 Layout and marking tools

- A **steel rule**: is one of the most common hand tools used. Steel rules are often used to make rough measurements and are not extremely precise.
- **Dividers:** are used primarily for spacing distances and scribing circles.

Figure.1.8 Divider

- A **precision steel square:** is used to layout lines as well as to check that two surfaces are squared to each other. It has two sides that form a 90˚ angle. Precision steel squares are extremely accurate.

Figure.1.9 Try square

- A **scriber:** creates fine lines on the surface of a work piece. Some scribers have angled points for scribing the inside of a circular object.

Figure.1.10 Scriber

A prick punch: marks small, sharp points along layout lines or prepares a part for Center drilling. A ball peen hammer is used to tap the prick punch to make a mark. The types of layout tools necessary will depend on the dimensions specified in the blueprint and their level of accuracy.

Figure.1.12 Prick punch

1.3.2 Cutting tools (hacksaw, chisel, files)

Cutting tools plays a most important role in removing excess metal from the job to obtain desired finished part. The various cutting tools used in fitting are:

1. Hack saw
1. Chisels
2. Files

1. **Hacksaw:-**It is basic and cutting tool used for cutting unwanted material.It is used for cutting metals and making recesses priperto filing or chipping.It is also used for cuttings lotsand contours.

Parts of hack saw :It consists of the following parts.

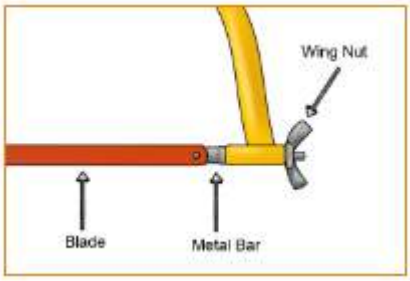
- Metalframe
- Handle.
- Blade
- Wingnut and Screw

The frame is made to hold the blade tightly.They are made in two types.

a)The solidframehacksaw in which the length cannot be changed.

b)Theadjustable frame in which the frame canbe adjusted to hold the blades of different lengths.

Hack Saw Blade: It is thin, narrow steel strip made of high carbon steel or low alloy steel or high speed steel The blade has two pin holes at the ends which fits over two pins which project from the stand that slides in and out of the remind.



Figue 1.13 Replacing hack saw blade

Methods of replacing hack saw blade

Turn the wing nut in an anti-clockwise direction. This controls the position of a metal bar at the end of the frame's arm. This bar holds one end of the blade.Turning the wing nut anti-clockwise pushes the bar forward, so that it's no longer stretching the blade.

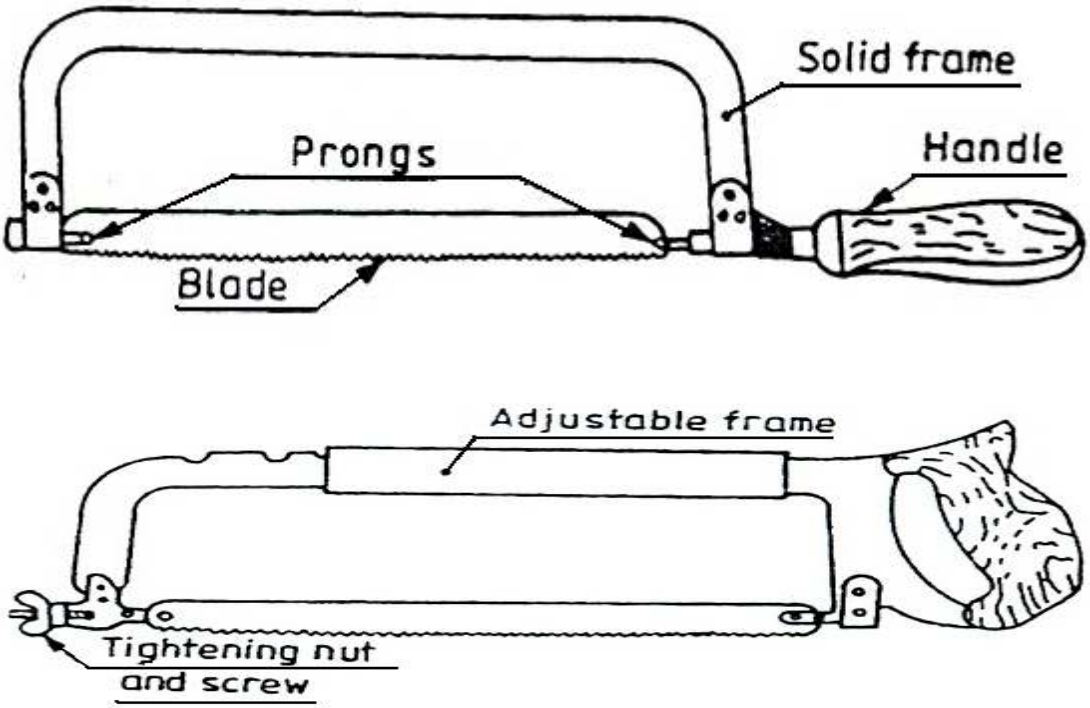


Figure: 1.14 Hacksaw frame with blade

2. **Chisels**

Chisels include:

Cold chisels are used for cutting thin sheet sand to remove excess material from large surfaces. Parts of a typical cold chisel are as follows ;

Chisels are used for removing surplus metal or for cutting thin sheets. These tools are made from 0.9% to 1.0% carbon steel of octagonal or hexagonal section. Chisels are annealed, hardened and tempered to produce a tough shank and hard cutting edge. Annealing relieves the internal stresses in a metal. The cutting angle of the chisel for general purpose is about 60°.

Chiseling is the working on material with a sharpened wedge-shaped tool named chisel.The cutting effectis achieved by striking the head of the chisel with hammer.The most common type of chisel is flat chisel.

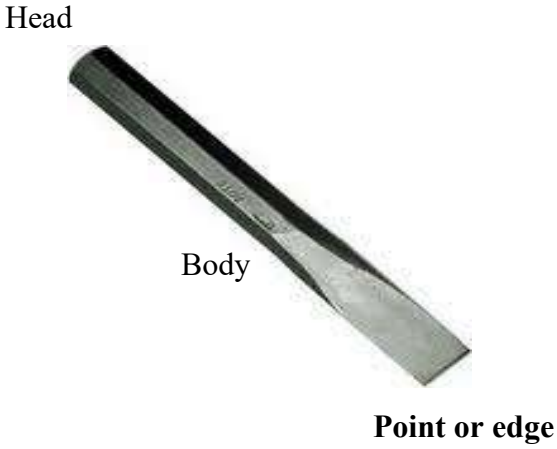


Fig 1.15 Flat Chisel.

Files:-is a process to remove surplus metal and to produce finished surfaces .File components consist of tang ,heel ,face, edge and point. When a file is applied to a metal surface with a reciprocating motion, the teeth act as small chisel ,each removing small chips. Shapes of files in common use are flat, hand, square, three square ,and half-round and round files .In the work shop ,there are three type of files, which are flat ,three-square and half round.

File is a cutting tool with multiple teeth like cuttings edges used for producing smooth surface.The accuracy that can be achieved from 0.2 to 0.05mm.

Figure:1.16 File

The files of different cross section or types are needed to suit the various job operations. The most commonly used files are

- Flat File
- Square file
- Round File
- Half Round File and Triangular File

Drills, reamers, laps

Drilling is the processing of a material by mechanical cutting using a drilling tool (drilling machine and twist drill) that revolves on its longitudinal axis and thereby carries out a longitudinal motion. Drilling produces drilled holes to a required diameter. There are various types of hole making operation. For examples drilling, boring, counter boring, countersinking and taping.

Reamers :A drill does not produce accurate hole and it must be finished by finishing tool called reamer When an accurate hole with a smoother finish are quire are aimer is used. Hence the reamer can only follow the drilled hole and removes very small amount of metal to make its smooth.

Inspection and measuring tools (templates, venire caliper, micrometer, straight edge, gages, etc…)

1. Measuring tools

Accurate measurement is very essential in carpentry work, to produce parts to exact size. To transfer dimensions on to the work; the following are the marking and measuring tools that are required in a carpentry shop.

2. Steel rule and Steel tape

Steel rule is a simple measuring instrument consisting of a long, thin metal strip with a marked scale of unit divisions. It is an important tool for linear measurement. *Steel tape* is used for large measurements, such as marking on boards and checking the overall dimensions of the work.

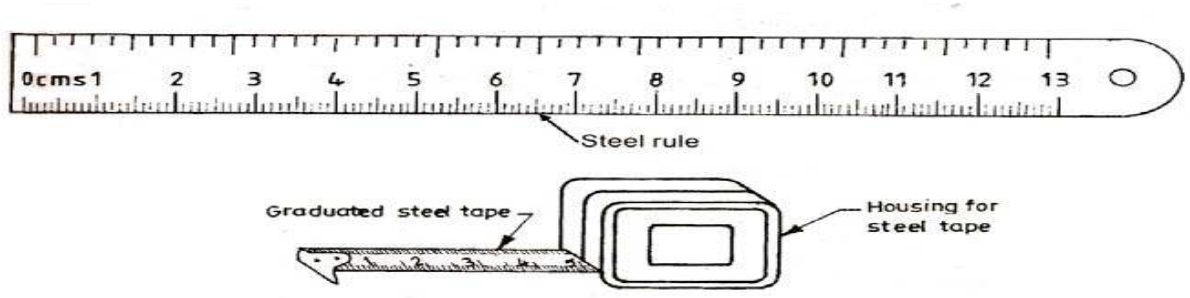


Figure:1.17 Steel rule and Steel tape

3. Try-square

It is used for marking and testing the sureness and straightness of planed surfaces. It consists of a steel blade, fitted in a cast iron stock. It is also used for checking the planed surfaces for flatness. Its size varies from 150 to 300 mm, according to the length of the blade. It is less accurate when compared to the try-square used in the fitting shop.

Figure:1.18 Try square

4. Compass and divider

Compass and divider, are used for marking arcs and circles on the planed surfaces of the wood.

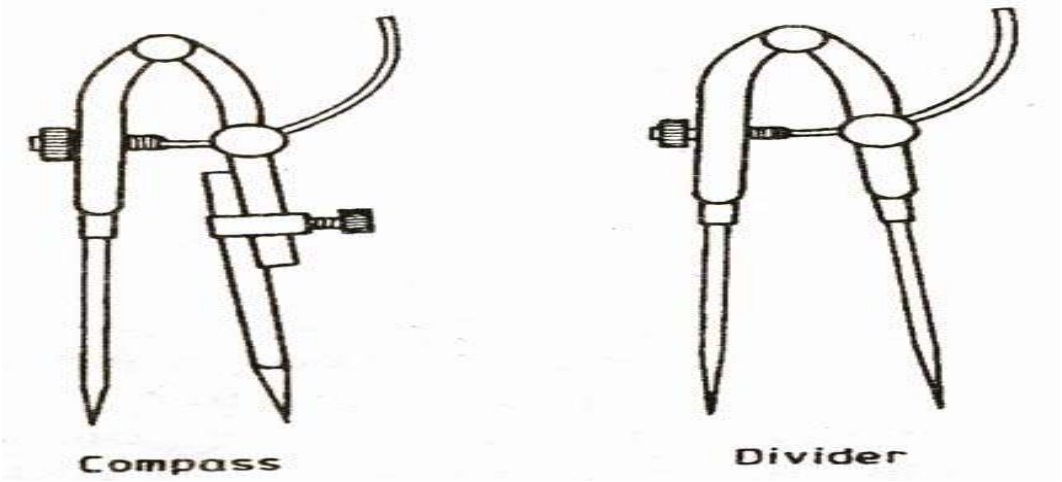


Figure: 1.19Compass and Divider

5. Calipers

They are indirect measuring tools used to measure or transfer linear dimensions. These are used with the help of a steel Rule to check inside and outside measurements. These are made of Case

hardened mild steel or hardened and tempered low carbon steel. While using, but the legs of the caliper are set against the surface of the work, whether inside or outside and the distance between the legs is measured with the help of a scale and the same can be transferred to another desired place. These are specified by the length of the leg. In the case of outside caliper, the legs are bent inwards and in the case of inside caliper, the legs bent outwards.

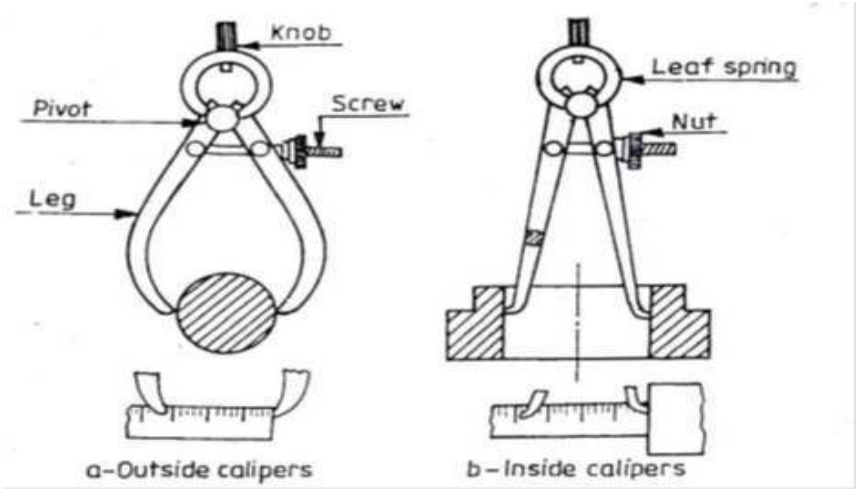


Figure:1.20 Calipers

6. Venire Calipers

These are used for measuring outside as well as inside dimensions accurately. It may also be used as a depth gauge. It has two jaws. One jaw is formed at one end of its main scale and the other jaw is made part of a venire scale.

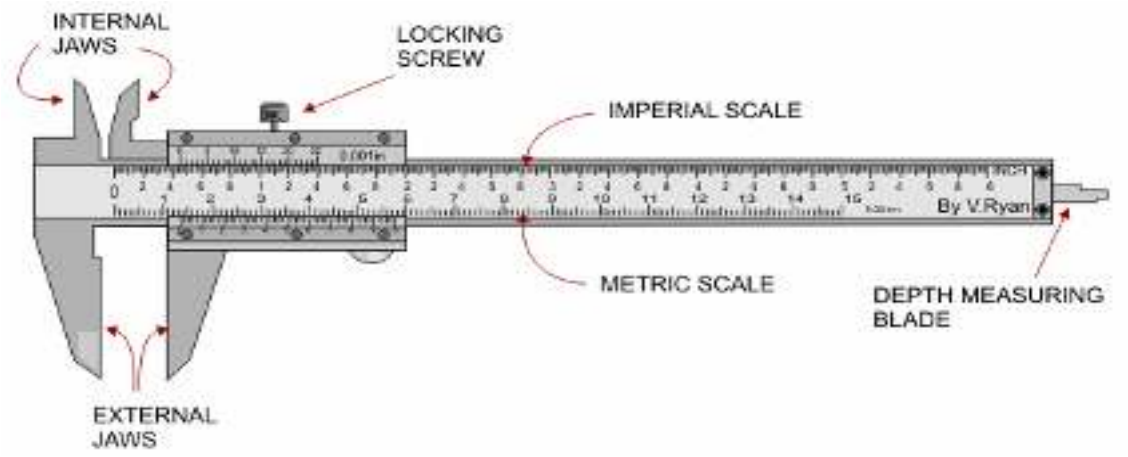


Figure:1.21 Venire caliper

Self check-1

Directions: Choose the best answer for the questions (2 point each):

1. Which one of the following are used for measuring outside as well as inside dimensions accurately.

   A. Micrometer C. Steel rule

   B. Vernier caliper D. Divider

2. ----------are used for measuring outside diameter of cylindrical objects, parallel surfaces or other outside dimension.

   A. Center punch B. Divider C. prick punch D. outside micrometer

3. Which one of the following is for measuring the depth of holes, slots, grooves and shoulders?

   A. vernier caliper C. File card

   B. depth micrometer D. Reamer

OPERATION SHEET 1.1: layout and mark dimension

Operation Title: Procedure for Removing Paint from your Vehicle
Instruction: Do not! Try to remove paint by scrubbing the vehicle's finish with a solvent or Scouring cleanser as doing so will cause damage to the finish.

Purpose: the purpose of this Operation Sheet is applying the paint removal method

Required tools and equipment:

- Tape rule - divider
- Prick punch - angle plate
- Try square - steel rule
- Scriber - ball peen hammer
- Surface plate - combination set

Procedure: - The procedure for layout and marking a work piece is as follows:

- Select the material of the desired dimension.
- Put it on a surface plate
- Measure with a steel rule starting from the safe edge
- Mark with a scriber and scribe as per the given drawing.
- Scribe circles and arcs using a divider and angles with a combination set
- Prick punch the dimension lines

Safety:-

- Do not try to layout without wearing hand gloves.
- Always use a sharp scriber or divider
- Press firmly as you scribe so as to make the layout lines visible enough.

Criteria:

-1. The work piece is laid out according to the drawing.

LAP Test 1.1	Practical Demonstration

Name_____ Date_____

Time started_____ Time finished_____

Instructions:

You are required to perform the following:

1. Request your teacher the necessary layout and marking tools
2. For procedures you can refer operation sheet.
3. Request your teacher for evaluation and feedback.

Unit Two: Cut, Chip and File Flat Rectangular and Round Blocks

This unit to provide you the necessary information regarding the following content coverage and topics:

- Applying safety procedures
- Clamping work pieces
- Cutting, chipping or filing work pieces
- Replacing broken or dull hacksaw blades.

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Apply safety procedures
- Clamp work pieces
- Cut, chip or fil work pieces
- Replace broken or dull hacksaw blades.

2.1. Applying safety procedures and using PPE

Safety: - means protecting our selves and others from injury or any other accidents. These accidents in the workplace are prevented by the following;

a. Working safely and
b. Follow the right work procedure.

The ways to learn and understand safety are;

a. Accidental experiences and
b. Safety education.

Accidental experiences: - are experiences which were caused by accidents. But, you can't afford to learn safety through experiences. However, being safe can mean the difference between life and death.

Safety education: - means knowing by learning safety before performing anything. This is a method which makes us aware of dangerous situations to avoid accidents or injuries.

In general, there are three safety guide lines and called general workshop safety procedures. These are:-

- Personal safety,
- Tools and equipment safety and
- Work area safety

Personal safety /personal protection equipment or needs/

Personal safety means protecting ourselves from injury or accidents. How to protect or take care yourself in the workshop?

Protecting yourself from injury is by wearing of personal protective equipment (PPE) and clothing. These are:

- Wearing eye glasses(goggles)
- Wearing ear protection
- Wearing cap head band or hairnet.
- Wearing proper clothing, shoes, and gloves.

Tools and equipment safety: - this is

- Correctly handling of tools and equipment
- Proper use of tools and equipment

When working with any tool and equipment;

- Make sure it is make properly,
- It should be properly maintained
- Check it before you use it.

Work area safety: - that means;

- Keeping the workshop clear of obstruction such as oil, water, acid, chips of metal wood and wastage particles in automotive work shop areas.
- A clean and an organized work area such as machines, tools and consumable material.

This is done by implementing workshop activities, such as:

- Regular inspection
- Cleaning of areas
- Disposal of wastes
- Storage of equipment that are not in use.

First aid: - is an immediate care given to person who has been injured or suddenly taken ill. It includes self-care and home care.

2.2. Clamping work pieces in work holding devices

A C-clamp

This is used to hold work against an angle plate or v-block or any other surface, when gripping is required. Its fixed jaw is shaped like English alphabet ‘C’ and the movable jaw is round in

shape and directly fitted to the threaded screw at the end .The working principle of this clamp is the same as that of the bench vice.

Fig2.1 C. clamp

Drop forged and designed with a deep throat. Copper plated screw and swivel pad to prevent weld splatter from sticking to them.

Design and materials are exactly the same as Parco-Lubricate finish. However, forcing screw is zinc plated to resist the adhesion of welding splatter.

B Parallel Clamps

Jaws are made of hardened and tempered steel. Clamps are equipped with spring clips

Fig2.2 Parallel Clamp

C Vises

Bench Vises with Swivel Base

Removable hardened alloy steel jaw inserts. Completely enclosed center screw Cutting, chipping or filing work pieces

2.3 Cutting, Chipping and Filing

- **Cutting metals**

Some of the most common tools used to cut metals are **hacksaws**, **cold chisels**, **bolt cutters and file**. Large stock is sawed, while bar stock is either sawed or cut with a cold chisel. Sheet metal is usually cut with metal snips. In fabrication facilities, large amounts of metal are cut with horizontal band saws or metal shears, commonly called "iron workers .Layout tools are used to measure and mark metal stock before cutting, shaping, and doing other types of work with cold metal.

- **Chipping**

Removing the metal with a chisel is called chipping and is normally used where machining is not possible. While chipping, safety goggles must be put on to protect eyes from the flying chips. To ensure safety of others, a chip guard is placed in position. Care should be taken to see that the chisel is free from mushroom head.

- **Filing**

Files are multi points cutting tools. It is used to remove the material by rubbing it on the metals.

Filing is one of the methods of removing small amounts of material from the surface of a metal part. A file is hardened steel too, having small parallel rows of cutting edges or teeth on its surfaces. On the faces, the teeth are usually diagonal to the edge. One end of the file is shaped to fit into a wooden handle. The figure shows various parts of a hand file. The hand file is parallel in width and tapering slightly in thickness, towards the tip. It is provided with double cut teeth. On the faces, single cut on one edge and no teeth on the other edge, this is known as a safe edge.

Files are available in a number of sizes, shapes and degree of coarseness.

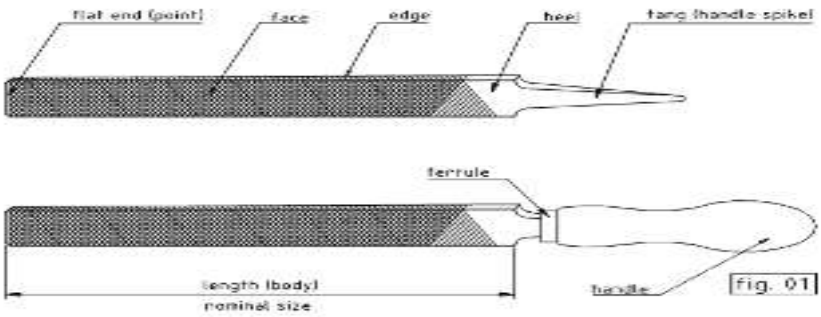


Fig. 01

Figure; 2.3 Parts of a hand file

Classification of files and Cut Pattern

Files are classified according to their shape, cutting teeth and pitch or grade of the teeth. The figure shows the various types of files based on their shape. It is suitable for the soft metal.

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

A. single

B. Double

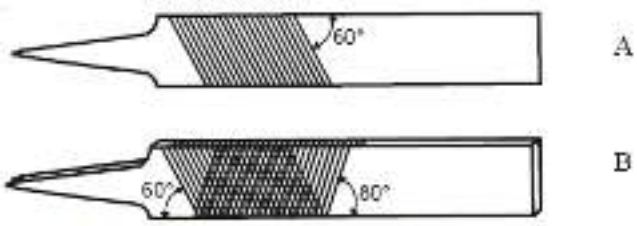
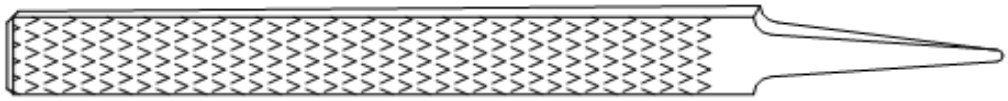


Fig 2.8 Single cut and Double cut file
A. Single cut B. Double cut

Figure 2.4

Double Cut - A double cut file has one set of teeth cut at 60 degrees to one edge, and another set of grooves cut at 80 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.



rasps-file (flat)

Figure:2.5 Single and double cut files

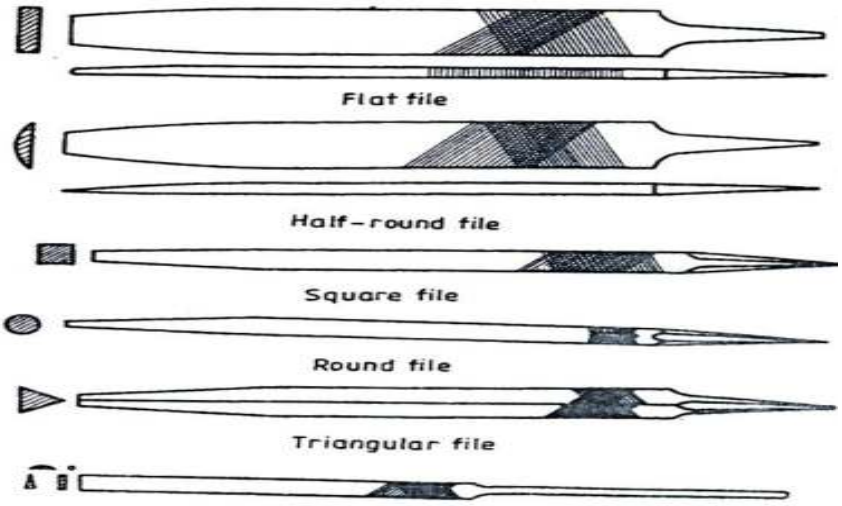


Figure2.6: types of file

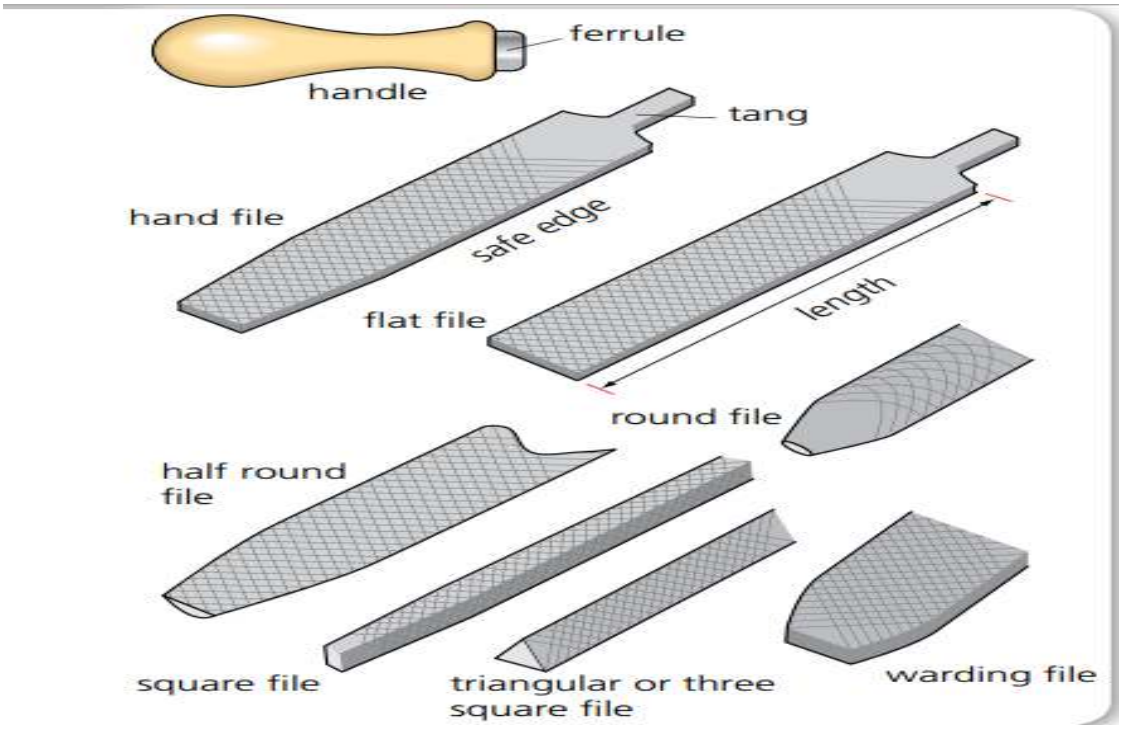


Figure: 2.6.- parts of Files

There are several methods of filing, each with a specific purpose. With reference to the figure,the following may be noted:

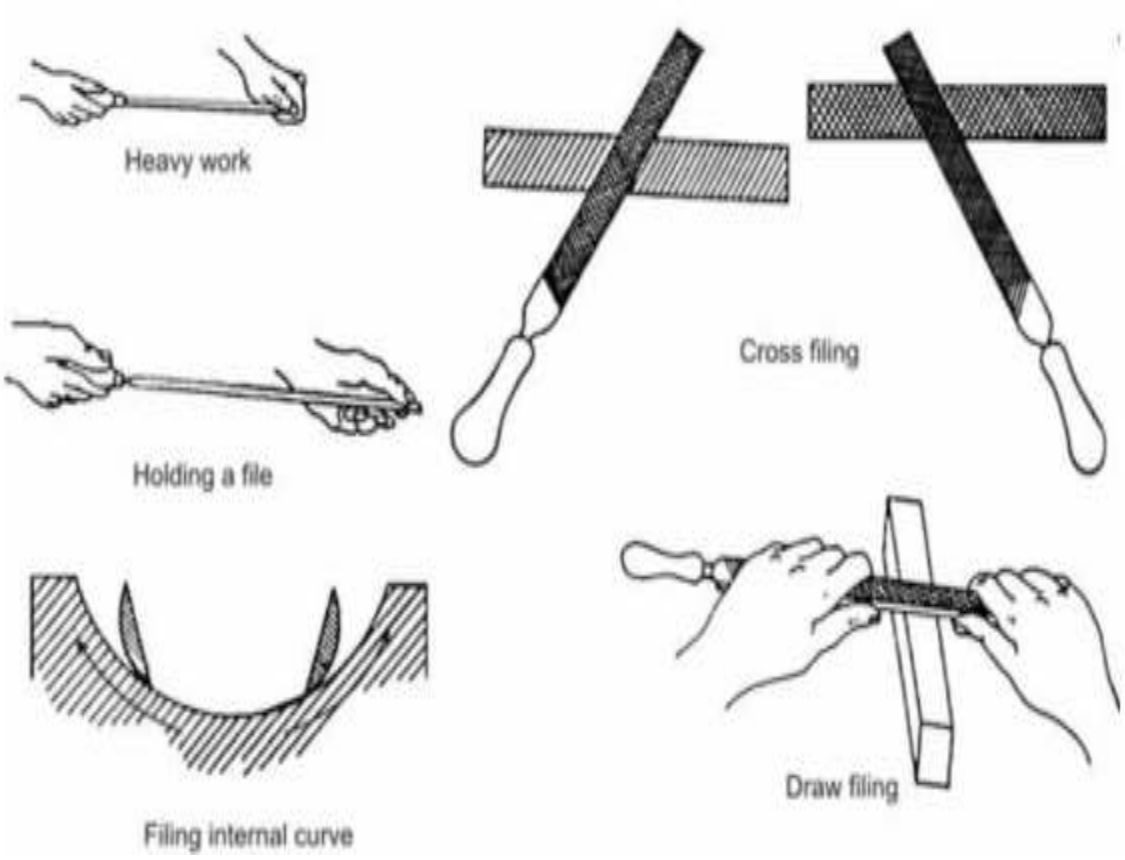
Holding the file: For heavy work and to remove more metal, a high pressure is used. For light and fine work, a light pressure is applied.

Filing internal curves: A part of half round file only makes contact as shown during filing operation. Movement of the file is indicated by arrows.

Cross filing: It is the most common method of filing. Cross filing is carried out across two diagonals, to produce medium surface finish. It is used when large an amount of metal is to be removed. By cross filing 'rounding' the surface is reduced.

Straight filing: When a short length of work piece is required to have a flat surface, straight filing is used. File marks made during cross filing may be removed, to produce a relatively smooth surface.

Draw filing: It is done to get a finely finished surface. It produces a smoother surface finish than straight filing. A smooth or dead smooth flat file is used for this.



Fiure.2.7 Filing methods

File card (steel brush)

It is a metal brush, used for cleaning the files, to free them from filings, clogged in-between the teeth. It is a device fashioned like a wire brush used to clean dirt and chips from the teeth of a

file. When particles of metal clog the teeth the file is said to the pinned, a condition that causes scratching of the surface of the work. Files, therefore, require cleaning by means of a file card or by dislodging the material between the teeth by means of a piece of soft iron, copper, brass, tin plate and so on, sharpened at the end. Hardened steel should never be used.

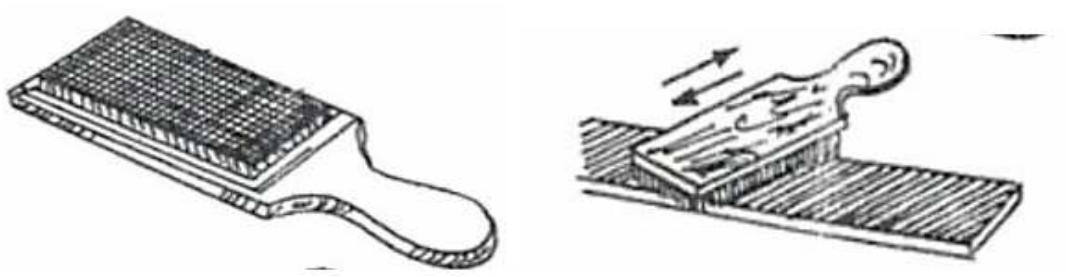


Figure: 2.8File card, a wire brush used to clean the teeth of the file

2.4Replacing broken or dull hacksaw blades.

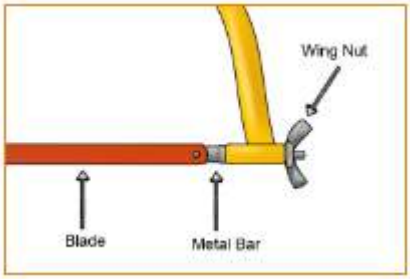


Figure.2.9Replacing hack blades

Methodereplacing hack saw blade

Turn the wing nut in an anti-clockwise direction. This controls the position of a metal bar at the end of the frame's arm.

This bar holds one end of the blade. Turning the wing nut anti-clockwise pushes the bar forward, so that it's no longer stretching the blade.

Self-Check -2	

Multiple choice

Directions: choose the best answer for the following question (2 point each):

1. Removing the metal with a file is called_____

   A. Scrapping C. Chipping

   B. Filling D. All

2. Some of the most common tools used to cut metals are_____

   A. hacksaws C. cold chisels

   B. tin snips D. all

3. _____a file is used when large an amount of metal is to be removed.

   A. Cross filing C. Draw filing

   B. Straight filing D. All

Operation Sheet-2.1	File flat ,rectangular or round blocks

Purpose: - To file to the desired accuracy

Conditions or situation for the operation:

The work piece (flat iron) must be selected filed as per the given drawing.

Equipment, tools and materials: -

- Tape rule
- steel rule
- Ball peen hammer
- combination set
- files
- File card
- flat iron
- Prick punch
- Try square
- Scriber
- Divider
- angle plate
- **Sheet metal 150 mmx50 mmx1.5 mm**

Procedure: - The procedure for chipping a work piece is as follows:

1. Hold the work firmly in the vice.
2. Allow a small part of the work to project from the vice and avoid vibration.
3. The work should normally be level with your elbow
4. Apply pressure in the forward stroke only.
5. Observe the correct methods for handling files, for heavy and light filing.

Precaution:-

1. Do not try to chip without wearing hand gloves.
2. Do not chip without wearing safety glass
3. Never use a file without a handle.

Criteria: - 1. The work piece is filed according to the drawing.

1. The filing must be done with 99.9% accuracy.

Operation Sheet-2.2	Cut flat ,rectangular or round blocks

Purpose: - To cut to the desired accuracy

Conditions or situation for the operation:

The work piece (flat iron) must be selected cut as per the given drawing.

Equipment, tools and materials: -

- File - flat iron
- Hack saw - divider
- Tape rule - angle plate
- Prick punch - steel rule
- Try square - ball peen hammer
- Scriber - combination set
- Surface plate
- **Sheet metal 150 mmx50 mmx1.5 mm**

Procedure: - The procedure for cutting a work piece is as follows:

- Hold the work securely in the vice.
- Grip the hacksaw firmly, using both hands.
- Use the same stance as for filing.
- Use the full length of the blade.

Safety:-

- Do not try to cut without wearing hand gloves.
- Grip the hacksaw firmly, using both hands Press firmly as you scribe so as to make the layout lines visible enough.

Criteria: - 1. The work piece is laid out according to the drawing.
2. The cutting must be done with 99.9% accuracy.

Lap test

Name ……. Date……

Time Started…….Time finished……

Produce a rectangular block at standards surface finish with in a specification given below

100mmx20mmx1.5mm

1.Ask every procedures from your teacher

3.Request your teacher for evaluation and feed back

2 Prepare all necessary tools and equipments , refer information sheet 2.2

Unit Three: Drill, ream and lap holes

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Drilling and reaming
- spot-facing and lapping

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Drill and reaming
- Apply spot-facing and lapping

3.1. Drilling and reaming

A wide variety of drill presses are available, ranging from the simple sensitive drill to highly complex automatic and numerically controlled machines. The size of the drill press may be designated in different ways by manufacturers. Some manufacturing company state the size of as the distance from the center of the spindle to the column of the machine. Others specify the size by the diameter of the largest circular piece that can be drilled in the center. Drilling machines may be used for performing a variety of operations besides drilling a round hole. **Drilling** is may be defined as the operation of producing a hole by removing a metal from a solid mass using a cutting tool called a twist drill.

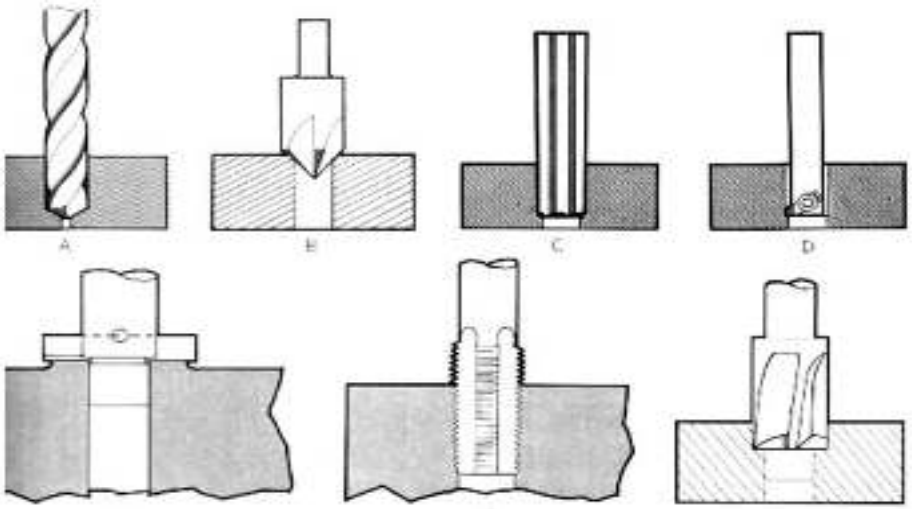


Figure.3.1Reaming

Procedure of drilling

1. Prior to drilling a hole, locate the hole by drawing two crossing lines. Use a center punch to make an indentation for the drill point to aid the drill in starting the hole.
2. Select the proper drill bit according to the size needed.
3. Select an appropriate size center drill.
4. Select a cutting fluid.
5. Properly secure the work piece to the table.
6. Select the correct RPM for the drill bit.
7. Use an interrupted feed, called peck drilling, to break up the chips being produced.
8. Pilot holes should be used on holes larger than 10mm dia. Holes are to be enlarged in no more than 7mm increments.
9. Clean the drill press and surrounding area when finished.

Sensitive Drill Presses machine is illustrated below

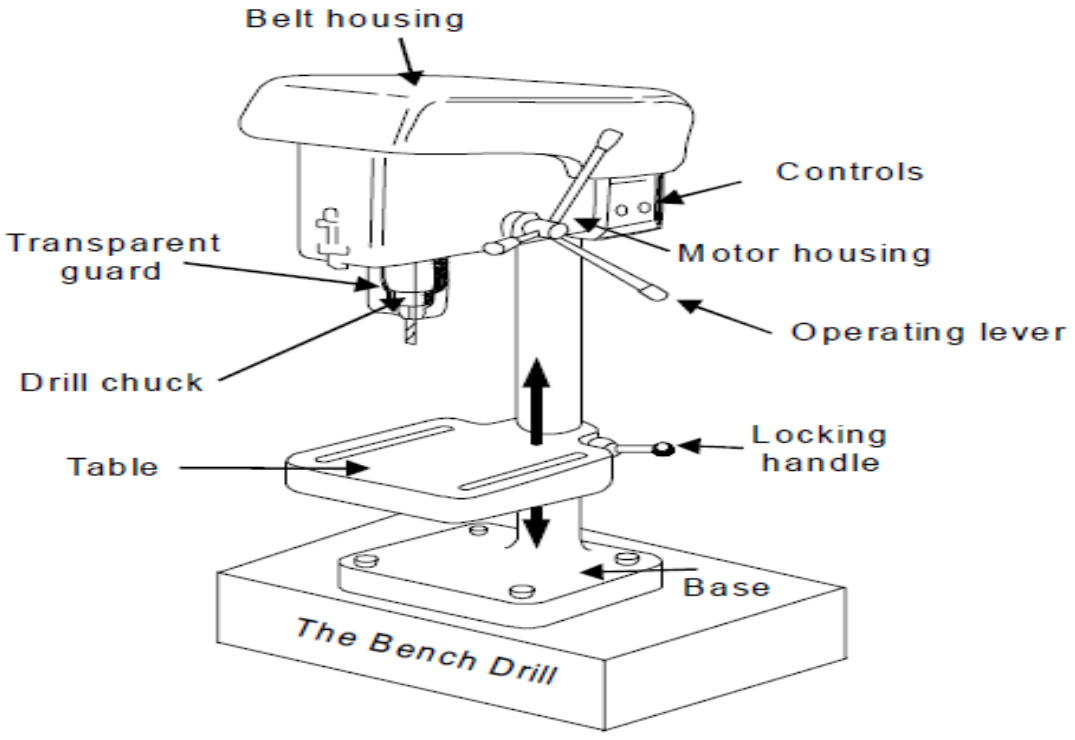


Figure.3.2 Drill press

Drill Bits

Twist drills are end-cutting tools used to produce holes in most types of material. On standard drills, two helical grooves, or flutes, are cut lengthwise around the body of the drill. They provide cutting edges and space for the cuttings to escape in the drilling process. Since drills are one of the most efficient tools, it is necessary to know the main parts, how to sharpen the cutting edges, and the correct speeds and feeds for drilling various metals in order to use them most efficiently and prolong their life.

Parts of Twist drills bits

Shank

Most twist drills used in machine shop work today are made of high-speed steel. High-speed drills have replaced carbon-steel drills since they can be operated at double the cutting speed and the cutting edge lasts longer. A drill may be divided into three main parts: the shank, the body and the point.

Generally drills up to 13mm in diameter have straight drill shanks, while those over this diameter usually have tapered shanks. Straight-shank drills (fig. 08/02) are held in a drill chuck; tapered-shank drills (fig. 08/01) fit into the internal taper of the drill press spindle.

A tang (fig. 08/01) is provided on the end of tapered-shank drills to prevent the drill from slipping while it is cutting and to allow the drill to be removed from the spindle or socket without the shank being damaged by using a drill drift.

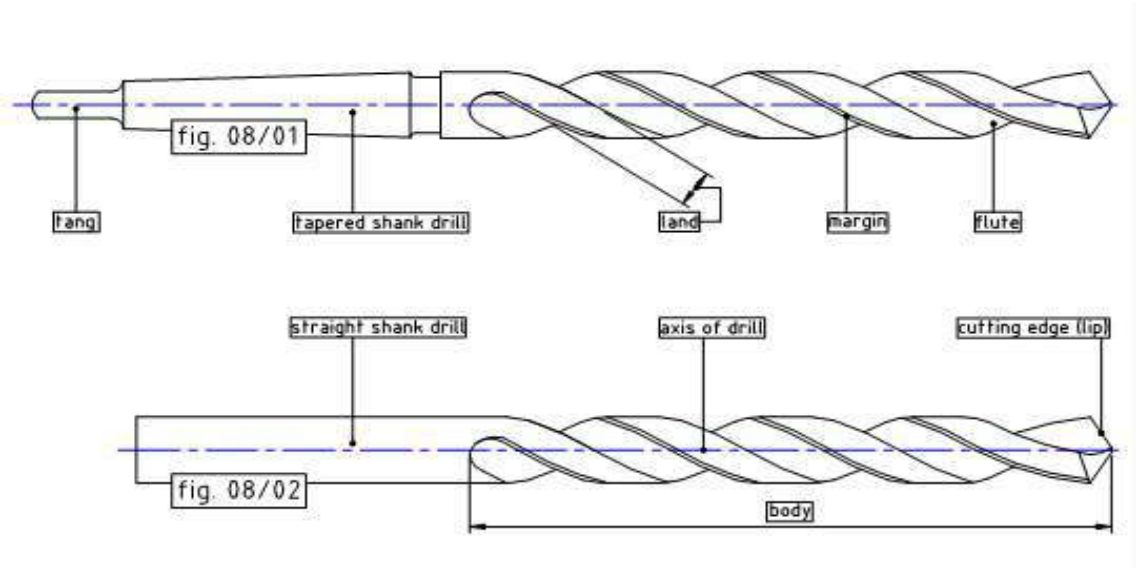


Figure.3.3Drill bit parts

Body

The body is the portion of the drill between the shank and the point. It consists of a number of parts important to the efficiency of the cutting action. The flutes are two or more helical grooves cut around the body the body of the drill. They form the cutting edges, admit cutting fluid, and allow the chips to escape from the hole.

A wide range of drills and drill sizes is used to cut various metals; an equally wide range of speeds is required for the drill to cut efficiently. For every job, there is the problem of choosing the drill sp eed which will result in the best production rates and the least amount of downtime for regrinding the drill. The recommended cutting speeds for drilling various types of materials may be found in the table shown below. The most economical drilling speed depends upon many variables such as:

- the type and hardness of the material
- the diameter and material of the drill
- the type and condition of the drill press
- the efficiency of the cutting fluid employed

perform drilling Procedures

Start with a clean sharp grinding wheel. Hold the drill at approximately 55 degrees off of the axial centerline of the drill (Figure).

Figure:3.5 The approach angle is steeper when web splitting than it is when web thinning.

- Line up the corner of the wheel with the tip of the web (Figure). Turn the cutting lip out approximately 10 degrees away from the wheel edge.
- Lightly grind away the heel of the drill until you have ground away the appropriate amount of the web of the drill.

Figure:3.6 Line up the end of the web with the corner of the wheel.

3.2. spot-facing and lapping

- **Spot-facing**

Spot facing is the operation of smoothing and squaring the surface around a hole to provide a seat for the head of a cap screw or a nut. A boring bar with a pilot section on the end to fit into the existing hole is generally fitted with a double-edged cutting tool. The pilot on the bar provides rigidity for the cutting tool and keeps it concentric with the hole. For the spot facing operation, the work being machined should be securely clamped and the machine set approximately ¼ of the drilling speed.

- **Lapping**

In lapping, instead of a bonded abrasive tool, oil-based fluid suspension of very small free abrasive grains (aluminum oxide and silicon carbide, with typical grit sizes between 300 and 600) called a lapping compound is applied between the work piece and the lapping tool. The lapping tool is called a lap, which is made of soft materials like copper, lead or wood. The lap has the reverse of the desired shape of the work part. To accomplish the process, the lap is pressed against the work and moved back and forth over the surface in a figure-eight or other motion pattern, subjecting all portions of the surface to the same action. Lapping is sometimes performed by hand, but lapping machines accomplish the process with greater consistency and efficiency.

The cutting mechanism in lapping is that the abrasives become embedded in the lap surface, and the cutting action is very similar to grinding, but a concurrent cutting action of the free abrasive particles in the fluid cannot be excluded. Lapping is used to produce optical lenses, metallic bearing surfaces, gages, and other parts requiring very good finishes and extreme accuracy.

Schematics of lapping process showing the lap and the cutting action of suspended abrasive particles.

Self-Check -3	

Multiple choices

Directions: choose the best answer for the following questions (2 points each)

1. ----------is a circular multi- tooth cutting tool which can be used in a drilling machine, when a very accurate hole with a high grade finish is required.

   A. Reamer B. Drill C. Hone D. Fill

4. ----------is a process of producing round holes in a solid material or enlarging existing holes with the use of multi tooth cutting tools.

   A. Honing B. filling C. Sawing D. Drilling

5. ---------- is the operation of smoothing and squaring the surface around a hole to provide a seat for the head of a cap screw or a nut.

   A. Drilling B. Honing C. spot facing D. None

4. ------- is may be defined as the operation of producing a hole by removing a metal from a solid mass using a cutting tool called a twist drill.

   A. vice B. hacksaw C. drilling D. C- clamp

5. One of the following is the Parts of Twist drills

   A. Body C. shank

   B. Thimble D. A&C

6. _____ is the operation of sizing and producing a smooth round hole from a previously drilled or bored hole with the use of a cutting tool having several cutting edges.

   A. Bench vice C. reaming

   B. C-clamp D. All

Operation Sheet-3	Ream holes

Purpose: - To ream to the desired accuracy

Conditions or situation for the operation:

The work piece (flat iron) must be reamed as per the given drawing.

Equipment, tools and materials: -

- Tape rule
- Machine vice
- combination set
- Reamer
- Try square
- Prick punch
- ball peen hammer
- hack saw
- Drilling machine
- Scriber

Procedure: - The procedure for drilling a work piece is as follows:

1. Drill the hole to be reamed with care.
2. Hold the work securely in the vice.
3. Use a good supply of cutting lubricant to help remove chips and reduce friction to obtain a smooth finish.

Precaution:-

- Do not try to cut without wearing hand gloves and safety glass.
- Check the perpendicularity of the reamer to the punch mark before turning on the machine.

Criteria: -

- The work piece is prick punched drilled according to the drawing.

The Reaming must be done with 99.9% accuracy

Lap test

Name…….. Date……..

Time started……. Time finished……

Instruction. According to the following specifications drill and ream a hole . 50mmx150mm

Note. Cooling fluid must be used and every safety procedures should be under taken.

Unit Four: Cut Threads Using Tap, Stock and Die

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Cutting internal thread
- Cutting external thread

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Cut internal thread
- Cut external thread

4.1. Cutting internal thread

Tools for internal threading (tapping)

Internal threads are cut by serial taps or by nut taps.

Serial taps: They consist of two or three tools the distinguishing feature being the design of the cutting part.

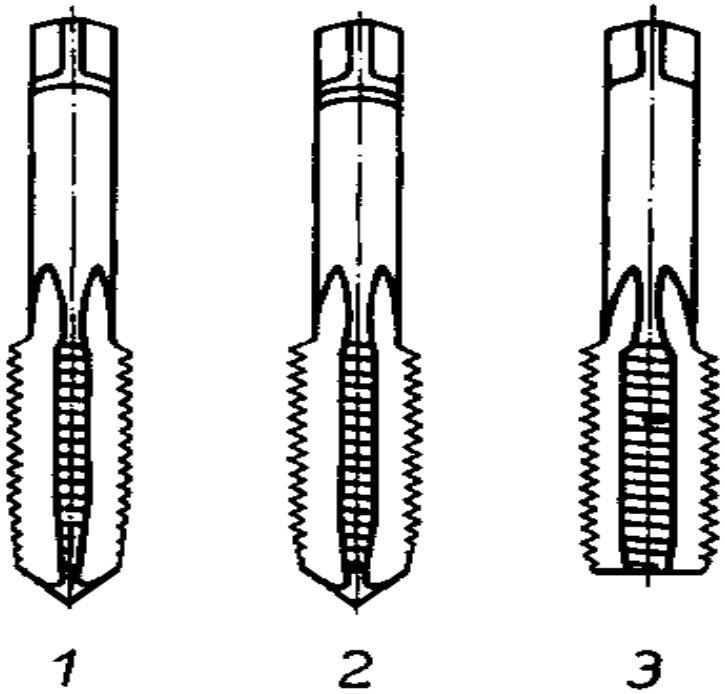


Figure 4.1: Serial taps

1 − Entering tap

2 − Plug tap

3 − Third tap

The plug tap (2nd pass) has a short chamfer and trapper form cutting edges which are deeper; it does approximately 30 % of the cutting work. The (finishing) third tap (3rd pass) has a short chamfer and cutting edges which create the final sharp form of the thread groove; it cuts the thread to nominal size and finishes the thread flanks.

The individual tools are additionally distinguished by marks in the form of engraved rings at the shank below the square. Modern versions of serial taps consist of entering tap and finishing tap only.

Threads may be cut internally using a tap externally using a die. The proper selection and use of these threading tools is an important phase of machine shop work.

- **Dies**

Dies are made either of high-carbon steel or of high-speed steel. Unlike taps, dies are used for cutting external (male) threads. There are three types (Figure blow). The circular split die is a circular piece with a split across one of the flutes. The split is provided to enable small adjustments to be made, using three set screws in the stock. The half die comprises two loose pieces, which are held in the stock. There is a small screw on the stock for adjustment. The die nut has a hexagonal body. This type, strictly speaking, does not cut new threads but is used to 'clean up' threads that are damaged.

- **Taps**

These are the tools used for cutting internal (female) threads. They are made of high-carbon steel or high-speed steel. The tap has a shank with a square end to take the tap wrench or holder.

- **Nut taps:** The nut tap (also called single−pass hand tap) in its cutting part unites the cutting parts of the three serial taps. Consequently, it has a long chamfer representing about 70 % of the total length of the cutting part; the cutting edges are initially trapeze form and become sharp only towards the end. The cutting part is not essentially longer

than that of the serial tap. Yet this cutting part has to do all the cutting operation. The shank with the square is relatively long.

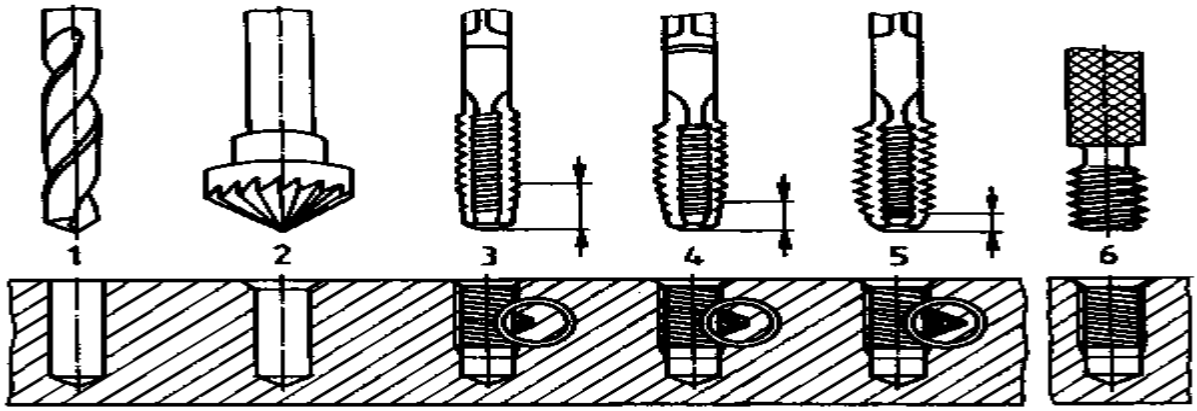


Figure:4.2 Technology of internal thread cutting (tapping)

Nut taps enable quick threading which, however, involves a great cutting power (tearing of the thread may occur). Due to its long chamfer, this tool cannot be used for blind holes.

Note ; Nut taps are used for tapping short through holes.

4.2. Cutting External threads

4.3.1 Tools for external threading

External threads are made with the help of a threading die or die−stock.

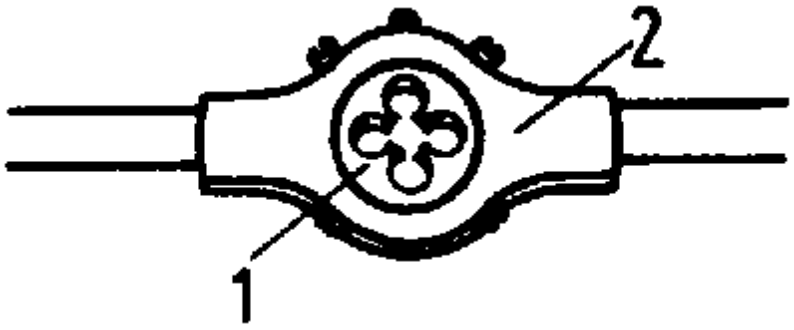


Figure 4.3− Threading die

1 − Threading die 2 − Die holder

- **Threading die:** It consists of a cutting body (similar to a nut with milled−in chip grooves) with a chamfer on either side so that it can be applied both−way. The threading die is put into a die holder which is equipped with two handles.

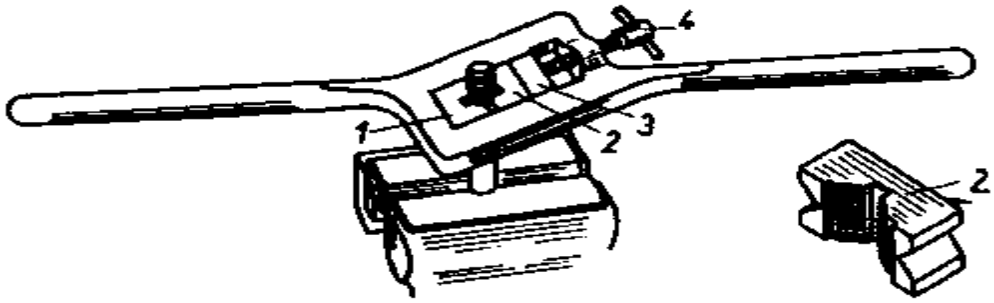


Figure 4.4− Die−stock

1 − Fixed die
2 − Movable die
3 − Pressure piece
4 − Locking screw

- **Die−stock:** It consists of a handle−equipped holder in which two threading dies are placed. One of them is fixed, the other one can be moved by means of a pressure piece via a locking screw. Three to five pairs of exchangeable threading dies for various sizes of threads belong to a die−stock.

4.2.1 Application of the tools

Threading dies cut the thread in one operation; they are used with bolt diameters up to 12mm. Bolt diameters between 12 mm and 30 mm can be cut by threading die or die−stock as well. Die stocks are mainly used with bolt diameters over 30 mm; they are drawn over the bolt in several operations. Readjustment before every new operation is necessary. In the course of the last operation, the thread is accurately cut to size by a threading die, Hints for starting the cutting operation.

The threading die is set in exactly horizontal position on the bevel of the bolt and turned clockwise slowly and with slight pressure from above (with right−hand thread). Only when the starting end of the thread is cut and the threading die guides itself, the breaking of chips can begin. The die−stock is opened as much as is necessary to shove it over the bolt − a small piece of the bolt must project above. The die−stock is adjusted to horizontal position and the movable threading die is tightened. Then, the die−stock is turned up to the bevel so that it is still guided. The movable threading die is further tightened. Then, the thread can be cut by turning the die−stock up and down adjusting the threading die simultaneously.

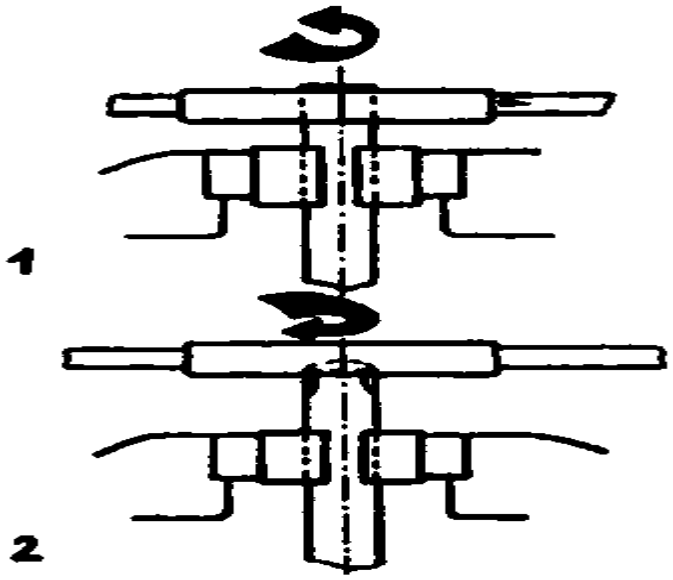


Figure:4.5 Application of the die−stock

1. Putting−on and turning−up 2. Turning−down

- **Cutting process**

The saw is moved from the right to left and shows how the chip is formed. The cutting process is the result of the horizontal cutting direction and the pressure on the work piece. The angle of the teeth enables the saw to cut the material effectively. The teeth are set (bent out) that they do not get jammed in the cut.

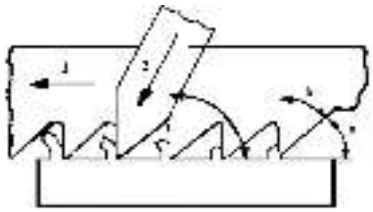


Figure.4.6 Backlash

1 = clearance **2= cutting angle**

Forces on a saw blade:

1 = indicates the cutting direction

2 = indicates the pressure on the work piece

- **Working Steps for Hand Tapping**

1. Select the correct size and type of tap for the job (blind hole or through hole).
2. Select the correct tap wrench for the size being used.
3. Use a suitable cutting fluid (No cutting fluid for brass or cast iron).
4. Place the tap in the hole as near to **vertical** as possible.
5. Apply equal down pressure on both handles, and turn the tap clockwise (for right-hand thread) for about two turns.
6. Remove the tap wrench and check the tap for sureness. Check at two positions 90 degree to each other.
7. If the tap has not entered squarely, remove it from the hole and restart it by applying slight pressure in the direction from which the tap leans. Be careful not to exert too much pressure inthe straightening process, otherwise the tap may be broken.

✓ Turn the tap clockwise one−half turn and then turn it backward about one−quarter of a turn to break the chip. This must be done with a steady motion to avoid breaking the tap.

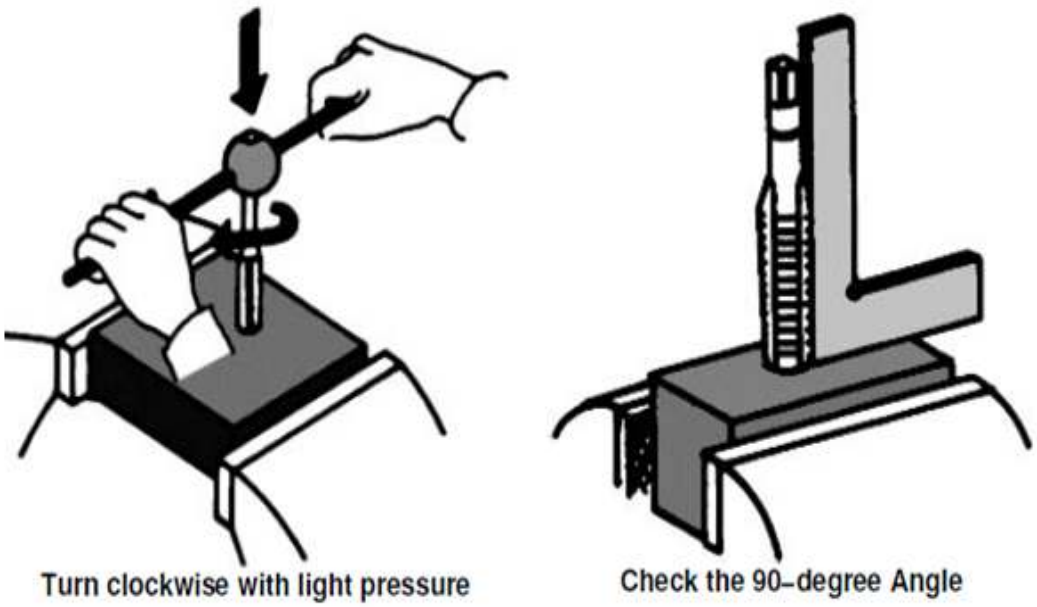


Figure.4.7Tapping internal thread

Table.4.1Drill size Threading Dies

Table of Drill sizes

Metric	Pitch mm	Drill Ø mm		UNC	TPI	Drill Ø mm		UNF	TPI	Drill Ø mm
M 3	0.50	2.5		1/4"	20	5.1		1/4"	28	5.5
M 4	0.70	3.3		5/16"	18	6.6		5/16"	24	6.9
M 5	0.80	4.2		3/8"	16	8.0		3/8"	24	8.5
M 6	1.00	5.0		7/16"	14	9.4		7/16"	20	9.9
M 8	1.25	6.8		1/2"	13	10.8		1/2"	20	11.5
M 10	1.50	8.5		9/16"	12	12.2		9/16"	18	12.9
M 12	1.75	10.2		5/8"	11	13.5		5/8"	18	14.5
M 16	2.00	14.0		3/4"	10	16.5		3/4"	16	17.5
M 20	2.50	17.5		7/8"	9	19.5		7/8"	14	20.4
M 24	3.00	21.0		1"	8	22.25		1"	12	23.25

A threading die is used to cut external threads on round work pieces. The most common threading dies are the adjustable and solid types. The round adjustable die is split on one side and can be adjusted to cut slightly over or undersized threads. It is mounted in a die stock, which has two handles for turning the dies onto the work. The solid die, cannot be adjusted and generally used for re-cutting damaged or oversized threads. Solid dies are turned onto the thread with a **special** diestock, or adjustable wrench.

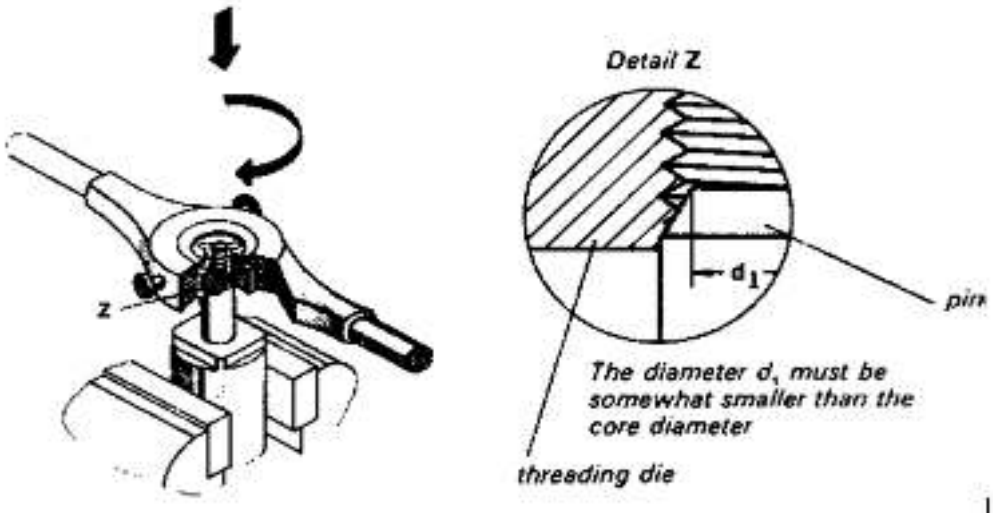


Figure 4.7.1.Die Turning position

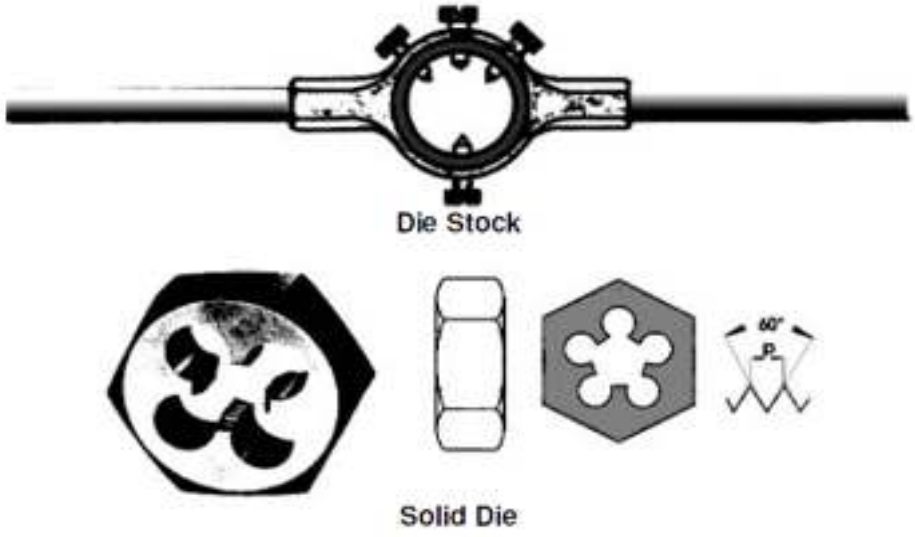


Figure.4.8 Die Holder

1. Perform thread cutting operations

Hacksaw blades are made of high-speed steel.

How to handle a hacksaw

1. And 3. Indicate the forward stroke with pressure
2. And 4. The backward stroke without pressure the circle shows the direction of teeth (facing the front of the hacksaw) all strokes should be in a straight line and along the whole length of the blade

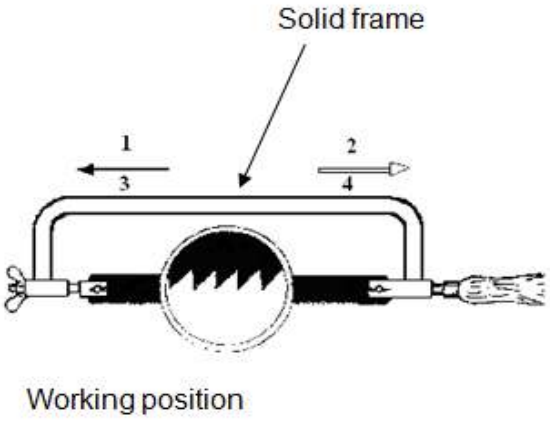


Figure.9 Sawing working position

The work piece must be clamped to allow free movement when sawing. Left-handed people clamp their work to the right of the vice and right-hander people to the left.

Working Position

Body position when sawing

Figure4.10 Body position when sawing

- **Saw teeth for different materials**
  Table .4.2 Thread numbering

No of teeth /inch	Functions
14	For solid sections of soft materials
18	Suitable for general use. Solid sections of soft materials and large sections of hard materials (e.g. alloy steel)
24	Small solid sections, between 3 and 6 mm(e.g. heavy tubing and sheets)
32	For sections less than 3 mm thick

At least three consecutive teeth should be in contact with the material. If the material is soft and has a large section, use a blade with few teeth per 25 mm (14 or 18 teeth per 25 mm) Use a fine-tooth blade when cutting a fairly thin section.

Hacksaw blades are made of high-speed steel.

There are two types: all-hard and flexible. The difference between the two is that the all-hard snaps easily, and it is therefore not recommended for school work. The blades come in the following lengths: 200, 250 and 300 mm. They are also available with 14, 18, 24 and 32 teeth per 25 mm for cutting different materials

There are two types: all-hard and flexible. The difference between the two is that the all-hard snaps easily, and it is therefore not recommended for school work. The blades come in the following lengths: 200, 250 and 300 mm. They are also available with 14, 18, 24 and 32 teeth per 25 mm for cutting different materials.

The procedure for cutting external threads is as follows.

1. Square the end of the work and chamfer it (using a file, grinding machine or center lathe) for an easy start.
2. Grip the die, held in the stock, firmly and squarely on the work.
3. Turn clockwise, about a quarter-turn, and ease back to remove chippings.
4. Apply a good supply of oil (lubricant).
5. Make adjustments of the screws after making a full cut until the depth required is achieved.

Care and maintenance is important:

- Do not use either the stock or the die as a hammer; the threads may be broken.
- Remove the die from the stock after every thread cutting, clean them and pack them into their boxes.
- Use plenty of oil during cutting to reduce friction.

Tap Drill Size

Before a tap is used, the hole must be drilled to the correct tap drill size. This is the drill size that would leave the proper amount of material in the hole for a tap to cut a thread. When a chart is not available, the tap drill size for the ISO (International Standards Organization) thread can be found easily by applying this simple formula:

$$TDS = M - P$$

TDS = tap drill size
M = metric diameter of the tap
P = pitch of the thread in millimeters

Hand Tap

A tap is a cutting tool used to cut internal threads. Normally it's made of high-speed steel (HSS). Hand taps are usually made in sets of three, because it is better to distribute all the cutting work during the thread–process to three taps.

No. 1 (taper) tap: 1 ring on shank

No. 2 (plug) tap: 2 rings on shank

No. 3 (bottoming) tap: without ring

The most common taps have two or three flutes in order to form the cutting edges, transport the chips out of the hole and give way for the lubricant. The end of the tap is square so that a tap wrench can be used to turn it into a hole.

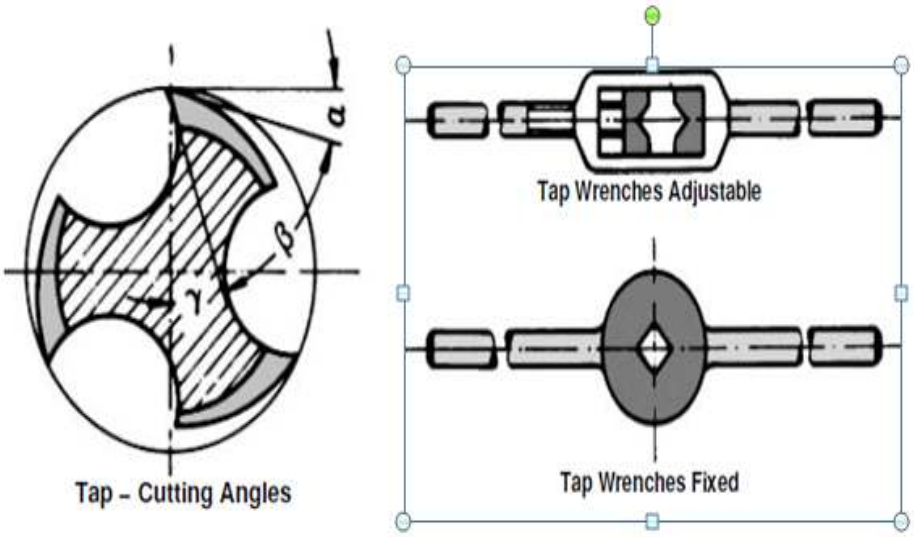


Figure.4.11 Tapping a hole

Before a tap is used, a hole must be drilled in the work piece to the correct tap drill size. The tap drill size (T.D.S.) is the size of the drill that should be used to leave the proper amount of material in the hole for a tap to cut threads. Then counter sink both sides of the hole.

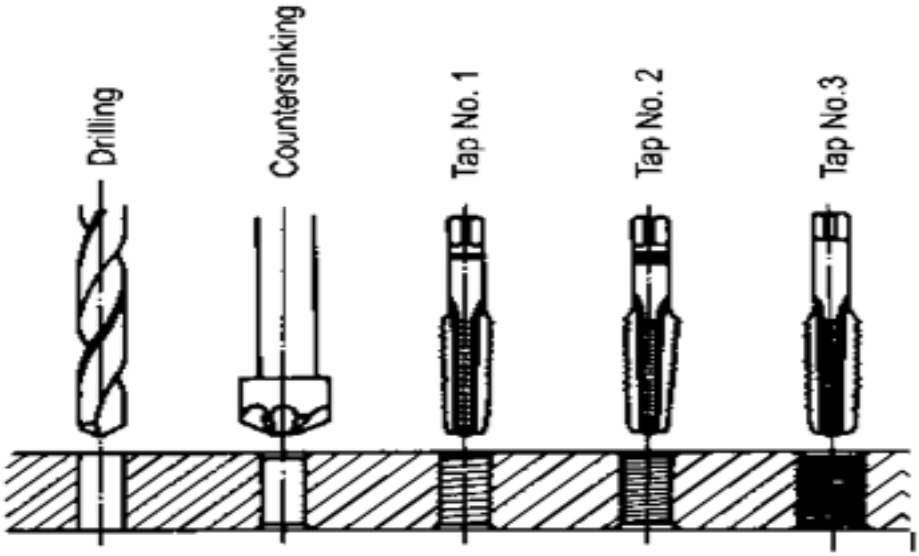


Figure.4.11Tapping

- **Thread with a Hand Die Working Steps**

The threading process requires the machinist to work carefully to produce usable parts and avoid damage. The following describes the procedure to be used. Chamfer the end of the work piece with a file or on the grinder. Consider that a 3/4" thread requires a bolt with an outside diameter of 3/4".Fasten the work piece securely in a vise. Hold small diameter work short to prevent it from bending. Select the proper die and die stock. Lubricate the tapered end of the die with a suitable cutting lubricant. Place the tapered end of the die squarely on the work piece. Apply down pressure on both die stock handles and turn clockwise several turns. Check the die to see if it has started squarely with the work. If it is not square, remove the die from the work piece and restart it squarely, applying slight pressure while the die is being turned. Turn the die forward one turn, and then reverse it approximately one half of a turn to break the chip. Apply cutting fluid frequently during the threading process.

Metric Threads

These threads are identified by the letter „M", the nominal diameter, and the pitch. For example, a metric thread with an outside diameter of 5mm and a pitch of 0.8mm would be identified as follows: M5x0.80

Table .4.3Metric system notification

nom. dia.	Pitch	nom. dia.	Pitch
M3	0.50	M9	1.50
M4	0.70	M10	1.75
M5	0.80	M11	2.00
M6	1.00	M12	2.50
M8	1.25	M13	3.00

Special hints on the designation of threads by the example of the metric threads

Fastening screw threads are internationally standardized in a different way. A large group of these kinds of threads is the group of the metric ISO threads marked by a uniform designation.

Metric ISO threads:-Example of the designation of a coarse screw thread:

M 8 **M** = metric thread

8 = nominal diameter 8 mm

Example of the designation of a fine screw thread:

M 10 x 1.25

(The fine screw thread is additionally marked by the indication of the thread pitch)

M = metric thread

10 = nominal diameter 10 mm

1.25 = thread pitch 1.25 mm

The designation is to be found on the shank of the thread tap or on the surface of the threading die or the die−stock dies, respectively. In addition, symbols for left−hand threads may appear after the designation.

Note: The designation of the threads is identical on cutting tools and testing tools − with a certain cutting tool the matching testing tool must be used.

Self-Check -4

Directions: choose the best answer for the following questions (2points each):

1 _____is used to cut internal threads in holes which are usually drilled for the purpose of attaching an item with bolts or metal threads.

A. Tap C. snips

B. Die D. all

2. Which one of the following is not include under hand tools?

A. Wrench C. Taps

B. Power hacksaw D. all

Directions: Answer the following questions (2 points each).

- Write function of threading die.

_____

- Write function of threading tap.

_____

Unit FIVE: Off-Hand Grind Cutting Tools

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Honing cut edges.
- Sharpening cutter
- Grounding cutters appropriate cooling agents.
- Performing cutting tool grinding.

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Hone cut edges with free of burrs.
- Sharp cutters to confirm to the specification.
- Ground cutters using appropriate cutting agent.
- Perform cutting tool grinding.

5.1. Honing cut edges

Honing is a finishing process performed by a honing tool, which contains a set of three to a dozen and more bonded abrasive sticks. The sticks are equally spaced about the periphery of the honing tool. They are held against the work surface with controlled light pressure, usually exercised by small springs. The honing tool is given a complex rotational and oscillatory axial motion, which combine to produce across hatched lay pattern of very low surface roughness:

Schematics of honing process showing the honing tool, how the abrasive sticks are pressed against the work surface by springs, and the resulting surface pattern.

In addition to the surface finish of about 0.1 μm, honing produces a characteristic crosshatched surface that tends to retain lubrication during operation of the component, thus contributing to its function and service life. A cutting fluid must be used in honing to cool and lubricate the tool

and to help remove the chips .A common application of honing is to finish the holes. examples in

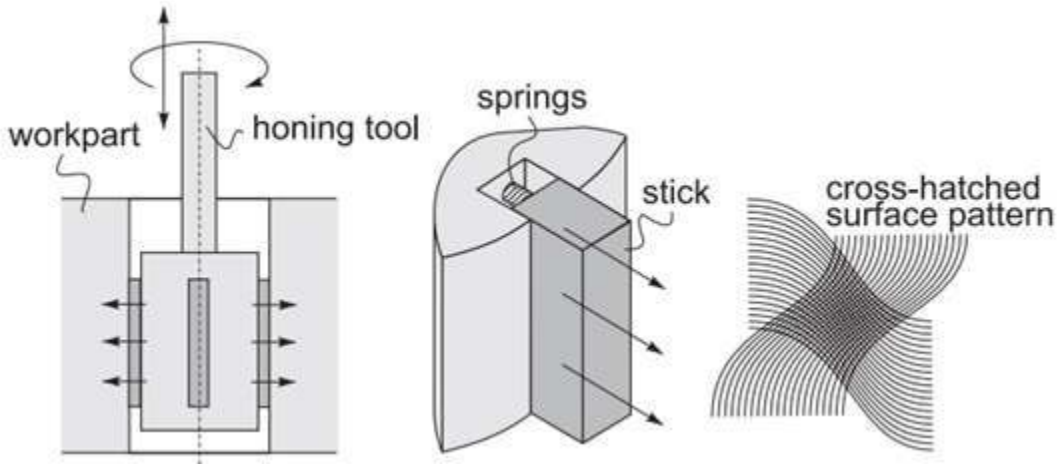


Figure 5.1 honing process

5.2. Sharpening cutter

For some tools it is very important to keep them sharp at all times. Common tools, such as scribers, center punch, chisels, drill bits, tool bits for lathe machine needs to be sharpened every time you feel that they do not cut well. **2. Sharpen cutter**

For some tools it is very important to keep them sharp at all times. Common tools, such as scribers, center punch, chisels, drill bits, tool bits for lathe machine needs to be sharpened every time you feel that they do not cut well.

❖ Cutting Tool Materials

- Tool material must be strong and hard enough to withstand high pressures.
- It should be able to retain the strength and Hardness at high operating temperatures.
- It should have sufficient wear resistance
- Tool material should be sufficiently tough to absorb shock and prevent chipping of cutting edges.
- It should be able to conduct heat at faster rates.
- It should have good Grind ability, Weld ability, Chemical stability and Thermal properties.

- Basic requirements of cutting tool material are conflicting and no tool material can satisfy all requirements. This led to development of wide variety of cutting tool materials.

1. Sharpening Scriber and Center Punch

- Scriber and center punch should be ground in the position as shown beside.
- Use the tool rest to rest your hands while bringing the tool in the right position.
- Rotate the tool while grinding.
- Cool the tool down from time to time.
- Do not overheat the metal.

2. Sharpening Chisel

- Use the tool rest to rest your hands while bringing the tool in the right position.
- Use the whole grinding wheel while grinding. Move with the tool regularly from the left to the right side and back.
- Cool the tool down from time to time.
- Do not overheat the metal.
- Grind the chisel point parallel and straight. See also the pictures below.

❖ **Drill Grinding Procedures**

1. Web Thinning

On a conventional twist drill bit there is what is known as a web. The web is the center part of the body that joins the lands (Figure)

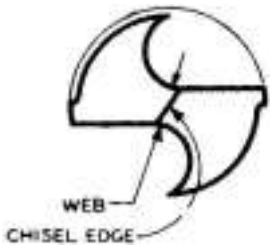


Figure.5.2web

The extreme ends of the web form the chisel edge. The thickness of the web is not uniform; it increases from the point to the shank (Figure).

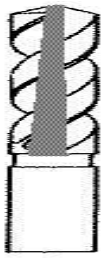


Figure5.3: Twist drill point

The cutting action of the chisel edge requires a relatively large amount of thrust be used to cause the drill to penetrate into the work piece. The increased amount of thrust needed to drive the chisel edge becomes more apparent as the drill is sharpened, since the web of the drill is made thicker toward the shank. We can reduce the amount of force it takes to cause the drill to penetrate by thinning the web of the drill (Figure).

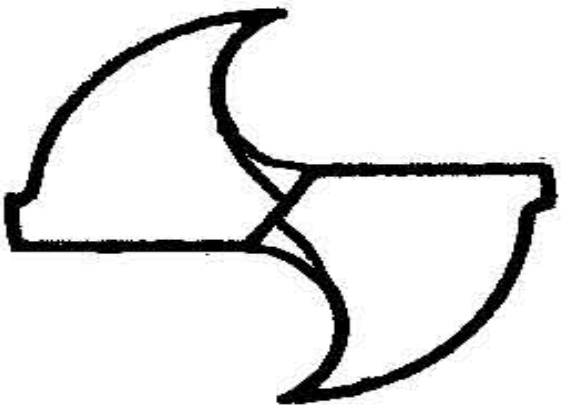


Figure5.4: - Web thinning

The best way to thin the web of a drill is by using a machine equipped with a drill point thinner. It is possible, however, to thin the web of a drill by hand using a pedestal grinder.

- **Modified split point done on a pedestal grinder** It is sometimes easier for a beginning student to grind a modified split point by hand than it is to do off-hand web thinning. The split point drill (Figure) accomplishes the same end result, a thinned web, but you are actually grinding away the heel or non-cutting side of the drill point.

5.3 Grounding Cutting Appropriate cooling agent

Tool material must be strong and hard enough to withstand high pressures. It should be able to retain the strength and Hardness at high operating temperatures. It should have sufficient wear resistance Tool material should be sufficiently tough to absorb shock and prevent chipping of cutting edges. It should be able to conduct heat at faster rates. It should have good Grind ability, Weld ability, Chemical stability and Thermal properties. Basic requirements of cutting tool material are conflicting and no tool material can satisfy all requirements. This led to development of wide variety of cutting tool materials.

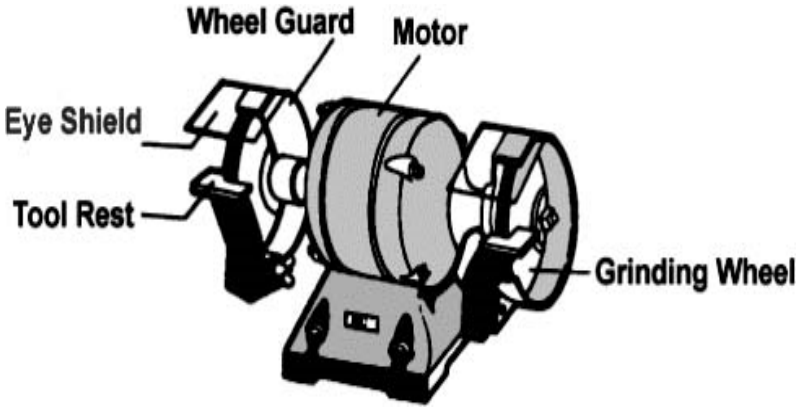
5.4 Perform cutting tools grinding

Scriber and center punch should be ground in the position as shown beside.

- Use the tool rest to rest your hands while bringing the tool in the right position.
- Rotate the tool while grinding.
- Cool the tool down from time to time.
- Do not overheat the metal.

- **Grinding Machine**

In the fields of production and maintenance, bench and pedestal type grinding machines are used which are equipped with two grinding wheels, mostly of a different grain size.



Double Wheel Grinder

- **Safety Precautions for grinding machine:**

1. When switching on the machine, stand beside, because a damaged wheel might burst during acceleration.
2. Always use safety goggles when grinding
3. The tool rest should never have more than 2-3 mm distance to the grinding wheel
4. Small work pieces should be held with clamps or other suitable devices
5. Keep the metal cool by dipping it frequently in water
6. Stand comfortable and don't give to much force to the work piece because in the case of slip off with the work piece you will grind your fingers or hand
7. While grinding, use only the face of the wheel

Self-Checks

Instruction .1Chooce the most appropriate answer.

1. One of the following is not off hand grind cutting tool?

A. Drill press machine B. Vice C. Hack saw D. All

2. Is the finishing process performed by a tool contains a set of three or dozen and more bonded abrasives sticks?

A .Honing B. Drilling C .Grinding D .All

Operation Sheet-Offhand grinding

Purpose: - To grind to the desired accuracy

Conditions or situation for the operation:

The work piece must be ground to the desired shape, size and surface finish. In addition the right type of scraper must be selected.

Equipment, tools and materials: -

- Grinders
- Safety glass
- Coolant

Procedure: The procedure for cutting external thread is as follows:

- Guard the protective sheets before you turn on the machine.
- Switch on the grinder by standing beside.
- Rest the tool to be ground on tool rest.
- Stand comfortable and don't give to much force to the work piece.
- While grinding, use only the face of the wheel.
- Keep the metal cool by dipping it frequently in coolant (water).

Precaution:

- Always use safety goggles when grinding.
- The tool rest should never have more than 2-3 mm distance to the grinding wheel.
- Small work pieces should be held with clamps or other suitable devices
- While grinding, use only the face of the wheel.

Criteria:

- The grinding must be done with 99.9% accuracy.

1. information sheet

2. different Books
3. Web Addresses (Putting Links)

Lap test

Name ……Date……

Time started ……Time finished……..

Instruction

Based on the following specification perform a hone in a hole on a round bar of metal

Specification 1

10mmx20mmx30mm

Unit SIX: Scrape and Hone Holes

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Selecting scrapers
- Selecting and applying honing flushing agent.
- Scraping and honing work pieces

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Select scrapers according to the requirements of operation.
- Select and apply honing flashing agent
- Scrape and hone work pace

6.1. Selecting scrapers

Scraping is fine finishing of largely rough-finished in order to smooth them, to correct defects of the form or to provide them with a pattern.

Scraping is highly qualified manual work and is applied only if the respective material cannot be fine-finished by machines.

Scrapers: These are used to shaving off thin slices of metal to make a fine and smooth surface which is not possible with a file or chisel .This is made of good quality forged steel and its cutting edge is usually made thin,made from old files.

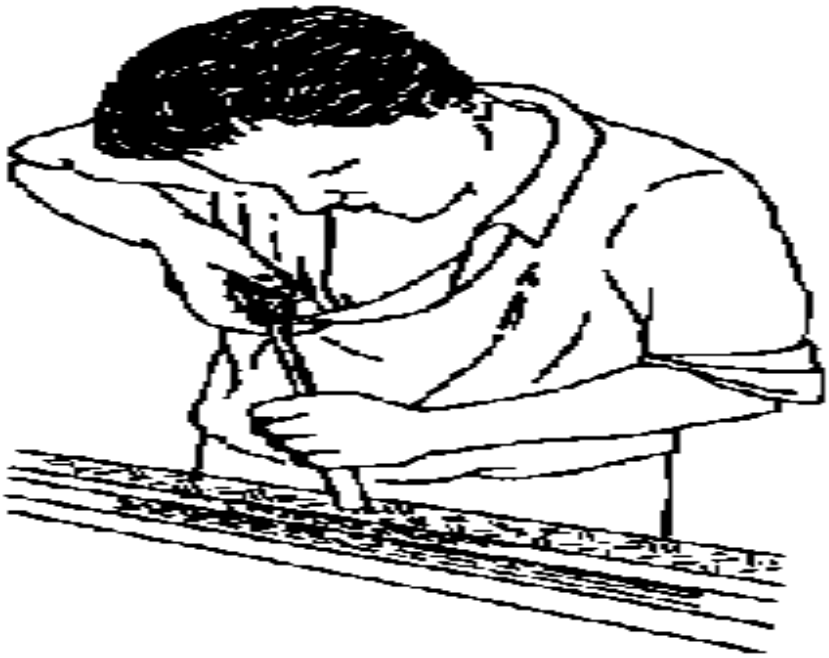


Figure 6.1 - Scraping

Normally, plane surfaces should be finished by surface grinding, curved surfaces and bore holes by precision boring or honing. By scraping mainly sliding parts of machines are worked such as carriages and slide bearings which must show a high surface quality. With sliding surfaces, the recesses achieved have a positive effect since they enable an accumulation of lubricating oil. An even lubricant film is required to reduce friction at these surfaces. By scraping also oil grooves are placed in domed brasses

Tools for scraping

Scrapers consist of high-grade, mostly alloyed tool steel; after drawing-out they are hardened, ground and whetted. The selection of the scraper depends on the shape of the surfaces to be worked.

Flat scrapers

Flat scraping are Pushing scrapers for pre-scraping and spot scraping of plane surfaces, suitable for removing larger quantities of chips. It is used for removing metal from flat surfaces .The blade must have a slight curvature at the cuttinge dge.The corner sarerounded to help the user,scrapeatthe exact spots.

This type of scraper is used for scapping plane surfaces or slots and the cuttingedge att heends of the balde is curved.The corners are rounded to prevent deep scratchesonfinished surface.It also helps to scrap the metalexactlyatthedesiredspot.

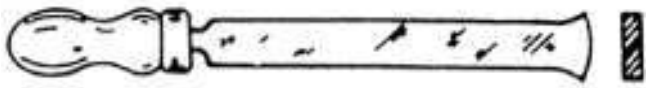


Figure 6.2 Flat scrapper

- **Curve surface (half-round bent scraper, three-cornered scraper)**

1. Half-round scrapers

Itisusedforfinishingcurvedsurfacesandchamferingholesandremovingburrs.

Thisisusedforscrapingcurvedandcylindricalsurface–splitbearings,bigbushbearingsetc.

2. Three-square scrapers

Three-square scrapers Tools are in the form of solid or hollow scrapers for scraping curved surfaces or bore holes as well as for de-burring edges.

- **Parts of Scrapers**

1.Cuttingedgewithroundedcorners:Thecuttingedgeishardenedwithouttemperedtomakehard.

2.Blade:Thebroadpartofascraper

3.Tang :Thenarrowpartwhich fitsintowoodenhandle.

4.Wooden handle: That fitsintotang tohavegrip whilescrapping

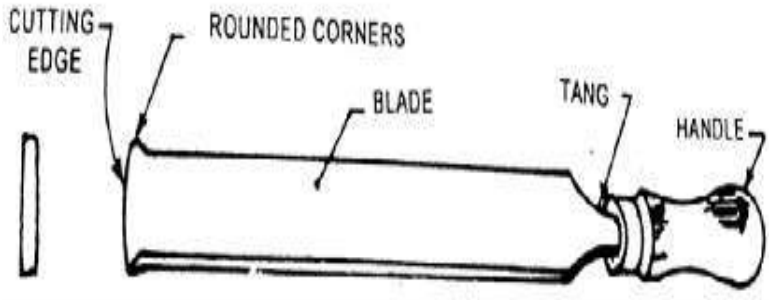


Fig.6.2 Parts of Scrapper

6.2. Selecting and applying honing flushing agent.

Purpose of Honing

Honing is the abrading process done mostly for finishing round holed Produced by drilling, reaming or boringly means of bonded abrasive stones Called ‘hones’. Honing is a machining process and is used to remove metal up to 0.25 mm. The surface roughness value can be maintained between 0.025and 0.4 microns. So honing is used to correct some out of roundness, tapers, tool marks and axial distortion.

6.3 Scrapping and Honing work piece

Honing is a finishing process performed by a honing tool, which contains a set of three to a dozen and more bonded abrasive sticks. The sticks are equally spaced about the periphery of the honing tool. They honing are held against the work surface with controlled light pressure, usually exercised by small springs. The honing tool is given a complex rotational and oscillatory axial motion, which combine to produce across hatched lay pattern of very low surface roughness:

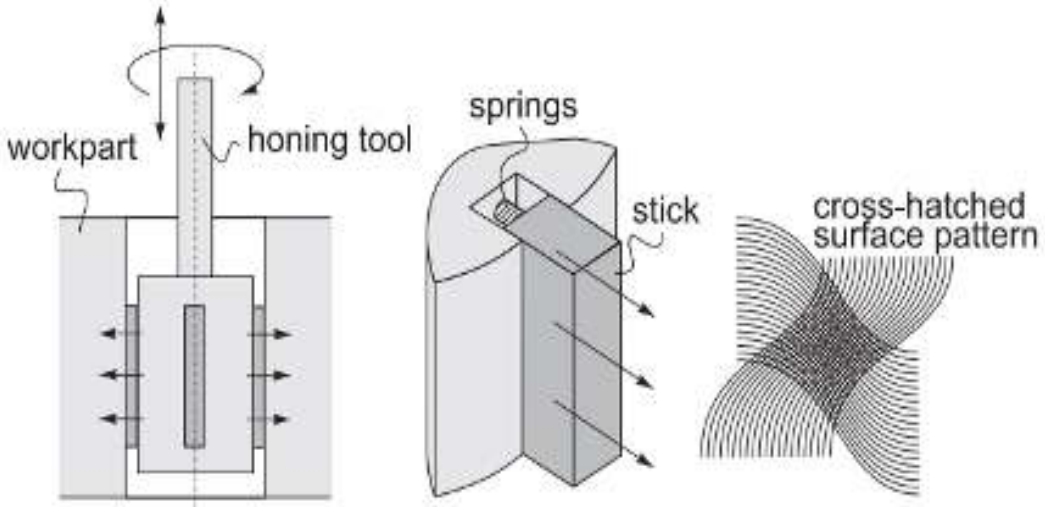


Figure.6.3 Honing tools

Schematics of honing process showing the honing tool, how the abrasive sticks are pressed against the work surface by springs, and the resulting surface pattern. A cutting fluid must be used in honing to cool and lubricate the tool and to help remove the chips. A common application of honing is to finish the holes. Typical examples include bores of internal combustion engines, bearings, hydraulic cylinders, and gun barrels.

6.3.1Operating Characteristics of honing

Honing is an abrasive process for finishing round holes by means of bonded abrasive stones or sticks, called hones. These abrasives are mounted to a honing head, which is mounted to the honing machine. Honing is usually a follow-up operation to drilling or boring. It is a cutting process used to remove small amounts of material such as plastics, silver, aluminum, brass, cast-iron, wrought steel and cemented carbides. Material removal from ground or machined surfaces depends on the work piece material, type of abrasive and the desired effect on the hole, which is mainly to produce a specific surface finish. During this process, geometric corrections to the existing hole also result, with respect to roundness, taper, tool marks, axial distortions and scratches. The honing head rotates slowly with an oscillating motion, holding the abrasive stones against the work surface under controlled light pressure.

Self-checks

Instruction.1 which one of the following is not part of scraper?

A .Handle B .Tang C Blade D .None

2.What are the two types of curve faces?

A. Half round B Three square C Five square D.A and B

3. The purpose of honing is clearly stated as?

A .Used to remove metal parts up to 0.25 B. Used to remove metal parts up to 2.5mm

C .Used to remove 0.005mm D .All

Instruction .2.Labele parts of hand tools.

1. Draw and label parts of a standard scraper tool.

Note. Satisfactory 3

Not satisfactory below 3 Answer sheet; Score……. Rating.....

Operation Sheet-6 Scraping holes

Purpose: - To scrap to the desired accuracy

Conditions or situation for the operation:

The work piece must be scraped to the desired shape, size and surface finish. In addition the right type of scraper must be selected.

Equipment, tools and materials: -

Engineers(marking) blue

Scrapers

Procedure: The procedure for cutting external thread is as follows:

Apply engineer's (marking) blue on the surface plate.

Rub the surfaces of the job to be scraped on the surface plate.

Scrape the high spots that show.

Continue testing and scraping until the entire work is covered with the color

Precaution:

Do not try to scrap without wearing hand gloves and safety glass.

Criteria:

The scraping must be done with 99.9% accuracy

LAP Test 6.1 Practical Demonstration

Name…….. Date…….

Time started ……. Time finished……

Instructions .Produce a dead smooth surface finish of metal surface from 2.5mmx30mmx30mm to final outcome of 1.5x30mm x30mm

1. Request required information from your instructor as well as tools and equipment's
2. For the right procedures please refer the operation sheet at 6.
3. .Ask your teacher for evaluations and feed back
4. Safety procedures will be credited