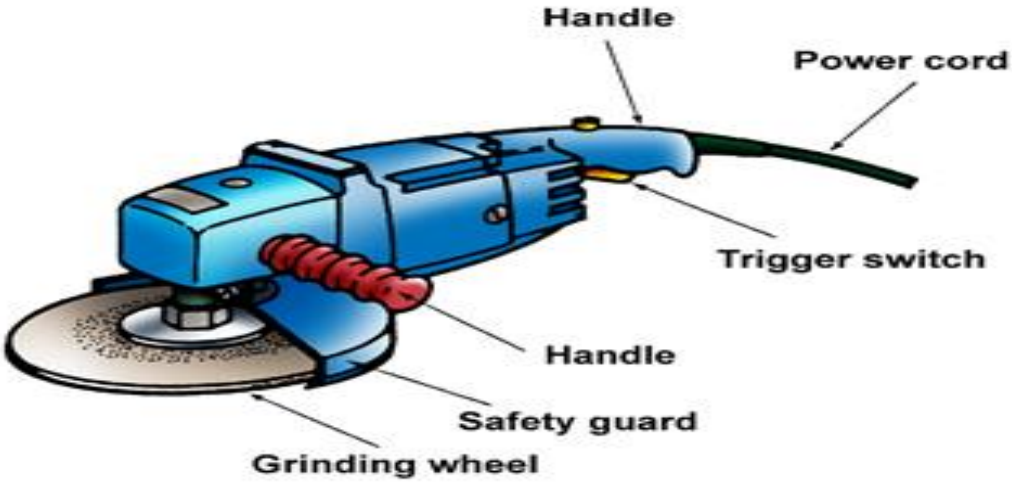
AUTOMOTIVE MECHANICS

Level – I

Based on March 2022, Curriculum Version 1



Module Title: - Performing Bench Work

Module code: EIS AUM1 M04 0322

Nominal duration: 60 Hours

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ACKNOWLEDGMENT

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Acronym

OHS	(Occupation Health and Safety)
PPE	(Personal Protective Equipment)
WHS	(Workplace Health and Safety)

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Introduction to the Module

In Automotive Mechanics filed; Carry out Service Tires and Wheel Balance helps during a tire mounting and balancing service, a service technician will remove the existing tires and wheels, spin the wheels using state-of-the-art tire balancing equipment then work to find any potential imbalance in the tires. Balancing your tires will help create a smoother ride and reduce tire wear.

Wheel balancing—also known as tire balancing—is the process of equalizing the weight of the combined tire and wheel assembly so that it spins smoothly at high speed. Balancing involves putting

the wheel/tire assembly on a balancer, which centers the wheel and spins it to determine where the weights should go.

In essence, wheels and tires are never exactly the same weight all around. The wheel's valve stem hole will usually subtract a small amount of weight from one side of the wheel. Tires will also have slight weight imbalances, whether from the joining point of the cap plies or simply from a slight deviation in the shape of the wheel. At high speeds, a tiny imbalance in weight can easily become a large imbalance in centrifugal force, causing the wheel/tire assembly to spin with a kind of "galumphing" motion. This usually translates into a vibration in the car as well as some very irregular and damaging wear on the tires.

This module is designed to meet the industry requirement under the Carry out Service Tires and Wheel Balance occupational standard, particularly for the unit of competency: Carry out Service Tires and Wheel Balance

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 die
- Off-hand grind cutting tools
- Scrape and hone holes

Learning Objective of the Module

- To apply Lay-out and mark dimensions
- To Cut, chip and file flat rectangular Carry out Calculation
- Perform Drill, ream and lap holes
- To Cut threads using tap, stock and die
- Apply Off-hand grind cutting tools
- To 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/ features on work piece

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

- Materials and related science
- Selecting materials
- Bench work tools and equipment
- Performing lay out and marking
- Applying safety and personal protective devices

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:

- Materials are selected according to the requirements specified in the drawing.
- Dimensions/features are laid out and marked in accordance with drawing specifications using bench work tools and equipment.
- Lay-outing and marking are performed applying safety procedures and using personal protective devices

1.1. Materials and related science

Sometimes it is useful to subdivide the discipline of materials science and engineering into materials science and materials engineering subdisciplines. Strictly speaking, materials science involves investigating the relationships that exist between the structures and properties of materials (i.e., why materials have their properties). In contrast, materials engineering involves, on the basis of these structure–property correlations, designing or engineering the structure of a material to produce a predetermined set of properties. From a functional perspective, the role of a materials scientist is to develop or synthesize new materials, whereas a materials engineer is called upon to create new products or systems using existing materials and/or to develop techniques for processing materials. Most graduates in materials programs are trained to be both materials scientists and materials engineers. Structure is, at this point, a nebulous term that deserves some explanation. In brief, the structure of a material usually relates to the arrangement of its internal components.

Structural elements may be classified on the basis of size and in this regard there are several levels:

• Subatomic structure—involves electrons within the individual atoms, their energies and interactions with the nuclei.

• Atomic structure—relates to the organization of atoms to yield molecules or crystals.

• Nanostructure—deals with aggregates of atoms that form particles (nanoparticles) that have Nano scale dimensions (less that about 100 nm).

• Microstructure—those structural elements that are subject to direct observation using some type of microscope (structural features having dimensions between 100 nm and several millimeters).

• Macrostructure—structural elements that may be viewed with the naked eye (with scale range between several millimeters and on the order of a meter).

1.2. Selecting materials

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

1.2.1. Ferrous metals

Are those composed primarily of iron (atomic symbol Fe) and iron alloys.

1.2.2. Nonferrous metals

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 Themetalwhichdonotcontainironasbase Eg:. They are used where their special properties such as corrosion resistance, electrical conductivity and thermal conductivity are required. Copper and aluminum are used as electrical conductors and, together with sheet zinc and sheet lead, are use as roofing materials

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

b. 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.Itisalloyof copperandtin.Thecompositionrangeis5-25%tinand75to95%copper.The corrosion resistance of bronze saresuperior than brasses

c. Copper: -iseasily identifi edfrom all ot hermetals due to red dish in colour and is extracted from copperpyrates.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

d. Aluminium:ismostabundantmetalintheearthcrust.Itissilverywhiteincolour.Itmakesupabout8% by weight of the earth's solid surface Aluminiisre mark able for it slow density and ability to resist corrosion

1.3. 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.

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.

Grinder

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.

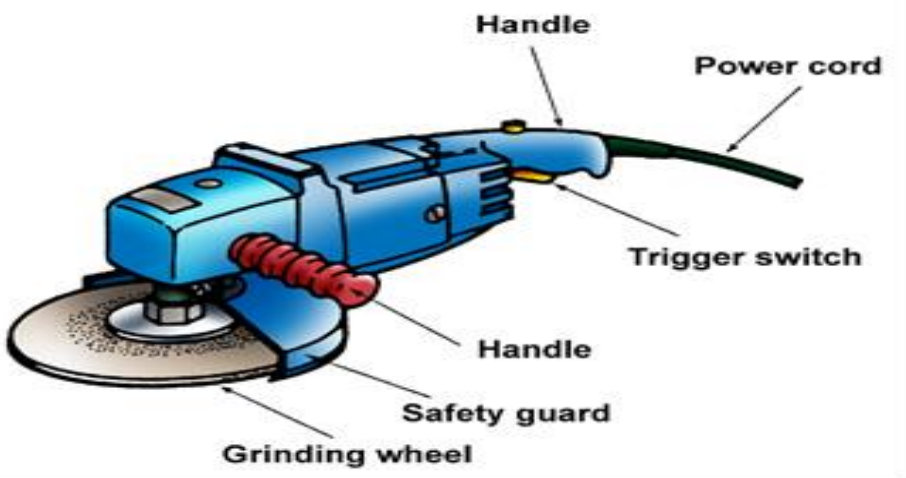


Fig1.1 grinding

- **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 Surfaceplate It is flat horizontal hardened steel plate used to hold workpiece along with anangle plate.Vblock,scriberetc.tomarktheworkpiece.It helpstomarkthesurfaceaccuretly.Itisusedforcheckingtheflatnessoftheworkpiece.Itisusedtomark theworkpiece.Itis ne.It is specified by thelength,breadth

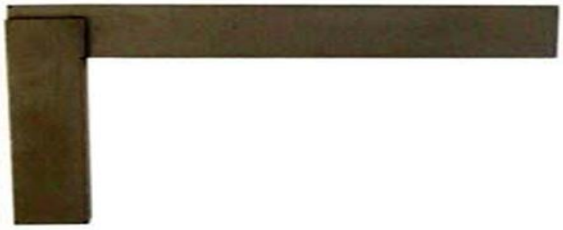


Layout and r

1. 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.
2. Dividers: are used primarily for spacing distances and scribing circles.



1 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.



2 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.



3 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.



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. Chisels

2. Hacksaws

3. Files

4. Chisels 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°.

Chiselingistheworkingonmaterialwithasharpenedwedgeshapedtoolnamedchisel.Thecuttingeffectisachievedbystrikingtheheadofthechiselwithhammer.Themostcommon type of chisel is flat chisel



Figure1.3 chisel

Hacksaw;- Hacksaw has a blade fitted in a frame and used for cutting metals as shown in Figure

a. Overview

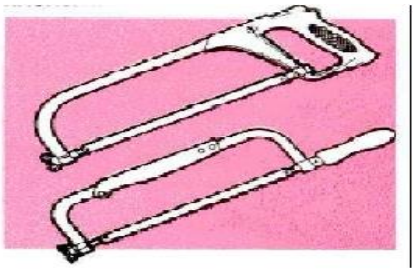
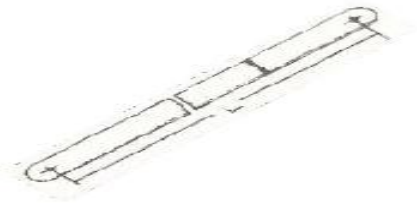


Fig.1.4 hacksaw

b. Hacksaw blade length

Hacksaw blade has a hole at each end and blade's length is given as the distance between these holes. Common blade lengths include 200, 250 and 300 mm. Refer to Fig. 2.2



c. Types of hacksaw blade according to tensile strength

I. Bi - metal hack saw blades

Provide longest life when cutting tougher materials. High speed steel cutting edges are hardened to Rc 65-67 to resist heat and wear. Flexible backers resist shattering, resulting in safer, and longer lasting blades.

II. High speed molybdenum hack saw blades.

Flexible high speed steel blades with unhardened center to make them shatter proof.

The tooth and back edges are hardened by induction process.

III. Carbon hack saw blades

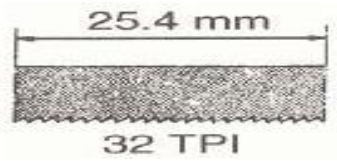
Economical blades for cutting easy to machine materials Manufacture from solid carbon steel.

IV. Blade TPI

The suitability of a hacksaw blade for cutting different materials depends on the number of teeth per inch (TPI). Some typical TPI specifications are as follows:

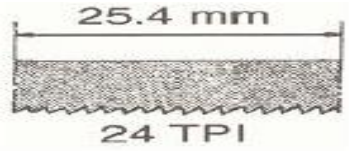
(1) 32 TPI

For thin rods, square bars, and steel pipes with thin walls



(2) 24 TPI

For hard steel and cast iron



(3)14 to 18 TPI

For mild steel and light alloys Edge

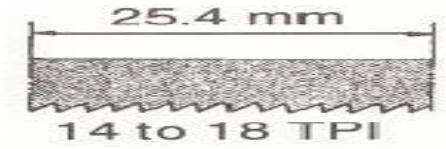


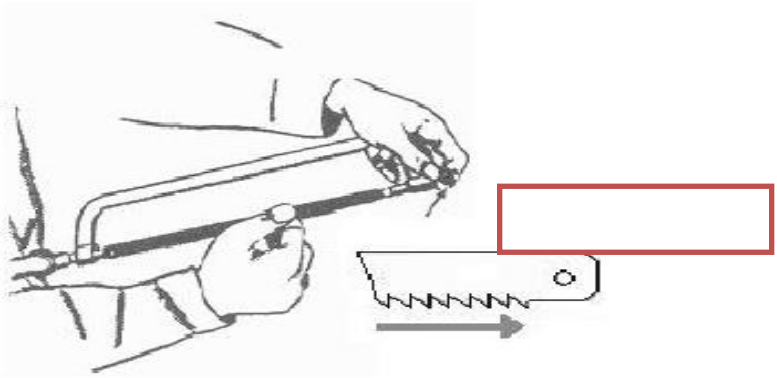
Fig. 1.5

d. Precautions

(1) Fitting blades

A hacksaw blade should be fitted in the frame with its teeth pointing forward as shown on

A correctly tensioned blade should not flex when moderately strong pressure is applied by hand to its center



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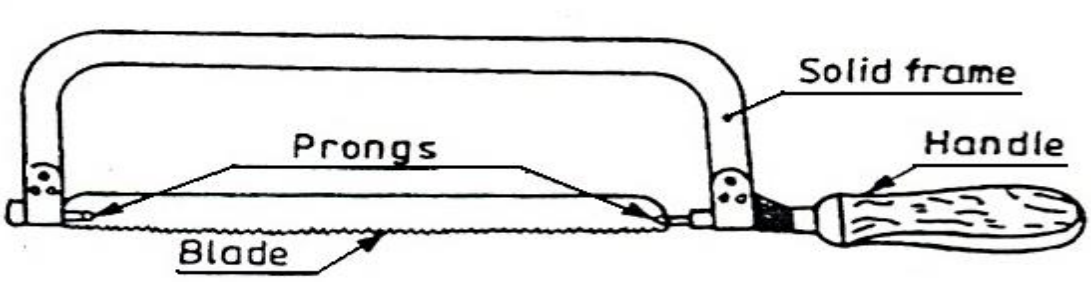


Figure1.6 Hacksaw frame with blade

FILES:is a process to remove surplusmetaland 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 workshop the rear three types of file which are flat, three-square and half round.

Types of files

According to cutting tooth Refer to Fig.

A. Single cut
B. Double Cut



Figure1.7 file

The files of different cross section or type sare needed to suit the various job operations.

Themostcommonlyusedfilesare

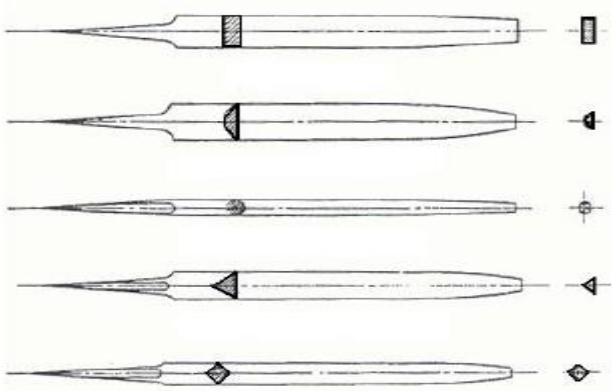
FlatFile

Squarefile

oundFile

HalfRoundFile and TriangularFile

Logitudinal motion.



Drilling produces drilled holes to a required diameter. There arevarious types of hole making operation. For examples drilling, boring, counter boring, countersinking and taping.

- Thread cutting tools (taps and stock and die)

Introduction

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.

- Taps are designed to cut threads and re-threading of bolt holes and other items.
- Tap has different sizes and threads. Refer to Fig.



Fig 1.8 Die

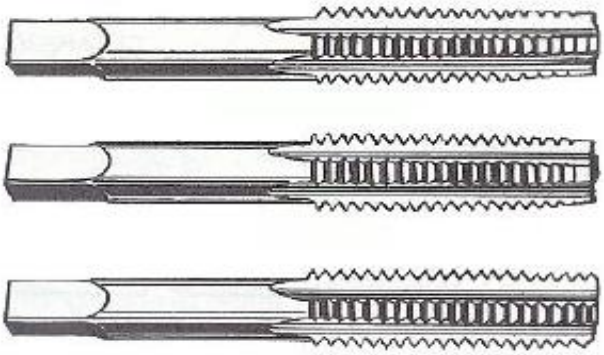


Fig1.9 Tap

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

- measuring tools

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

1. **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.

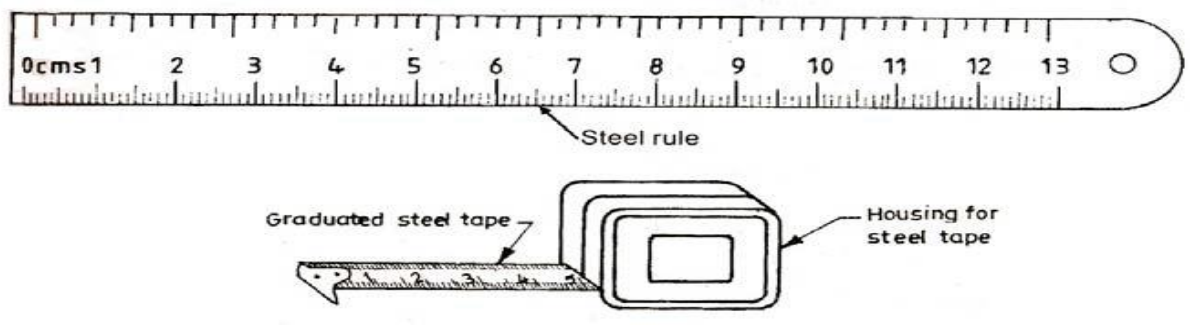


Figure1.11 Steel rule and Steel tape

2. 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.



Try square

1. Compass and divider

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

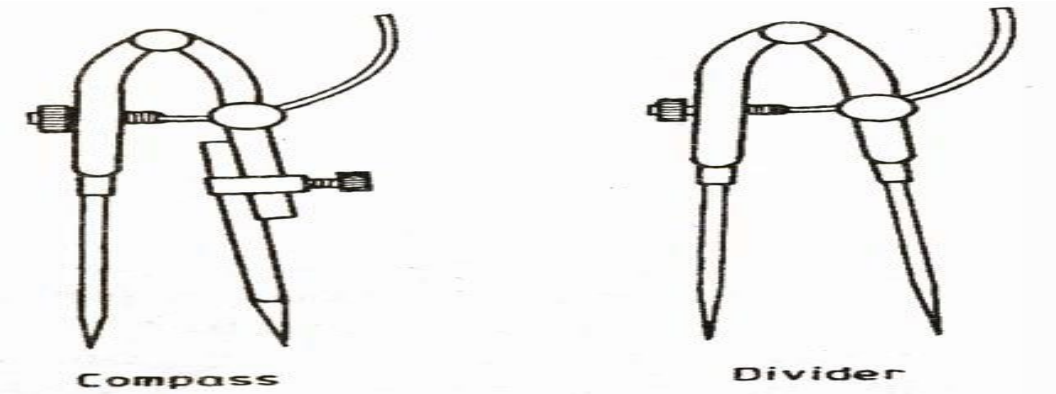


Figure1.12 Compass and Divider

2. 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.

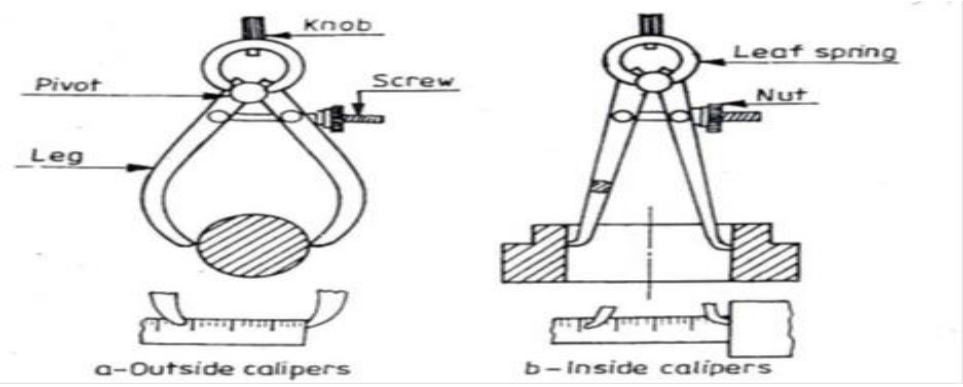


Figure1.13 Calipers

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.

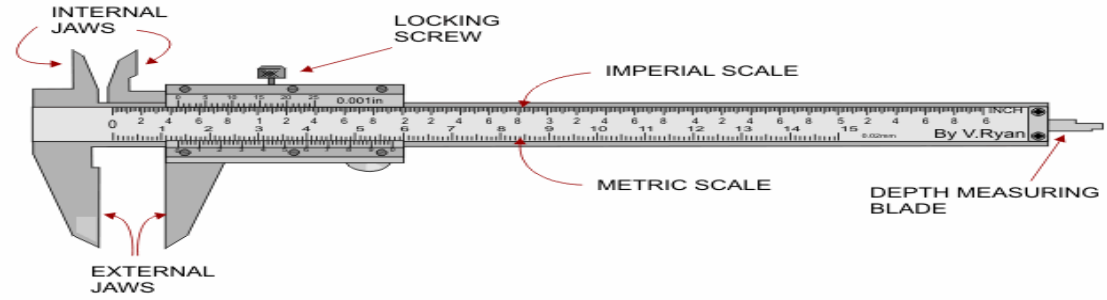


Figure1.14 Venire caliper

Cross cut or cape chisel :- the cross cut chisel or cape chiselis used for cutting grooves and channel sand keys ways in shafts andpulleys. Its cutting edge wider than the supporting metal to provide clearance.The length of chisel varies from 100mm to 400mm and width varies from 4mm to12mm.

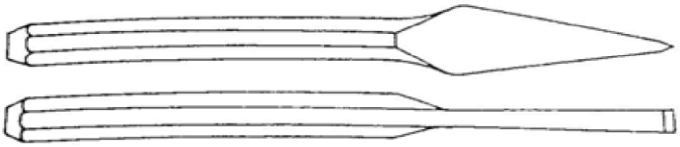


Fig1.15 Crosscut Chisel

Diamond-point chisels

DiamondPointChisel.:ItsedgeisintheformofdiamondusedforcuttingV-grooves cleaning corner sand squaring small holes.

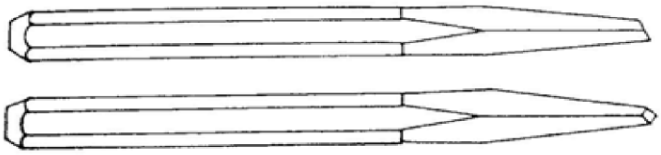


Fig1.16 .Diamond Point Chisel

- Performing lay out and marking

Marking:Itisoneofthe most important operationo fwoodwork and the success ofcompleting ajob depends on accurate and orderly marking. The sedi mension scan be measured from an existing model and can beset out from thed rawing prepared for the purpose The dimension sare marked with respectt ot he finished edgeorfinished faceofawork.

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

1. **Divider**

It is basically similar to the calipers except that its legs are kept straight and pointed at the measuring edge. This is used for marking circles, arcs laying out perpendicular lines, by setting

lines. It is made of case hardened mild steel or hardened and tempered low carbon steel. Its size is specified by the length of the leg.

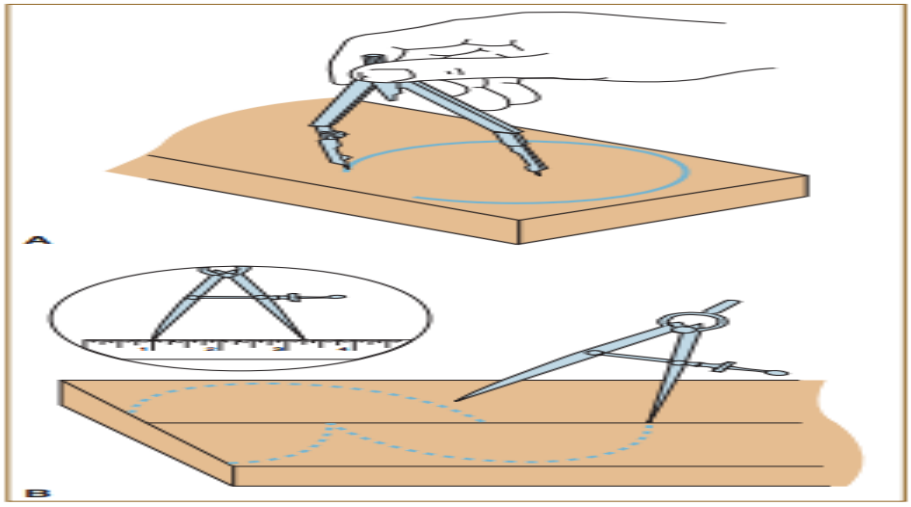


Figure1.17 A-place and swing the compass on the center point of the circle or arc.

B-Use the Divider to Step off Measurement

1.4. Applying safety and personal protective devices

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.





Fig 1.18 Safety equipment

Self-check 1

Name: _____ ID No _____ Date: _____

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

Conditions or situation for the operation:

The work piece (flat iron) must be selected, laid out and marked as per the given drawing.

Equipment, tools and materials: -

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

2. Sheet metal 242mmx100mmx1mm

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

Name: _____ Date: _____

Instruction I: Given necessary templates, tools and materials you are required to perform the following tasks within 3 hours.

Task 1:cut carefully the correct dimension of sheet metal.

Unit Two: Cut, chip and file flat rectangular and / or round blocks

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

- Methods of clamping work pieces
- Cutting chipping or filing work pieces
  - Grooves
  - Slots
  - Keyways

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:

- Work pieces are clamped in work holding devices to avoid damage and accidents.
- Work pieces are cut, chipped or filed to within tolerance specified in the drawing.
- Broken or dull hacksaw blades are replaced according to requirements
- Bench work operations are performed applying safety procedures and using personal protective devices.

2.1. Methods of clamping work pieces

A wide range of work holding devices are needed to secure the various work pieces that must be drilled. Table 1 addresses common work holding devices and their uses.

Table 2.1. - Uses of work holding devices.

Device	Use
Vises	Hold work of almost any size or shape and are the most versatile and convenient work holding devices. Vises include standard drill press vises, angle vises and contour vises.
Clamping sets	For large and irregularly shaped work pieces. These types of work pieces are not suitable for holding in a vise and must be clamped directly to the table. A clamping set includes a combination of strap Clamps, parallels step blocks and spacer blocks.
Jigs	Special work holding devices used to guide the drill when drilling a large number of identical work pieces.
Other work holding device	Other types of work holding devices that support, hold and clamp the work in the correct position include jacks, C-clamps, V-blocks and angle plates.

Standard Drill Vises

A standard drill press vise holds the work piece between a movable jaw and a fixed jaw. A screw thread transmits motion to open and close the vise. The handle attaches to the screw thread, which connects on the opposite end to the moveable jaw. Tighten the vise by rotating the handle until the

work piece is held securely between the jaws.

The vise in Figure 1 shows where improper depth of drilling has allowed the drill to damage the vise.

Caution: Do not allow the drill to proceed to a depth that will damage the vise.



Figure 2.1 Standard drill press vise.

The base is a light casting, which is machined on both the top and bottom. There are usually lugs on either side so it can be bolted to the table of the drill press. The middle of the base is cut away to provide clearance for the drill.

Vises

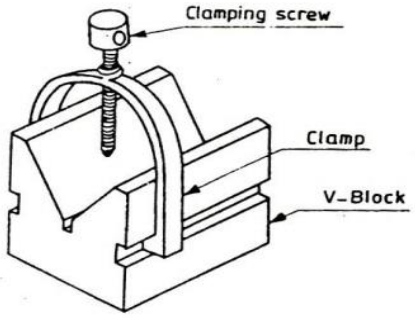
- ❖ Bench Vises with Swivel Base
- ➢ Removable hardened alloy steel jaw inserts.
- ➢ Completely enclosed center screw.
- ➢ Attractive hammered enamel finish

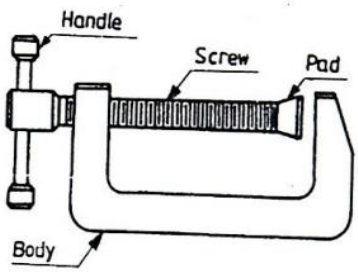


Fig2.2

C-Clamps

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.





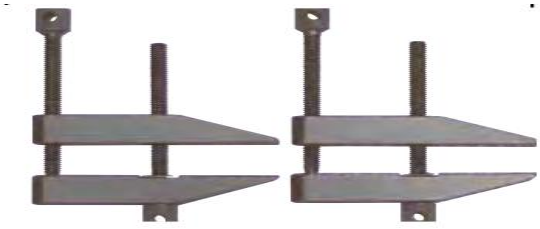
- Drop forged and designed with a deep throat. Copper plated screw and swivel pad to prevent weld splatter from sticking to them.



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

- **Parallel Clamps**

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



2.2. Cutting chipping or filing work pieces

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 it 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.

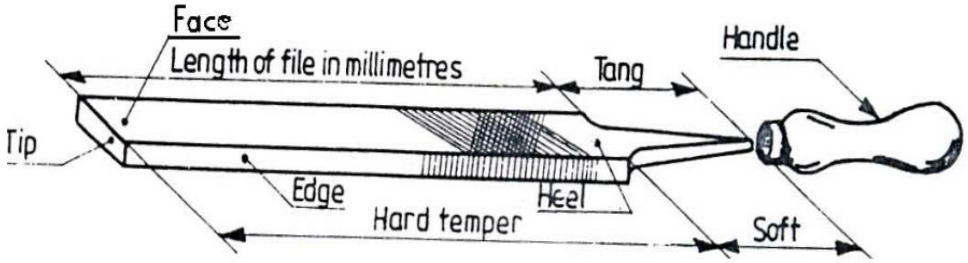


Figure2.3 Parts of a hand file

- **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.

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

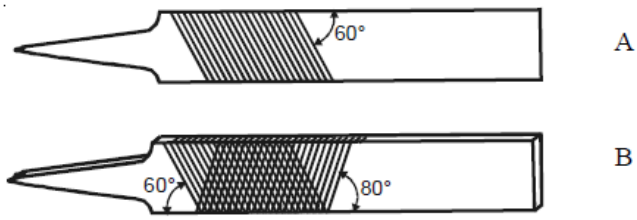


Fig 2.8 Single cut and Double cut file
A. Single cut B. Double cut

- It is suitable for the soft metal.
- 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.

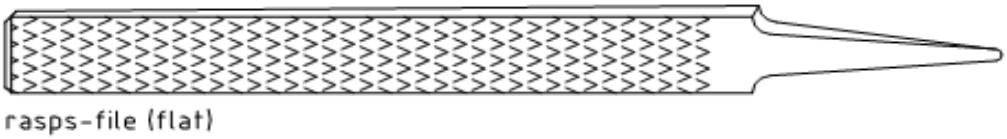


Figure: Single and double cut files

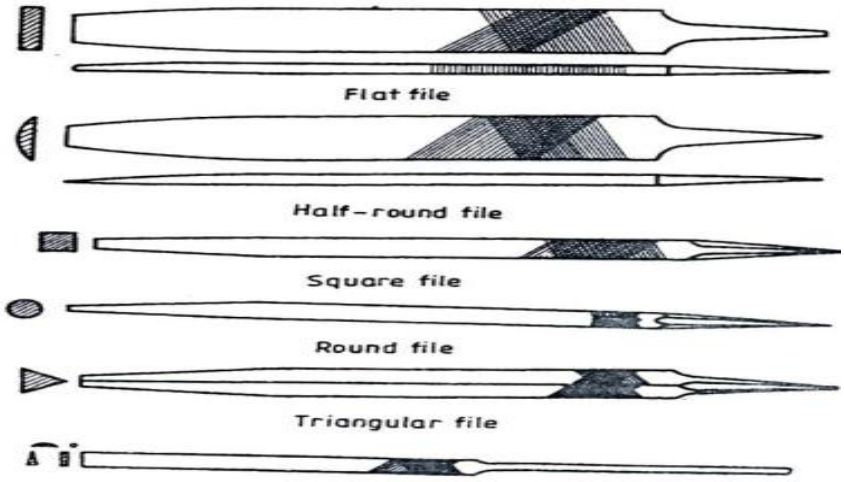


Figure2.4 types of file

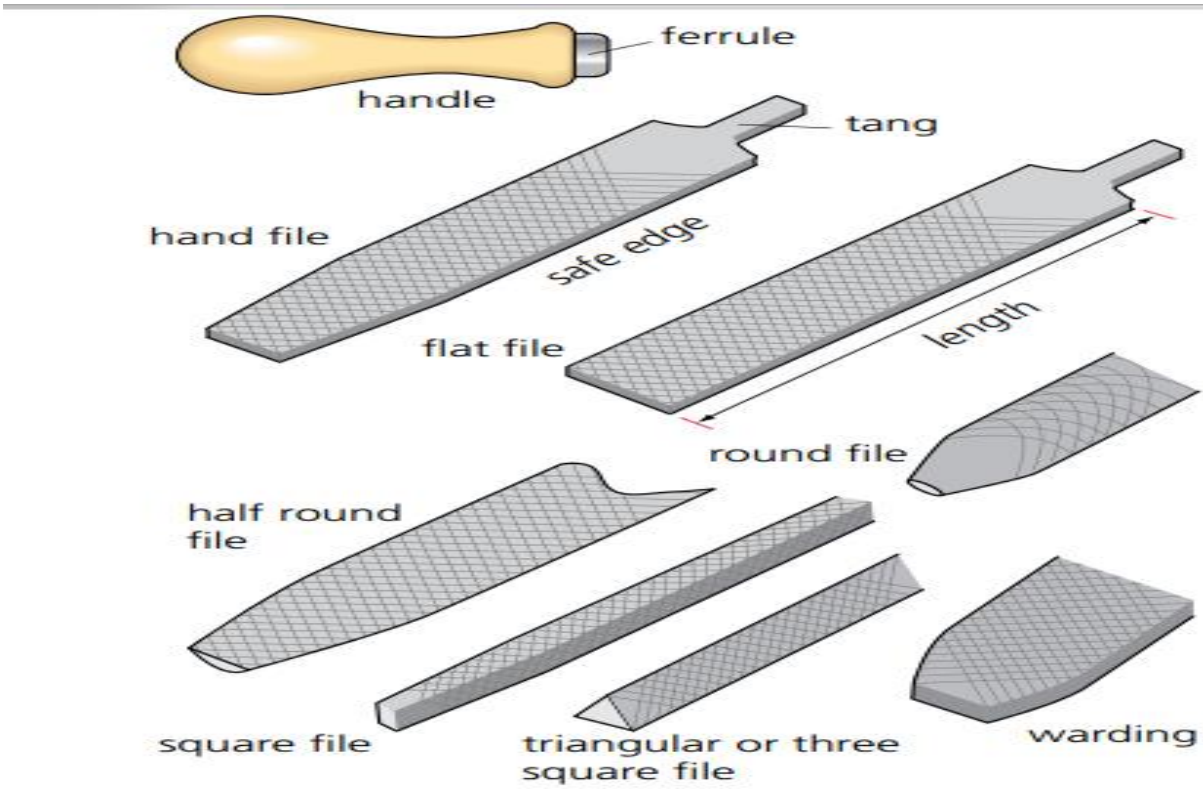
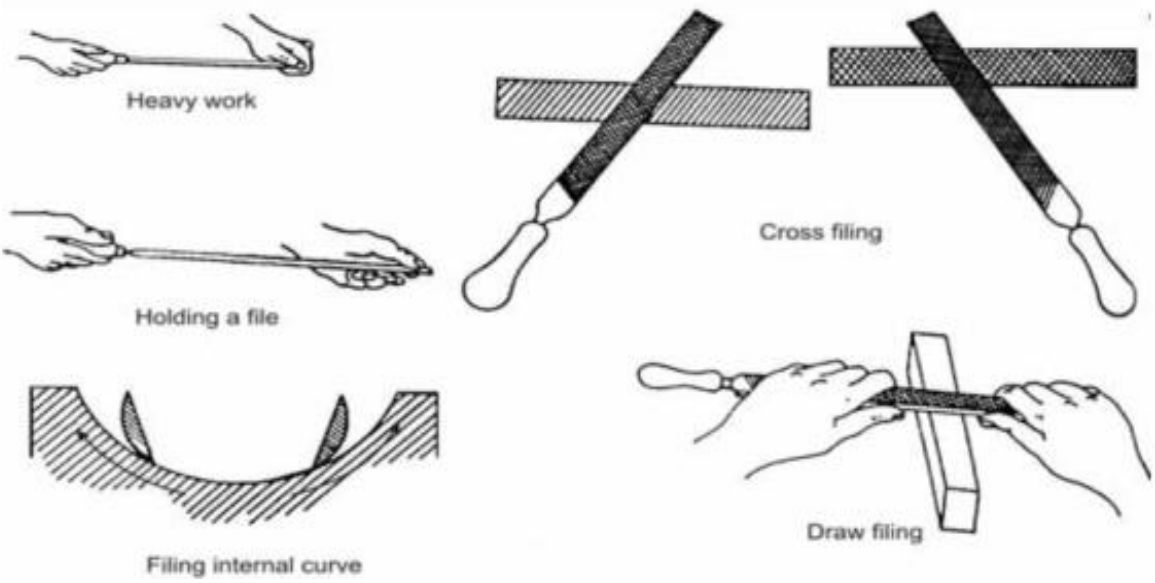


Figure2.5 parts of Files

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

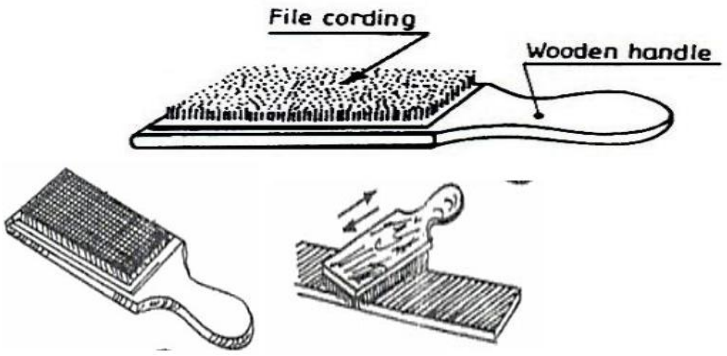
1. Holding the file: For heavy work and to remove more metal, a high pressure is used. For light and fine work, a light pressure is applied.
2. Filing internal curves: A part of half round file only makes contact as shown during filing operation. Movement of the file is indicated by arrows.
3. Cross 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.
4. 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.
5. 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.



- **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.



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

2.2.1. Grooves

- A long narrow cut in the surface of some thing hard

An effortless and well-coordinated performance) and ‘has groove’ (indicating for pleasurable and movement-inducing music). These examples exhibit the concept of groove with its performance, music, and listener experience aspects

2.2.2. Slots

Slot milling is a type of milling operation in which a rotating cutting tool is used to remove material from a workpiece by moving it in and out of a slot. This type of milling is typically used to create keyways, slots, or pockets

Slot milling cutters are cutting tools used to machine slots (grooves) in a workpiece. There are different types of slot milling cutters, selected depending on the shape, size, and width of the slots they are able to produce. Both a face milling cutter and end mills are capable to handle the job.A slot cutter is a powerful tool that can be used to cut slots in a variety of materials. There are several different types of slot cutter machines, each with its own unique set of features and benefits. Let’s take a look at the main components of a slot cutter machine.

- Table: The table is where you will place your work piece. It is also where the blade will be mounted.

- Base: The base of the machine is where all of the other components are mounted. It also contains the coin tray and the bill acceptor.

- Guide: The guide is used to keep the milling cutter in place and ensure that it cuts the slots in the correct location.
- Cross-slide: The cross-slide is the horizontal platform that the workpiece is mounted on.
- Ram: The ram is the vertical platform that the tool is mounted on.
- Hand wheel: The hand wheel is used to move the tool up and down.

2.2.3. Keyways

Keyway and Key Size Dimensions

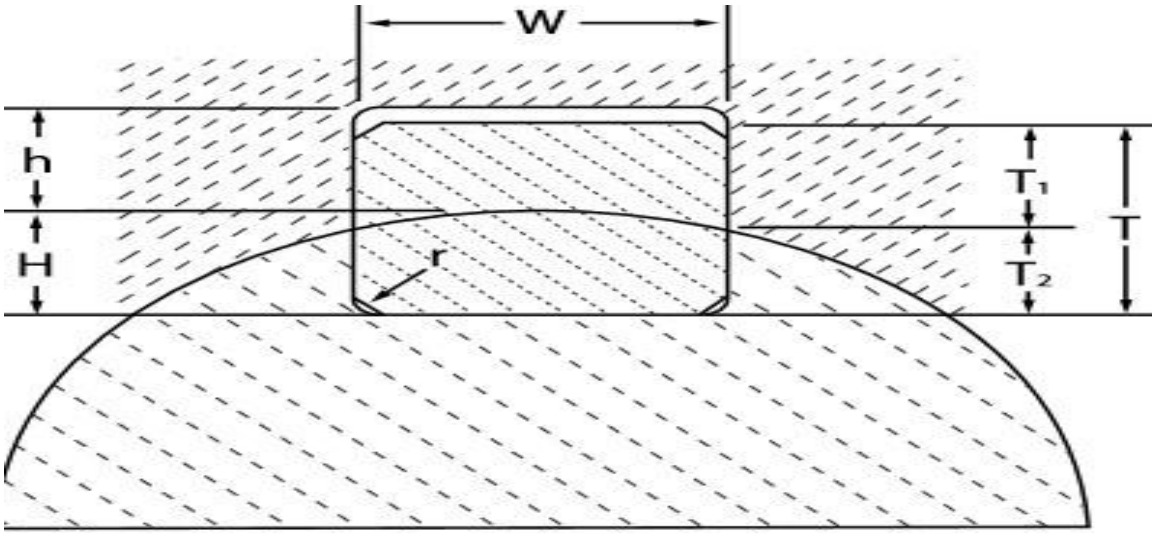


Fig 2.1 Keyway and Key Size Dimension Reference

English Standard Keyway and Key Sizes					
Shaft Diameter (in)		Keyway (in)*		Key (in)	
From	To	Width (W)	Depth (T_1)	Width (W)	Depth (T)
5/16	7/16	3/32	3/64	3/32	3/32
1/2	9/16	1/8	1/16	1/8	1/8
5/8	7/8	3/16	3/32	3/16	3/16
15/16	1-1/4	1/4	1/8	1/4	1/4
1-5/16	1-3/8	5/16	5/32	5/16	5/16
1-7/16	1-3/4	3/8	3/16	3/8	3/8
1-13/16	2-1/4	1/2	1/4	1/2	1/2
2-5/16	2-3/4	5/8	5/16	5/8	5/8

Table 2.2 English standard

Metric Standard Parallel Keyway and Key Sizes					
Shaft Diameter (mm)		Keyway (mm)		Key (mm)*	
From	To	Width (W)	Depth (h)	Width (W)	Depth (T)
6	8	2	1.0	2	2
9	10	3	1.4	3	3
11	12	4	1.8	4	4
13	17	5	2.3	5	5
18	22	6	2.8	6	6
23	30	8	3.3	8	7
31	38	10	3.3	10	8
39	44	12	3.3	12	8
45	50	14	3.8	14	9
51	58	16	4.3	16	10
59	65	18	4.4	18	11
66	75	20	4.9	20	12
76	86	22	5.4	22	14
86	96	25	5.4	25	14
96	110	28	6.4	28	16
111	130	32	7.4	32	18

Table2.3 metric standard

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:

- Perform drilling and reaming
- Spot-face and lapping Hole

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:

- Hole is drilled, reamed, spot-faced and lapped to drawing specification.
- Drilling, reaming or lapping holes are performed according to recommended sequence.

Operations are performed applying safety procedures and using personal protective devices.

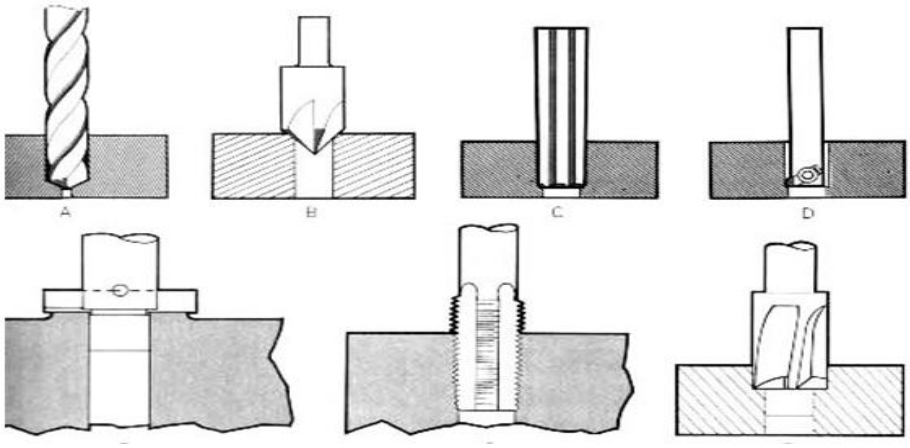
3.1. Perform drilling and reaming

- Principal Types of Drilling Machines

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.



- **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.

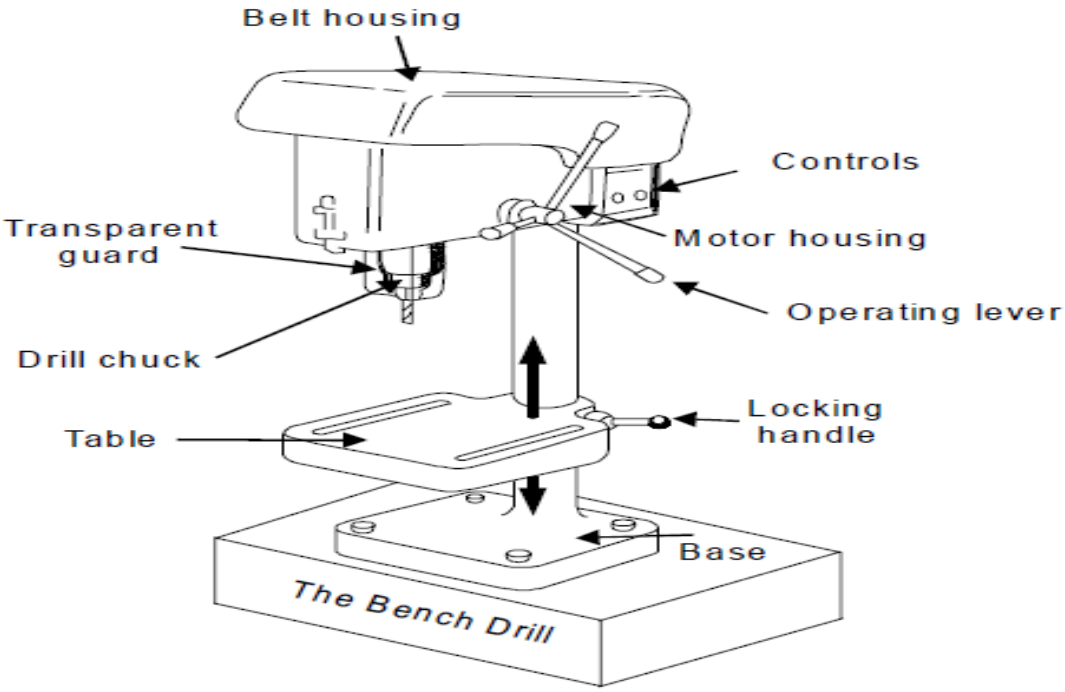
6. Select the correct RPM for the drill bit.

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



- **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.

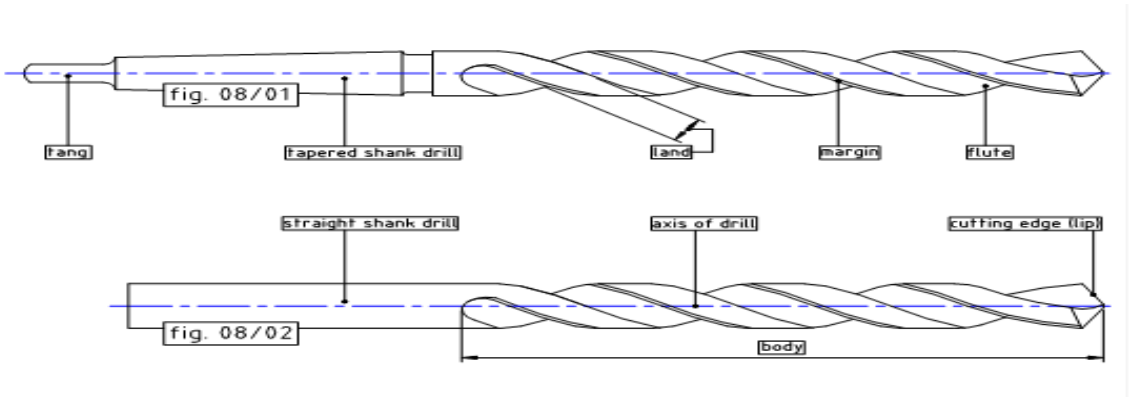
- Parts of Twist drills

- **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.

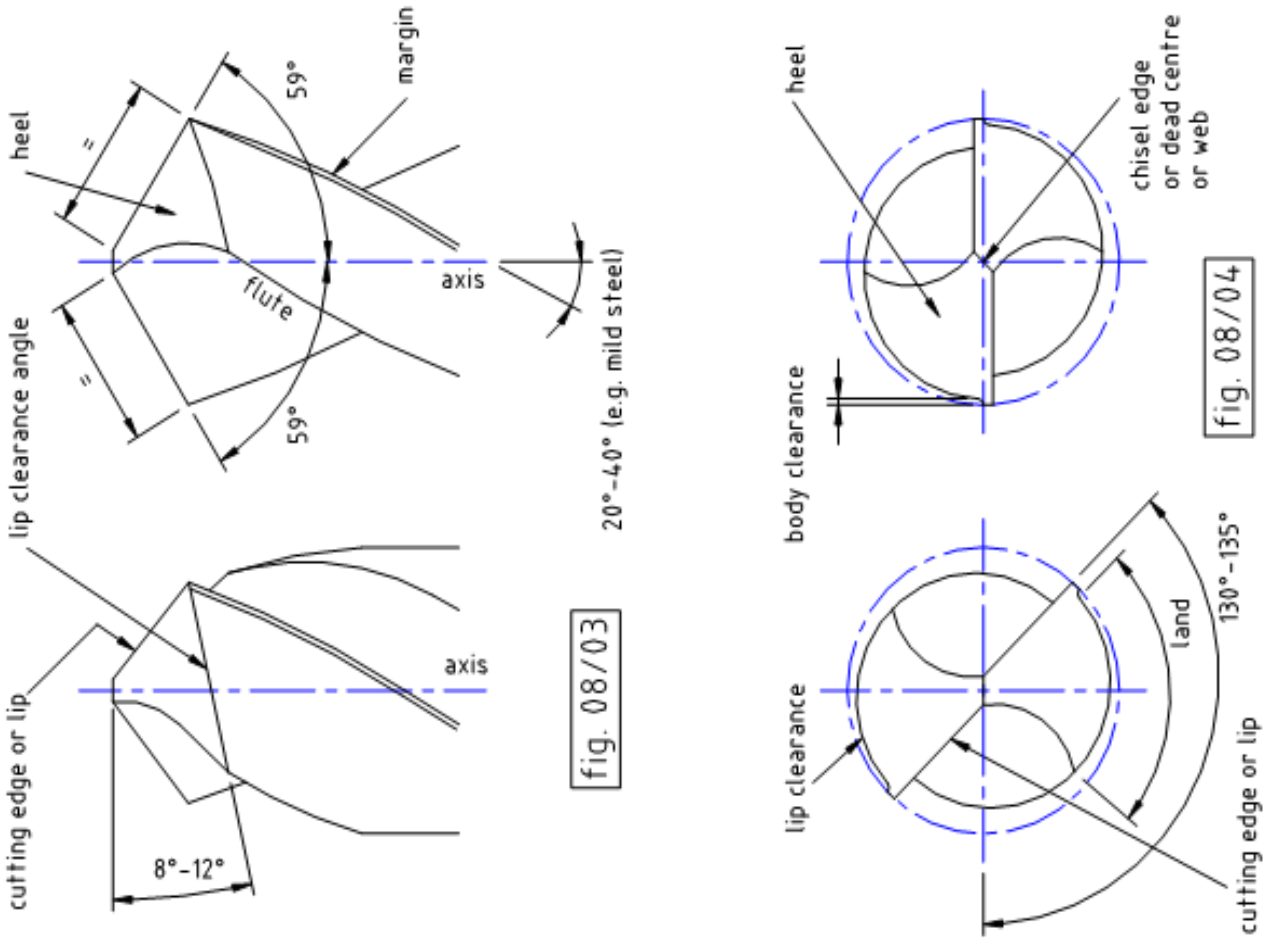
Generally drills up to 13mm in diameter have straight drill shanks, while those over this diameter usually have tapered shanks. Straight-shank drills (fig. 08/02) are held in a drill chuck; tapered-shank drills (fig. 08/01) fit into the internal taper of the drill press spindle.

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.



- **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.

- **Speed of drilling**

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 speed 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 dril bit Procedures

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



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

2. 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.
3. Lightly grind away the heel of the drill until you have ground away the appropriate amount of the web of the drill.



Line up the end of the web with the corner of the wheel.

Reamer 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 is a rotary cutting tool with several straight or helical cutting edges along its body. It is used to accurately size and smooth a hole which has been previously drilled or bored. Some reamers are operated by hand (hand reamers), while others may be used under power in any type of machine tool (machine reamers).

- **Parts of the Reamer**

Reamers generally consist of three main parts: shank, body and angle of chamfer. The shank, which may be straight or tapered, is used to drive the reamer. The shank of machine reamers may be straight or tapered, while hand reamers have a square end on the end to accommodate a tap wrench.

The body of a reamer contains several straight or helical grooves or flutes, and lands (the portion between the flutes). A margin (the top of each tooth) runs from the angle of chamfer to the end of the flute. The body clearance angle is the relief or clearance behind the margin which reduces the friction while the reamer is cutting. The rake angle is the angle formed by the face of the tooth when a line is drawn from a point on the front marginal edge through the center of the reamer. If there is no angle on the face of the tooth, the reamer is said to have radial land.

The angle of chamfer is the part of the reamer which actually does the cutting. It is ground on the end of each tooth and there is clearance behind each chamfered cutting edge. On rose reamers, the angle of chamfer is ground ion the end only and the cutting action occurs at this point. On fluted reamers, each tooth is relieved and most of the cutting is done by the reamer teeth



3.1. Spot-face and lapping Hole

- **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

I. choose the best answer for the following questions (2 points each)

1 ----------is a circularmulti-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

2 ----------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

3 ---------- 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. drilling C. hacksaw D. C- clamp

.

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:

- Internal thread cutting fit gauge
- External thread cutting fit gauge

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:

- Thread is cut to fit gage or mating screw, within tolerance given in drawing.
- Thread is cut in accordance with the recommended tapping sequence.
- Thread cutting operations are performed applying safety procedures and using personal protective devices.

4.1. Internal thread cutting fit gauge

Purpose cut threads to the desired accuracy

The work piece must be filed (turned) to the desired shape, size and surface finish. In addition the right pitch (size) of die must be selected.

Equipment, tools and materials: -

- Taps and tap holder
- Try square
- Ø 25mm round solid mild steel rod
- Oil (lubricant)
- Veirner caliper
- Pitch gauge

Procedure: The procedure for cutting internal thread is as follows

1. Drill a hole that has about the same diameter as the core of the tap.
2. Hold the work firmly in the vice.
3. Grip the first tap in the tap wrench or holder (Figure 4.19).
4. Insert the tap squarely in the hole and turn it clockwise to start threading
5. Turn anti-clockwise about a quarter-turn to break the chips.
6. Apply cutting oil through the flutes, to ease cutting and 'wash' away the chippings.
7. Repeat operation 5 until the entire length of thread on the tap has gone through (if it is a through hole).
8. Follow the same procedure using the second and plug taps.
9. Apply a good quantity of oil to reduce friction and to clean the chippings.
10. When you have finished, clean the taps and holder and pack them

Safety: Care and maintenance is important.

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

Criteria: Thread is cut to fit the pitch gauge or the mating screw within tolerance given in the blue print.

1. Thread is cut in accordance with the recommended tapping sequence.
2. Perform thread cutting operations by applying knowledge on safety procedures and using personal protective devices.

4.2. External thread cutting fit gauge

Purpose of drill to the desired accuracy

The work piece must be filed (turned) to the desired shape, size and surface finish. In addition the right pitch (size) of tap must be selected.

Equipment, tools and materials: -

- Die and die holder
- Try square
- Ø 25mm round solid mild steel rod
- Oil (lubricant)
- Veirner caliper
- Pitch gauge

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

1. Square the end of the work and chamfer it (using a file, grinding machine or Centre 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.

Precaution: Care and maintenance is important.

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

Criteria:

1. Thread is cut to fit the pitch gauge or the mating screw within tolerance given in the blue print.
2. Thread is cut in accordance with the recommended thread cutting sequence.
3. Perform thread cutting operations by applying knowledge on safety procedures and using personal protective devices.

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:

- **P**erforming grinding and cutting
- Honing cut edges
- Sharpening cutter

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 edges are honed and free of burrs.
- Cutter is sharpened to conform to specifications.
- Cutters are ground using appropriate cooling agents.
- Cutting tool grinding is performed applying safety procedures and using personal protective devices..

5.1. Performing grinding and cutting

- **Grinding**

➢ Removing of metal by a rotating abrasive wheel.(Very high speed, Shallow cuts)

➢ The wheel action similar to a milling cutter with very large number of cutting points.

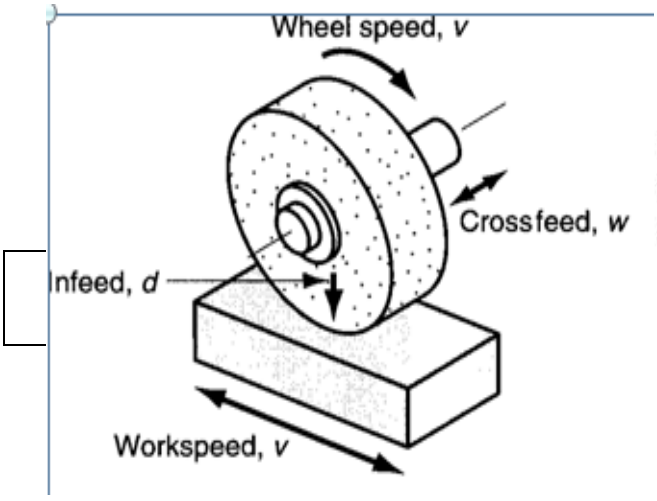
➢ Grinding was first used for making tools and arms.

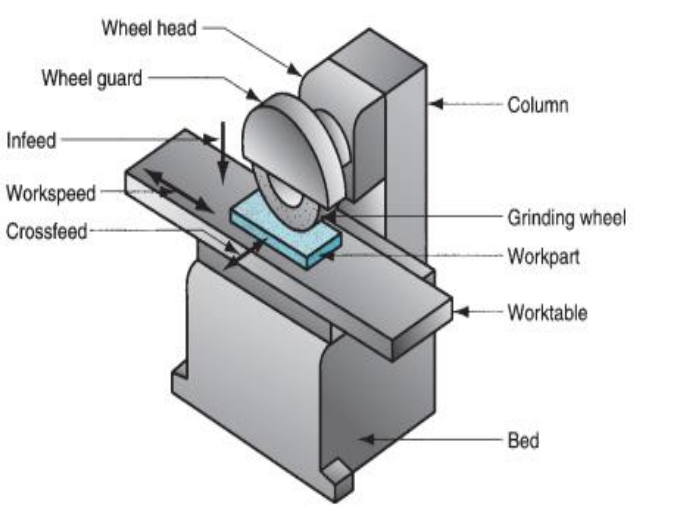
1. **Surface Grinding:**

➢ Depth of Cut: 2-5 thou, 50-125 microns

➢ Work Table -reciprocates beneath the wheel, Longitudinal feed

➢ Wheel -cross feed (Transverse feed) and





in feed

Fig 5.1 Surface grinding

What makes the grinding different?

- Large number of cutting edges that is very small and made of abrasive grits.
- The cutting edges cut simultaneously.
- Very fine and shallow cut are only possible ◊good surface finish (<Ra=0.8) and dimensional accuracy
- Finishing and important Operation
- Abrasive grits are extremely hard - very hard material can be machined.
  E.g hardened steel, glass, carbides, ceramics etc.
- Features with strict tolerance and surface finish are machined by grinding.
  E.g. Turbine Blade Fir-tree, Bearing seat diameters, tool making, tool repair, etc.
- Mesh sizes:4 - 240 for grinding 240 - 600 for honing & lapping
- The shape of the grain affects accuracy of the grain screening

- **Grinding Wheels**

Abrasive bonded together in a disk (wheel)◊three main factors influence the performance of the grinding wheel**:**

1. Abrasive material
2. Bonding material
3. Structure

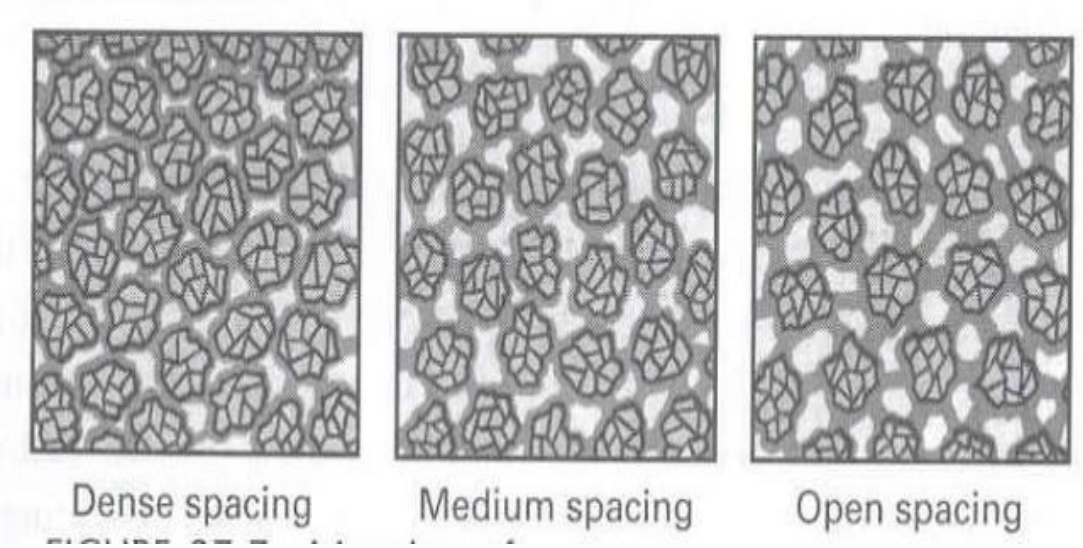


Figure5.2 Meaning of grinding wheel structure

- Sizing of Abrasive Grains:

➢ Determined by the maximum number of openings in 1" length of the screen in a mechanical sieving machine.

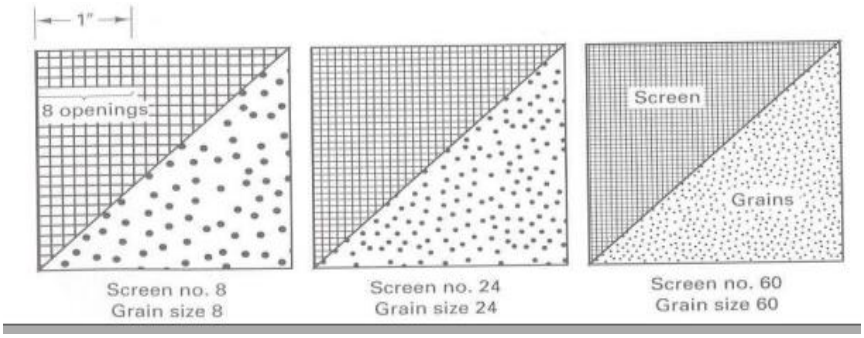
➢ Graded into sizes specified by number -- 4 to 600 grade numbers 4 – 600 -- the number of meshes in 1" that generates the mesh screen Ranges of grades:

Grade numbers (S): 4 – 24, Coarse

30 – 60, Medium

70 – 600, Fine

The average diameter of the grain ~ 0.7/S (Grid 600◊0.03mm size, 4--4.4mm size)



Manufacture of Wheels: Grains mixed with bonding material; *Molded or cut* to proper shape and heated so that the bond melts.

Heating (burning) process varies according to the type of bond used.

Bonding materials - determine the max. Allowed speed the wheels could work.

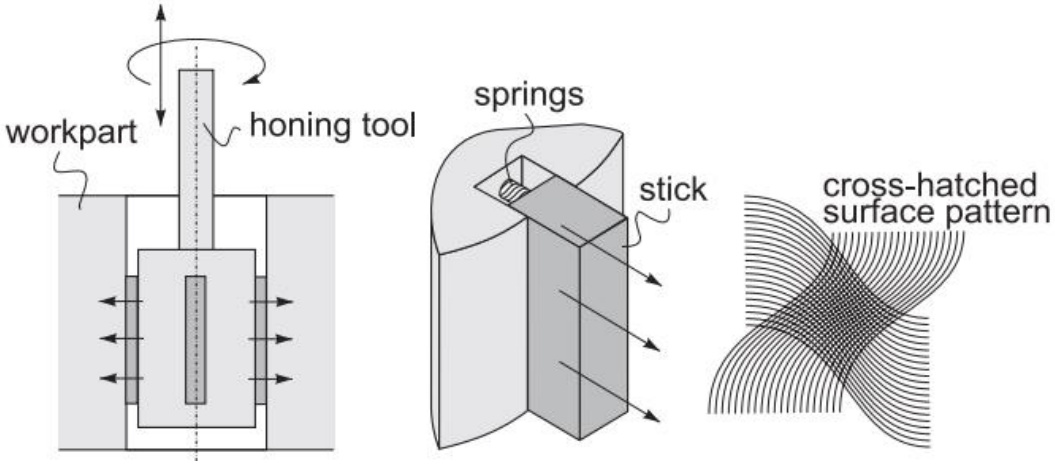
- determine the rigidity and the strength (flexibility & toughens)
- the force required to dislodge the grains
- Should have a similar wear rate as of abrasive grit**.**

Cooling agents

Cuttin fluidorcoolant is usedwhere thereissignificant friction and heatat the cutting interface between acutter suchas adrill or an endmill and the work piece Coolantis generally introduced by aspray a cross the face of the tool and work pieceto decrease friction and temperature at thecutting tool/workpieceinterface topreventexcessivetoolwear.Inpractice the rearem anymethod sofdeliveringcoolant.

5.2. 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. Typical examples include bores of internal combustion engines, bearings, hydraulic cylinders, and gun barrels.

5.3. 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.

✓ **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)

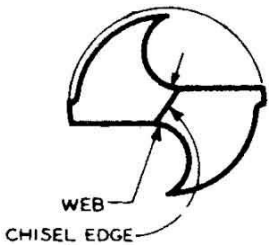


Figure: Twist drill point

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).

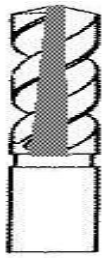


Figure: - the web thickness gets larger toward the shank of the drill

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).

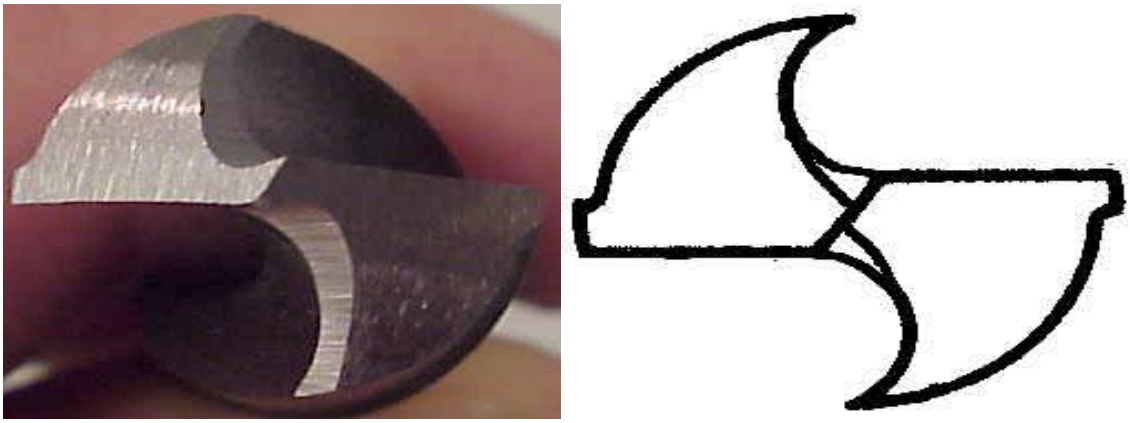


Figure5.3 Web thinning

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.

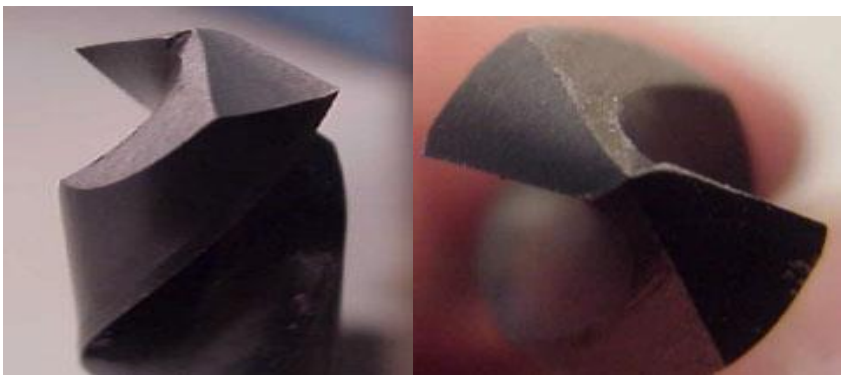
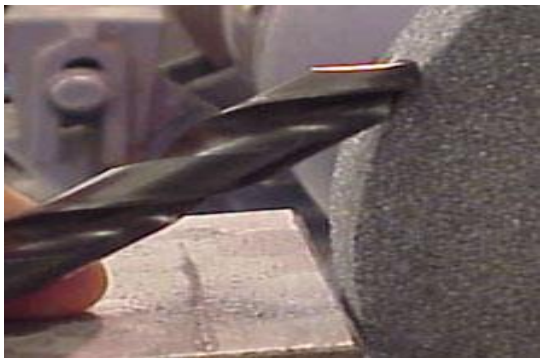


Figure5.4 Split point

- Procedures:

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



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

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

- **Twist Drill Operation**

Rotation and feeding result in relative motion between cutting edges and work piece

- Cutting speed varies along cutting edges as afunction of distance from axis of rotation
- Zero Relative velocity at drill point (no cutting)
- A large thrust force to drive the drill forward

Operation Sheet 5

To grind to the desired accuracy

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.

Direction:- Cut the metal and make honing

Unit Six: Scrape and hone holes

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

- Selecting Scrapers
  - Flat surface
  - Curve surface
- Applying flush agent honing operation
- Scraping and honing work pieces.

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:

- Scrapers are selected according to requirements of operation.
- Honing flushing agent is selected and applied according requirements of operation.
- Work pieces are scraped and honed according to drawing specifications.

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:Theseareusedto shaving off

thin slices of metal to make a fine and smooth surface which is not possible with afile or chisel This is made of good quality for gedsteel and it s cutting edge is usually made thin,made from old files.

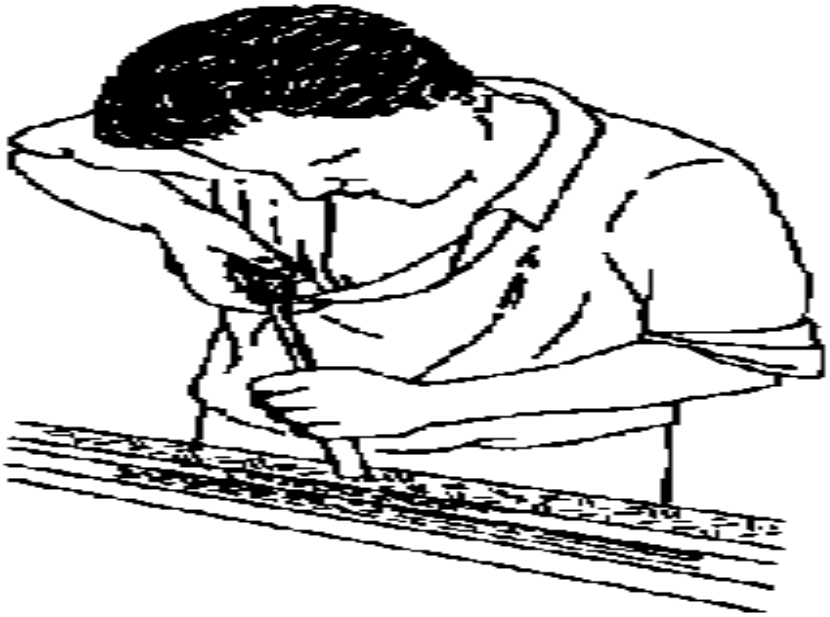


Figure 6.1 Scraping

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.

- 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. Cutting edge with round edcorners The cutting edge ishard ened with out tempered to make hard.

2. Blade:The broad part of ascraper

3. Tang :Thenarrowpartwhich fitsintowoodenhandle.

4. Wooden handle: That fitsintotang tohavegrip whilescrapping

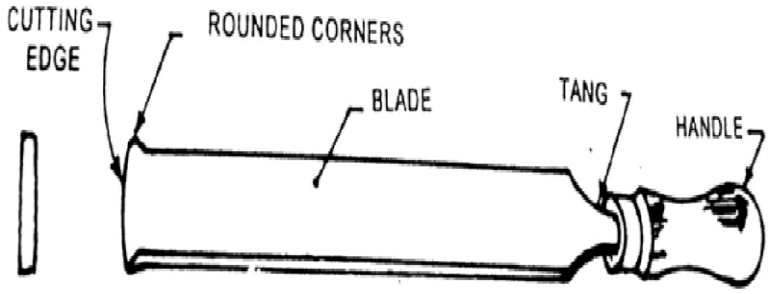


Fig.6.2 Parts of Scrapper

6.1.1.Flat surface

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

Equipment, tools and materials: -

1. Hack saw
2. Tape rule
3. Prick punch
4. Try square
5. Scriber
6. Surface plate
7. flat iron
8. divider
9. angle plate
10. steel rule
11. ball peen hammer
12. combination set

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:-

1. Do not try to cut without wearing hand gloves.
2. 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.

6.1.2.Curve surface

Curved surface shell structures can be used to create very useful, lightweight, rigid structural forms. Thispaperlooksatjustonetechniqueofproducingshellstructures,utilisingbentstripsofsheetmaterial such as steel plate or plywood, joined together into rigid tubes or shells. Sheet materials can only be bent/curved in particular ways, essentially limited to the surfaces of cylinders and cones, or combinations of various sized cylinders and cones (i.e., surfaces with zero Gaussian curvature).

6.2. Applying flush agent honing operation

Honing oil is a liquid, solution or emulsion used to aid in the cutting or grinding of metal, typically by abrasive tools or stones, and may or may not contain oil. It can also be called machining oil tool oil, cutting fluid, and cutting oil.

The two most common classes of honing oil are petroleum based (typically mineral oils), and non-petroleum (typically water or vegetable oil) based. Common additives include chlorine, sulfur, rust inhibitors, and detergents.

Honing oil has just the right consistency for sharpening stones. It will not gum it up nor glaze it, and it will provide just enough lubrication to avoid wearing out the stone prematurely.

6.3. Scraping and honing work pieces

The work piece can then be cut or machined to the required shapes and sizes.

What is honing?

Honing processing is a polishing process mainly combining rotational motion and reciprocating motion on the cylindrical inner peripheral surface.

Characteristic

1. Processing distortion is small at about 30 to 100m of low speed machining, which is about 1/20th of that of general grinding wheels.
2. General grinding is line contact processing. Honing is surface contact processing.
3. It acts as lubrication as a sliding surface and an oil reservoir of a rotating part.

The work piece can then be cut or machined to the required shapes and sizes.

Types of Honing Machine

Following are the two types of honing machine:

1. Horizontal Honing
2. Vertical Honing

In the horizontal honing machine, the longer size jobs are easily machined. These machines carry a horizontal axis with a honing tool. On some machines, the workpiece is placed on the table and it rotates back and forth.

In this machine, the workpiece is placed in a horizontal position and revolved around its axis. This type of machine is used for very long workpieces.

In this type of machining, the tool as well as the work piece, are placed vertically. These machines are available in more spindle types.

The workpiece is stationary and the tool rotates. Fixtures are in place to put the workpiece in the exact position. Hydraulic drives exist in modern types of machinery to control tools and workpieces.

The vertical honing machines are generally preferred for small jobs. These machines are mostly used compared to horizontal honing machines.

Hone and Honing Tools

Following are the different honing tools:

1. Flexible hones

2. Sharpening stones
3. Honing sticks
4. Hand hones

Self Check 6

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

1. an abrasive process for finishing round holes by means of bonded abrasive stones or sticks, is called_____

   A. Scrapping C. honing
   B. Chipping D. All

2. Pushing scrapers for pre-scraping and spot scraping of plane surfaces, suitable for removing larger quantities of chips is called_____

   A. Hacksaws C. cold chisels
   B. flat scrapping D. all

3. _____ 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.

   B. Cross filing C. scrapping
   C. Draw filing D. All

Reference

1. Automotive tool and equipment text book