STRUCTURAL CONSTRUCTION WORKS

Level – I

Based on March 2022, Curriculum Version 1




Module Title: - Perform Bench Work

Module code: - EIS SCW1 06 0322

Nominal duration: 40Hour

Prepared by: Ministry of Labor and Skill

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Addis Ababa,

Ethiopia

Table of Content

1.1. Acknowledgment

Ministry of Labor and Skills and Ministry of wish to extend thanks and appreciation to the many representatives of TVET instructors and respective industry experts who donated their time and expertise to the development of this Teaching, Training and Learning Materials (TTLM).

Acronym

C.....Carbon

Cm .....Centimeter

Fe .....Iron

Fig.....Figure

Mm .....millimeter

Mn.....Manganese

OHS .....Occupational Health and Safety

P .....Potassium

PPE.....personal protective equipment

S .....Supper

Si .....Silica

Introduction to the Module

In Structural construction works filed; **Perform Bench Work** helps to know the Work instructions, Layout and mark dimensions/ features on work piece, Cut, chip and file flat, rectangular or round blocks, Drill, ream and lap holes, Cut threads and Off-hand grind cut tools. This module is designed to meet the industry requirement under the Structural construction works occupational standard, particularly for the unit of competency: Perform Bench Work

This module covers the units:

- Layout and mark dimensions/ features on work piece
- Cut, chip and file flat, rectangular or round blocks
- Drill, ream and lap holes
- Cut threads
- Off-hand grind cut tools

Learning Objective of the Module

- Perform Layout and mark dimensions/ features on work piece
- Identify Cut, chip and file flat, rectangular or round blocks
- Perform Drill, ream and lap holes
- Apply Cut threads using tap and stock and die
- Understand Off-hand grind cut tools

Learning 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: - Layout and mark dimensions/ features on work piece

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

- Apply OHS Requirement
- Select materials
- Bench work tools and equipment
- Lie out and mark dimensions/features.

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:

- Identify Bench work tools and equipment
- Specify and Select materials
- Perform lay out and mark dimensions/features

Introduction to 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. It should be understood that the terms *bench work* and *vise work* mean the same thing; the latter, strictly speaking, is the correct term, as in most cases the work is held by the vise, while the bench simply provides an anchorage for the vise and a place for the tools. However, these terms are used almost equally. 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 machine

1.1. Apply OHS Requirement

1.4.1. 1.1.1. Using personal protective devices

- **safety shoes**

Safety boots are equipped with three safety measures. It must have:

1. Toes protection hood A steel hood to protect the toes from down falling heavy thing
2. A steel layer inside the soles protects the carrier from stepping into a turned up nail.
3. Benzene and oil resistant soles

- **Safety goggles**

Necessary during chiseling and grinding work protects against chips sparking around from the work piece

Helmet

Protects the carrier from down falling items. It should be a must for everybody who works or moves on a building site.

- **Leather gloves**: - Leather gloves offer **good grip, spark resistance, and protection against sharp or abrasive surfaces**. They also protect the wearer

from moderate levels of heat, such as the heat produced from welding or the friction from a rope sliding across the palms

- **Apron: -** Aprons are critical to a good bench in many ways not the least is the absolute unwavering rigidity essential to a hand tool workbench.

- **Applying safety procedures and tools, equipment's & materials**

Safety is to protect our self, co-worker, tools, equipment's & materials from danger or risk.

- Safety at all times should be positive. You must know what to do, what to use, what to prevent & what guards in the work area.
- Don't test sharpened tools with your finger.
- Don't use a file without handle.
- Use wire brush to remove metal chips, don't use your bare hands.
- Use sharp materials /tools properly used.
- Keep work area free from un necessary item, that cause slipping hazards.
- Avoid touch any machines & tools without the recognition
- Heavy hammers should not be done on a bench vise.

1.2. Select materials

1.2.1. Ferrous Materials

Ferrous materials are those which contain iron as their main constituent. Other constituents such as C, Mn, Si, S and P exist in varying proportions with iron (Fe) to form various ferrous materials such as pig iron, wrought iron, cast iron, alloy steel, carbon steel. Pig iron is the impure iron which is extracted from iron ores (Red Hematite, Brown Hematite) melting with coke and flux (Limestone) in Blast furnace. So Pig iron is therefore, refined and re-melted to produce other varieties of iron and steel.

- **Wrought iron**

Wrought iron is a highly refined iron (purest iron) which possesses at least 99% of iron. Wrought iron is produced by re-melting of Pig iron in pudding furnace

Composition:-

C = 0.02 -- 0.03%

S = 0.008 -- 0.02 %

P = 0.05 – 0.25 %

Mn = 0.0 – 0.02 %

Si = 0.02 – 0.10 %

Fe = Rest

Properties:-

(i): It has excellent corrosion resistance.

(ii): It has high ductility and can be easily forged.

(iii): It has good mach inability and weld ability

(IV): Its melting point is about 1500o C

(v): It can never be cast.

- **Cast Iron**

Cast iron is basically an alloy of iron and carbon and is obtained by re-melting of pig iron with coke, lime stone and steel scrap in a Cupola furnace.

Composition:-

C = 1.7 – 4.5 %

Si = 1.0 – 3.0 %

S = 0.0 – 0.15 %

P = 0.0 – 1.0 %

Mn = 0.5 – 1.0 %

Fe = Rest

Properties:-

(i): Hard and brittle.

(ii): Weak in tension.

(iii): High compressive strength.

(iv): Excellent casting characteristics.

(v): Excellent damping characteristics.

(vi): High machinability and wear resistance.

1.2.2 Types of Cast Iron

i) – Gray Cast Iron (C = 3.0 – 3.5 %)

This is obtained by allowing the molten metal to cool and solidify slowly. On solidifying, the iron is present with the carbon in the form of graphite flakes. It gives gray color

fracture due to presence of graphite.

Composition:-

C = 3.0 – 3.5 %
Si = 1.0 – 2.75 %
S = 0.02 – 0.15 %
P = 0.15 – 1.0 %
Mn = 0.4 – 1.0 %
Fe = Rest

Properties:-

(i) Due to free carbon (Graphite) it has self-lubricating properties.
(ii) High mach inability and wear resistance.
(iii) Low tensile strength and high compressive strength.
(iv) Excellent casting characteristics.
(v) Excellent damping capacity.

Applications: - Machine tool structures, pipes, pipe fitting, manhole covers, piston, cylinder head, etc.

ii) – White Cast Iron (C = 1.75 – 2.3 %)

In white cast iron, carbon is in the combined form (Fe_3C). This carbide is known as Cementite and it is extremely hard and brittle. Cementite formation takes place due to rapid cooling of molten iron. It shows white color at fracture.

Composition:

C = 1.75 – 2.3 %
Si = 0.85 – 1.2 %
S = 0.0 – 0.12 %
P = 0.05 – 0.2
Mn = 0.1 – 0.4 %
Fe = Rest

Properties:-

(i) extremely hard and brittle.
(ii) Poor machinability.
(iii) High tensile strength
(iv) Excellent wear resistance.

Applications: -

– It’s widely used in the manufacturing of wrought iron and malleable cast iron.

–(ii) Railway brake blocks, wheels and rim of ca

iii) – Malleable Cast Iron (C = 2.0 – 3.0 %

iv) – Nodular or Ductile Cast Iron (C = 3.2 – 4.2 %)

1.2.3 Non-Ferrous Metals

1.4.2. The two metals which comes under Non-Ferrous metals are

a) Aluminum: - is a lightweight metal with good formability. The pure metal is soft and weak but when employed with copper, magnesium and silicon or other metals, it becomes harder and stronger and is employed for various egg. Applications

Properties of Aluminum:

- It occurs in the form of oxide
- High electrical & thermal conductivity.
- Aluminum is nonmagnetic and has the property of corrosion Resistance.

b)Copper

- It has good electrical conductivity
- Corrosion resistance

  It is ductile and having the property of malleability

- Good thermal conductivity

1.3 Bench work tools and equipment

1.3.2 The Bench work Equipment

The prime requirements for a machinist's bench are that it should be strong, rigid, and of the proper width and height that the work can be performed conveniently. Correct height is important, and this will depend on the vise type used, that is, how far its jaws project above the bench. The location of the bench is important. It should be placed where there is plenty of light.

A great variety of tools is not necessary for bench work. They may be divided into a few general classes:

I Clamping tools

A) Vises A vise is a clamping device, usually consisting of two jaws that close with a screw or a lever, that is commonly attachable to a workbench; it is used for holding a piece of work firmly. There is a great variety of vises on the market, and they may be classed as follows:

• Blacksmith

• Machinist (plain, self-adjusting, quick-acting, or swivel)

• Combination

• Pipe

The machinist's vise shown in Figure 1-1 is usually provided on machine shop workbenches. Several types are provided; some of their features are parallelism, swivel action, and quick-acting jaws.

These vises will withstand terrific abuse and are well adapted for a heavy and rough class of work

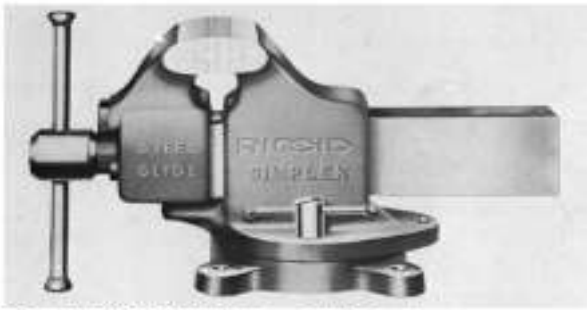


Figure 1-1 Machinist's vise. (Courtesy Ridge Tool Company.)

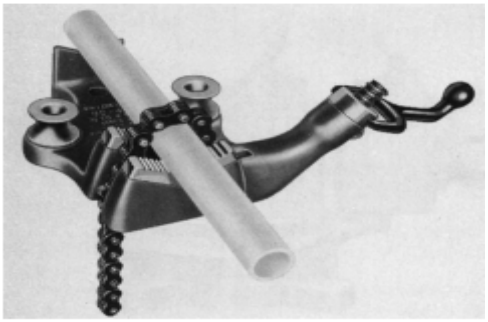


Figure 1:-Vises

B. Hand vice

:-used to grip very small objects. These are made in different shape and sizes. Commonly used hand at the bottom. A spring is provided between two legs. The jaws may be adjusted from a flange nut.

Figure 2Hand vice

C, **pin vice**: - pin vice is used to hold wire or small diameter rods. It is also used for grinding small drills. It consists of a small chuck made up to tools steels and a mild steel handle.

Figure 3pin vice

D, **pipe vice**

It is used to hold pipes. It consists of a vertical screw with guar threads. A handle is attaché on the top of the screw. A movable jaw is fixed on the lower end of the screw.

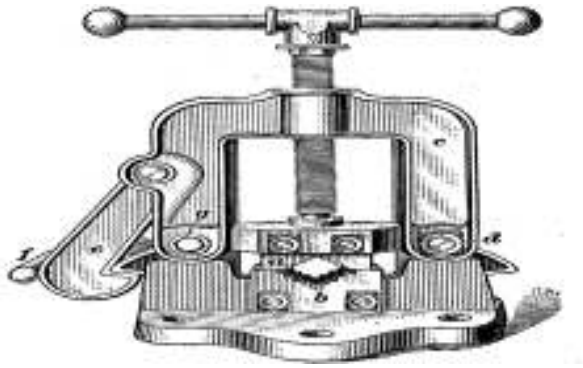


Figure 4pipe vice

II. Drilling machine

: - A drilling machine is a tool used to make holes in metal, wood, or concrete. The drill has to be fitted with a drill bit, which does the boring. The drill provides the power.

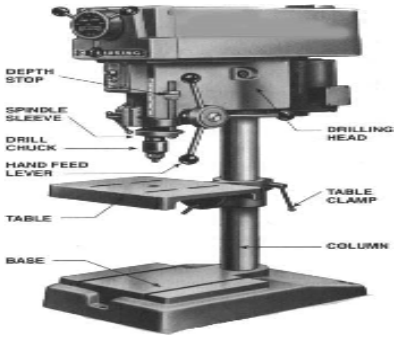


Figure 5 Drilling machine

a) 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.

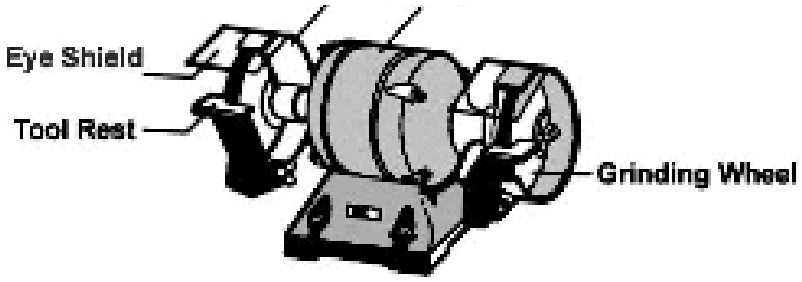


Figure 6. Drilling machine

II Bench work hand Tools

a) Hammers: - Hammers find frequent use in bench work. Machinist's hammers may be classed with respect to the peen as follows:

b) File:-File is used throughout the industry wherever metal must be removed rapidly and finish is of secondary importance. They include flat, hand, round, half-round, square, pillar, three-square, warding, knife, and several less commonly known kinds of files. Most machinist's files are double-cut.

Figure 7. File

Uses of file

should be used in perfect horizontal position. Most of the file their teeth pointing for ward. The pressure should be applied on the forward.

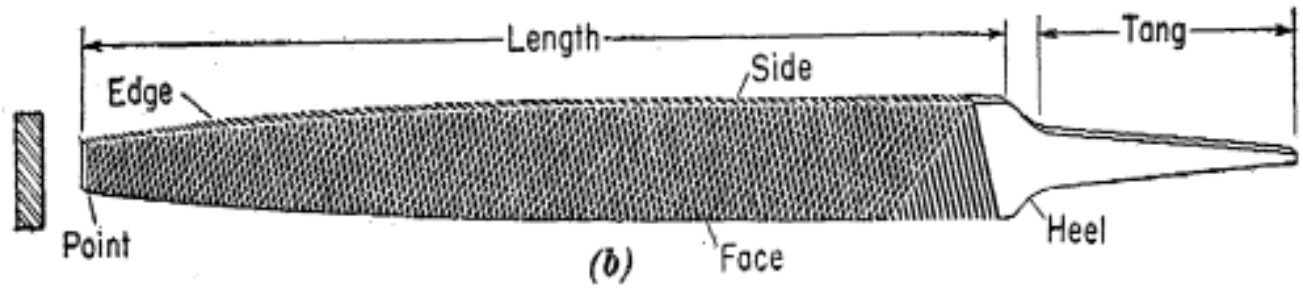


Figure 8Uses of file

- **Parts of file**

- **The tang**: - is a pointed or ends of file which fit in to the handle.
- **The point**: - is the end opposite of a tang.
- **The heel**: - is next to the handle or a tang.
- **The edge**: - is the side of a file which has no teeth.
- **Teeth**: - is the cutting edge of a file surface.

Uses of file should be used in perfect horizontal position. Most of the file their teeth pointing forward. The pressure should be applied on the forward.

- **Hand File** - The common file used for roughing and finishing. It is rectangular in cross section and parallel in width. It has double cut teeth on both faces, single cut teeth on one edge, and one save edge.

Figure 9Hand File

- . **Half-round File** – The cross section is a chord of circle with its taper towards the tip. It is used for forming radii, grooves, etc. Its flat side is used for finishing flat surfaces.

Figure 10 Half-round File

- . **Round File** - This is a round shaped cross section file with tapering toward the end. It is used for enlarging holes and producing internal round corners. It usually has double cut teeth in the larger sizes, and single cut teeth for the smaller sizes.

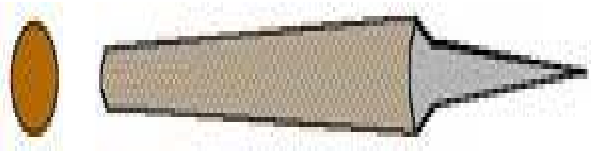


Figure 11Round File

- **Square File** - This is a file with square in section and taper towards the tip. It usually has double cut teeth on all four faces. It is used for filing rectangular slots or grooves.

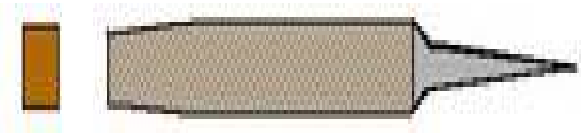
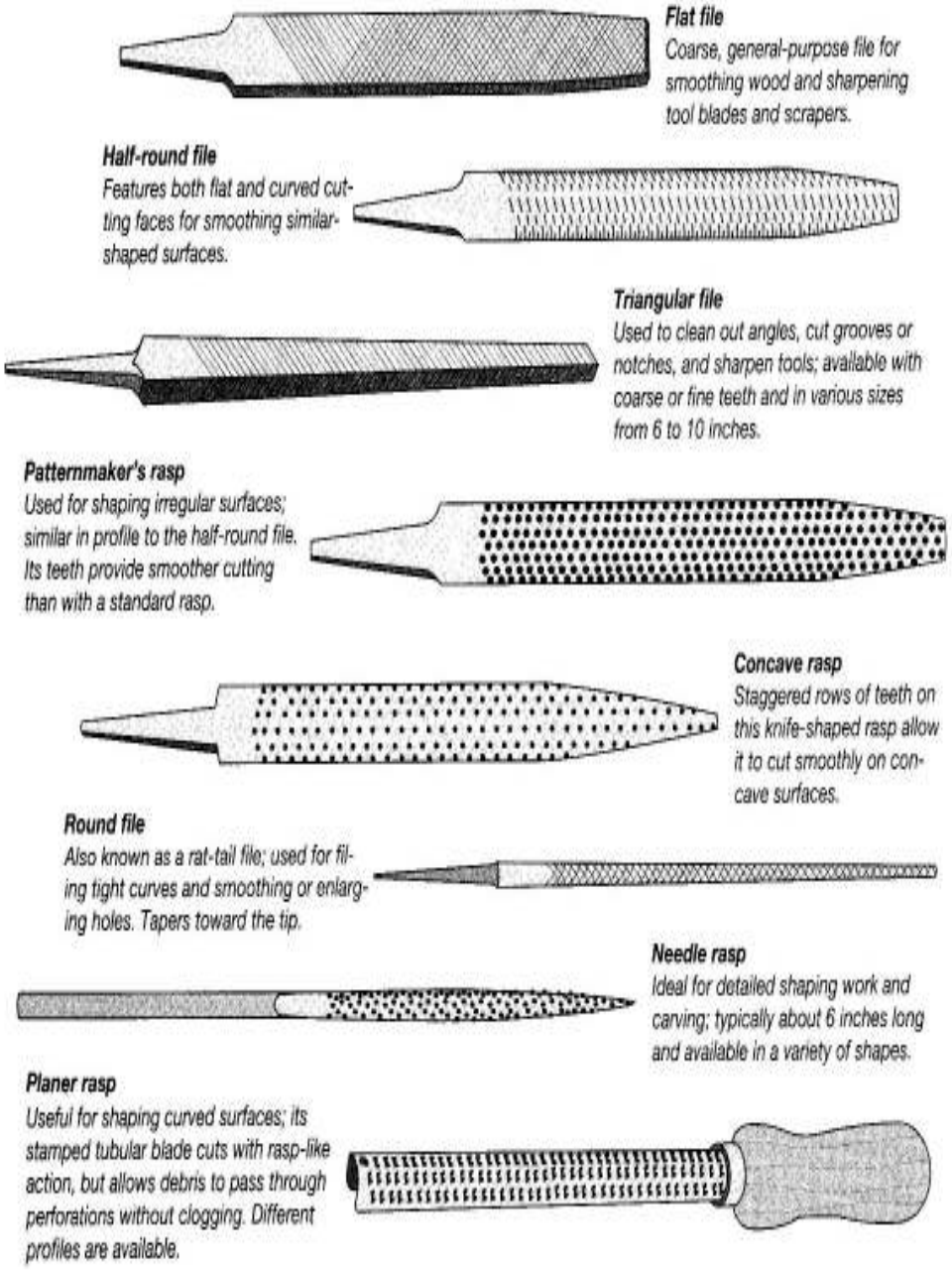


Figure 12Square File

- **Three Square File** - It is also known as triangular file. It is triangular in cross section with taper towards the tip. It has double cut teeth on both faces. It is used for filing corners or angles less than 90°.

Figure 13 Three Square File



b) **Scrapers:-**Scraping is the operation of correcting the irregularities of machined surfaces by means of scrapers so that the finished surface is a plane surface. Although it is impossible to produce a true plane surface, scrapers are used to approach a plane surface, or for truing up a plane surface. Scrapers are also used for truing up circular surfaces such as bearings.

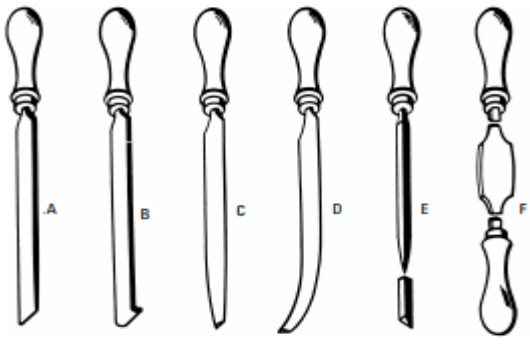


Figure 14b) Scrapers

Chisel: - this is used for chipping away the material from the work piece. This are made up of high carbon steel. Generally 6" to 8" long.

Chipping:- is the process of cutting metal with **chisel**.

a. **Chisel**: - this is used for chipping away the material from the work piece. This are made up of high carbon steel. Generally 6" to 8" long. This top is flattened and a sharp cutting edge is made on the bottom side.

Fig 15(a) Chisel the stone

- **Types of chisel**

There are **four** types of cold chisel are commonly used in metal works shop.

- **Flat chisel** used for general work cross cut chisel of half round chisels are used for grousing and diamond point chisels is used for precision work.

Figure 15Flat chisel

- **Diamond point chisel:-** is used for **V- shaped groves**& corners.
- **Cape chisel:-** is used for chipping **key ways**& cutting **rectangular grooves**.
- **Round nose chisel:-** is used for producing **round**& semicircular grooves**& inside round corner surfaces.**

❖ **Striking tools**

- Hammers:**-**are only tools generally used for striking in fitting shop. These are used for chipping, fitting punching etc a hammer consists of a heavy iron body with a wooden handle.

  The common types are:-
- **Ball pen hammer**
- **:-**is used for **general purpose** of work. It is also used for riveting.
  A hammer consists of a **heavy iron body** with a wooden handle.

Figure 16 Ball pen hammer

- **Cross pen hammer**
- **t**his hammer inside curves for bending or stretching metals. The larger striking surface is the face & the smaller end is peen.

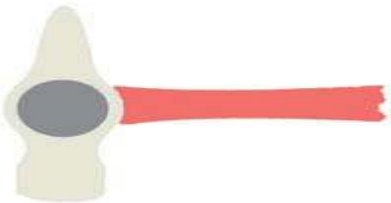


Figure 17•Cross pen hammer

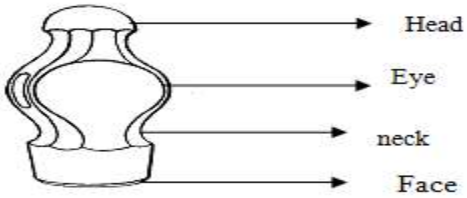
- **Straight peen hammer:-** is used for stretching the metal by hammering or by Full erring

Figure 18 Straight peen hammer

- **Mallet hammer**
- **:-** is used to strike **finished surfaces** with out causing damage or to position the work piece

Figure 19•Mallet hammer

- **Claw hammer:-** is used to drive nails in to woods. It is used only for driving & pull Nails



Different parts of hammer

III Measuring and marking tools

a) Try-square

It is used for checking squareness of two surfaces. It consists of a blade made up of steel which is attached to a base at 90o. The base is made up of cast iron and steel try square is also used for marking right angle and measuring straightness of surfaces.

Figure 20a) Try-square

b) Combination square

It is a multipurpose instrument that can be use a level, miter, and try square.

Figure 21b) Combination square

c) Scriber

it made up of height carbon steel and hardened from the front edge. It used to marking line.

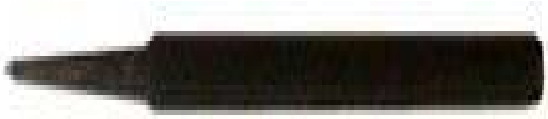


Figure 22c)Scriber

d) Center punch

it is like dot punch except the angle of the punching end is 90o. it is used to make the center of the hole before drilling.

e) Steel rules:

These are made up of stain less steel are available in many sizes ranging from ½ ft to 2ft. these are marked in inches or millimeters.

Figure 23e)Steel rules

f) Venire caliper:-

Venire caliper is a precision instrument used for measuring length and diameter. it can be used for measuring external and internal dimensions**.**

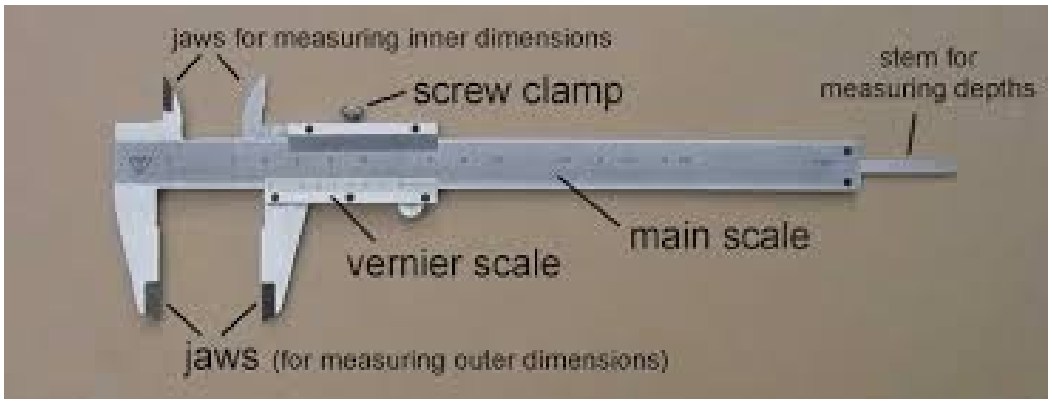


Figure 24f)Venire caliper

Venire caliper: - venire caliper is a recession instrument used for measuring length and diameter.

III (a) Parts of venire caliper

- **Outside jaw:-**is used to measure external diameter or width of an object.
- **Inside jaw/ear**:- is used to measure internal diameter of an object.
- **Main scale**:- is used to scale marked every millimeter, inches & fractions.
- **Venire scale/movable scale:-** is gives interpolated measurements to the division of 1/10, 1/20, 1/50mm etc.
- **Depth gauge**:- is used to measure depth of an object or a hole.
- **Locking screw**:- it is tighten & loosening of the sliding parts.
- **Two types of calipers**

– **Outside calipers**

– **,** as shown in are used for measuring external dimensions such as the length, diameter, or even the thickness of a solid

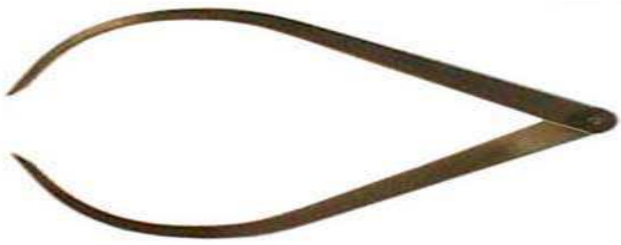


Figure 25Outside calipers

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

Figure 26 Inside calipers

It can be used for measuring external and internal dimensions. It consists of a graduated bar of rectangular section. It has two jaws one is movable with a small venire head and the other is fixed.

A fine adjustment nut is also attached to the head. The dimension is measured by the jaw and is indicated on graduated bar. Minimum dimension that can be expressed on vainer caliper is 0.001 or 0.02mm generally. The material of the part is stainless steel.

▪ **Divider**:- these are a made up of steel. Dividers have two legs having sharp feet. These are hinged at the top. It is used for marking arcs dividing a line or transferring the dimensions. The blade should be tightened sufficiently.

Figure 27 Divider

Scriber: - It made up of height carbon steel and hardened from the front edge. It used to marking line.

Dot punch It used for marking dotted line. It made up of high carbon steel or high speed steel one end is sharpened.

Figure 28Dot punch

H. **Center punch**: - it is like dot punch except the angle of the punching end is 90o. it is used to make the center of the hole before drilling.

IV Cutting tools

The tools which are used to remove the material are known as cutting tools.

- **Hacksaw**: it used for cutting of rods, flats etc. The blade of the hack saw is made up of high carbon steak or high carbon steel and the frame is made from mild steel. The blade is placed inside the frame. The teeth of saw blade are generally forward cut.

3. Cutting tools: - the tools which are used to remove the material are known as cutting tools.

Hacksaw: it used for cutting of rods, flats etc

The blade of the hack saw is made up of high carbon steak or high carbon steel and the frame is made from mild steel. The blade is placed inside the frame. The teeth of saw blade are generally forward cut.

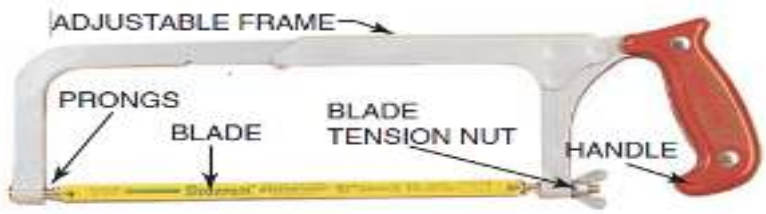


Figure 29Hacksa

- **Types of hacksaw frames**

There are two types of hack saw frames

a. Fixed frame
b. Adjustable frame

In fixed frame only one the type of blade is where as in adjusted frame, can be increased or decreased as per requirement and the blade from 8 to long can be used in to.

Use of hack saw the material to be cut with hack. Saw is clamped in to vice and mark that material the handle of hack saw is held in right hand and the left hand is kept on the frame start sawing at the marking, keeping the blade slightly inclined to the horizontal. The hack saw should be moved perfectly straight and horizontal.

Care of hack saw, the following precautions should be observed. While using hacksaw.

1, always move the hacksaw in perfect straight and horizontal direction

2, never tile (intend) the frame while sawing.

3, while cutting thin section wooden piece must be clamped along with the work piece.

4, don't use a new blade in the cut made be another blade.

Dipper: - it is generally used for measure the inside and outside diameters. It is made different sizes and shapes.

It consists of two bent legs connected at one end by means of rivet or bolts. The edge are made to just touch the job. The dimension is with the help of steel rules.

1.4 Lay out and mark dimensions/features

LAYING OUT is the term used to describethe locating and marking out of lines, circles,arcs an d points for drilling holes. These lines
and reference points on the metal show themachinist where to machine.The tools used for this work are known as**LAYOUT TOOLS**. Many common hand toolsfall into this category. The ac curacy of the jobwill depend upon the proper and careful used ofthese tools.

1.4.1 Lay out and mark dimensions/features

LAYOUT DYE
is probably the easiestto use of the many coating devised to make thelines stand out better. Th is blue colored fluid,when applied to the metal, offers an excellentcontrast between the metal a nd the layout lines.All grease and oil must be removed beforeapplying the dye, otherwise it wi ll not adhereproperly. In a pinch, layout fluid can be made by
dissolving the coating on spirit duplicator
carbons in alcohol. Chalk can be used onhot rolled metal as a layout background.A layout, to be accurate, requires finelines that must be scribed or scratched in the metal. A SCRIBER
is used to
produce these lines.The point is made of hardened steel, andis kept needle sharp by frequent h oning on a fine oilstone. Many styles of scribers are availabl.

1.4.2 Making Lines on Metal

The shiny finish of metal makes it difficultto distinguish the layout lines from the metal.

Layout

Dyeis probably the easiestto use of the many coating devised to make thelines stand out better . This blue colored fluid,when applied to the metal, offers an excellentcontrast between the metal and the layout lines.All grease and oil must be removed beforeapplying the dye, otherwise it will not adhereproperly. In a pinch, layout fluid can be made by dissolving the coating on spirit duplicator carbons in alcohol. Chalk can be used onhot rolled metal as a layout background.A layout, to be accurate, requires finelines that must be scribed or scratched in the metal. A SCRIBER is used to produce these lines.The point is made of hardened steel, andis kept needle sharp by frequent honing on a fine oilstone. Many styles of scribers are available.

The main scale is accurately graduated in **1** millimeter. A movable jaw is fixed to a caliper jaw. The movable scale is equally divided in to **10, 20, 50** divisions.

1.4.3 Steps of reading venire caliper

1. Read the large numbered from the main scale & multiply by **10** mm.
2. Read the un numbered division from the main scale **before zero counted**& add the large number
3. Read the venire scale which **concedes** from the main scale& count un numbered division added & also multiply by the accuracy **0.05or 0.02mm**.
4. Last step is total value are **added all** steps.

*In **ten** division parts the length is only **nine** millimeter. Therefore one division on the venire scale is equivalent to **0.9mm**. These means the difference b/n one graduation on the main scale & one graduation on the venire scale is, **1.0-0.9 = 0.1mm**.

1.3.2 Steps in Making a Layout

Each layout job has its peculiarities and requires some planning before the operation can be started. Study the drawings carefully.

Step 1. Cut the stock to size and remove all burrs and sharp edges

Step 2. Clean the work surface of all oil and grease and apply layout dye.

Step3. Locate and scribe a REFERENCE or BASE LINE.

Step 4. Make all of your measurements fromthi

Step 5. If the material has one true edge, it can be used in place of the reference lines.

Step 6 Locate the center points of all circles and arcs.

Step7.Use the PRICK PUNCHto mark the point where the center lines intersect.The sharp poin t (30 to 60 deg.) of this punch makes it easy to locate this position. Afterthe prick pun ch mark has been checked and found on center, it is enlarged with theCENTER PUNC H,

Step 8.. Using the divider or trammel, scribe in all circles and arcs.

Step 9. If angular lines are necessary, use the proper protractor type tool, or locate the correct points by measuring, and connect them by using a rule or straightedge.

Step 10 Scribe in all other internal openings.

Step 11. Use only clean sharp lines

3.1.4. Conversion to metric system.

A. Metric system: - is a system of measurements which is established based up on meters.

B. Inch system: - is a system of measurements which is established based up on inches.

E.g.1 inch = 2.54 cm

C. Metric thread:-is identified by the letter ‘M’ the nominal diameter& the pitch of thread.

E.g. The metric thread is outside diameter of 5mm & the pitch of thread 0.8mm, which identified as M5*O.8m

1.5 Self- check-1

Test-I Matching

Instruction: select the correct answer for the give choice. You have given 1 Minute for each question. Each question carries 2 Point.

Column "A"	"Column B"
1. Used to Protects the carrier from down falling items	A. Ferrous
2. Used to protect against sharp or abrasive surfaces.	B. Helmet
3. Which contain iron as their main constituent	C. safety shoe
4. Type of Clamping tools	D. Google
	E. Vice

Test II: short Answer writing

Instruction: write short answer for the given question. You are provided 3 minute for each question and each point has 5Points.Explain at least three types of bench vice?

What is the use of Try square?

Describe methods of reading veneer caliper?

List parts of veneer caliper?

Explain the difference between inside and outside caliper

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

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

- Clamp work pieces
- Cut Work pieces
- Dull hacksaw blades
- Bench work operations

This guide will also assist you to attain the learning outcomes stated below. Upon completion of this learning guide, you will be able to:

- Identify Clamp work pieces
- Specify Cutting Work pieces
- Replace broken or dull hacksaw blades
- Perform bench work operations

2.1 Clamp work pieces

2.1.1 Concepts of clamping

Once work piece is located, it is necessary to press it against locating surfaces and hold it there against the force acting upon it. The tool designer refers to this action as clamping and the mechanisms used for this action are known as clamps. It is necessary that the work should be properly and securely held on for machining operations, a VISE is an effective work holding device.

Vises: Vises are the most common appliances for holding work on table due to its quick loading and unloading arrangement.

Types of work holding devices

- **Bench vice**

A **bench vise** is like an extra hand and is a common tool found in any shop or garage. It is attached to a **workbench** and its purpose is to hold material steady, allowing you to use both hands to work on the material with other tools. They are ideal for sawing, sanding, planing, drilling, screwing, soldering and more.

There are mainly three types of vises commonly used:

- Plain vise
- Swivel vise
- Tool makers universal vise

1 Removable hardened alloy steel jaw inserts.

2 Completely enclosed center screw.

3 Attractive hammered enamel finish *Machine vice*

bench vice

Figure 30• Bench Vises

- **V-block**

V-block is rectangular or square block with a V-groove on one or both sides opposite to each other. The angle of the 'V' is usually 90^0. V-block with a clamp is used to hold cylindrical work securely, during layout of measurement, for measuring operations or for drilling for this the bar is faced longitudinally in the V-Groove and the screw of V-clamp is tightened. This grip the rod is firm with its axis parallel to the axis of the v-groove

- **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.

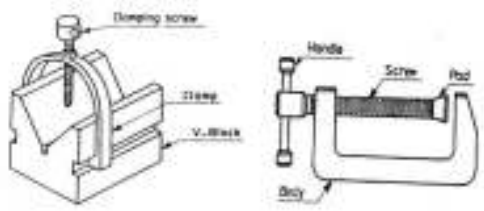


Figure 31V-Block and C- Clamp

2.2 Cut Work pieces

2.2.1 Introduction to Cutting metals

Sawing is the process of cutting metal stock that is impractical to use a file, a chisel or a machine with a multi-point cutting tool called a hand hack saw. A hand hack saw can also be used for cutting off a jammed bolt, pipes, tubing and rods for special or custom fittings on the job (on the field work).

Some of the most common tools used to cut metals are **hacksaws**, **band saws**, **cold chisels**, **bolt cutters, tin snips, and abrasive saws**. 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 "ironworkers. Layout tools are used to measure and mark metal stock before cutting, shaping, and doing other types of work with cold metal.

- **Saws**

Saws are used to cut material that is not needed away from material which is. Saw blades have alternate teeth bent out or 'set' in opposite directions. This is so that when they cut, they

make a gap, called the kerfs. The kerfs must be wider than the saw blade so that the blade cannot get stuck. When using a saw, you should always cut to the waste side of the marked line so that you leave a small amount for finishing by either sanding or filing. Whatever you are cutting, it is important to keep as many teeth in contact with the piece being cut as possible. You should choose the correct saw for the type of material you are using. Table 2.3 on the next page shows the most common types of saws used in school workshops.

2.2.2 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.

Steps to Follow in Making the Cut with a Hacksaw

Place the metal to be cut in a vise and mark it. The mark should be placed near the jaws, especially if the metal is thin. It may be necessary to use boards between the vise jaws to prevent scarring the work. Mark over the original mark with a file.

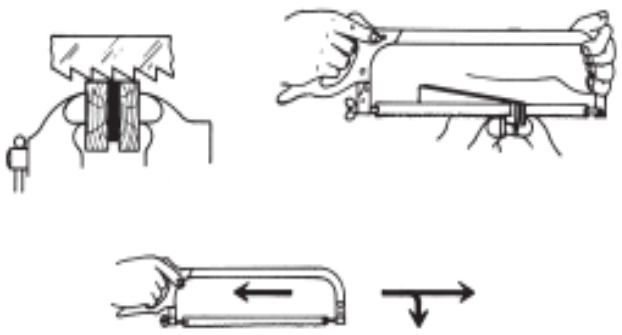


Figure 32Using a hack saw

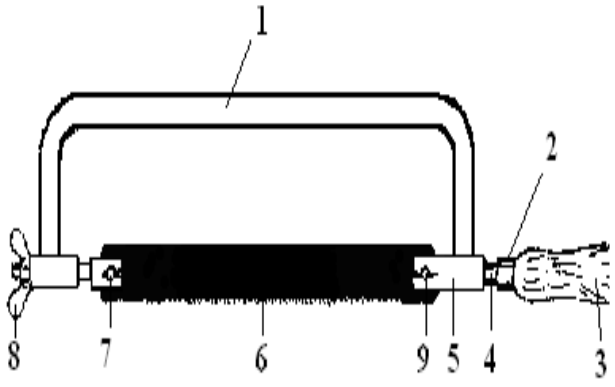
Depending upon the direction of cut, blades are classified as:

- ✓ Forward cut
- ✓ Backward cut.

Depending upon the pitch of the teeth (Distance between the two consecutive teeth) blades is classified as:

- ✓ Coarse (8-14 teeth per Inch)
- ✓ Medium (16-20 teeth per inch)
- ✓ Fine (24-32 teeth per inch)

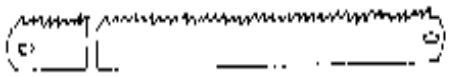
- **Parts of a hacksaw**



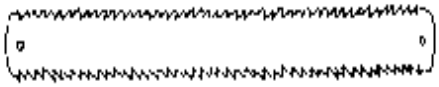
1. Saw frame
2. Handle protector
3. Handle
4. Tang
5. Blade holder
6. Blade
7. Pins
8. Wing-Nut
9. Pins

Figure 33Parts of hack saw

- **Types of blades for hacksaws**



One side toothed

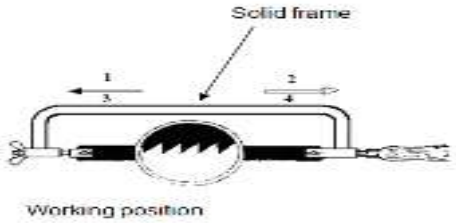


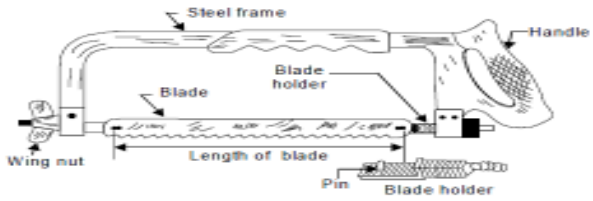
Both sides toothed.

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.

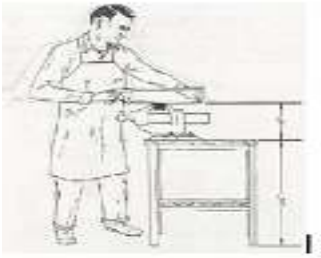




Fig(1) Non- adjustable frame (fixed frame)

Fig (2) Aadjustable frame

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

Figure 34Working position

Table 2.2.2. Saw teeth for different materials

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

Note: 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

2.2.3 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.

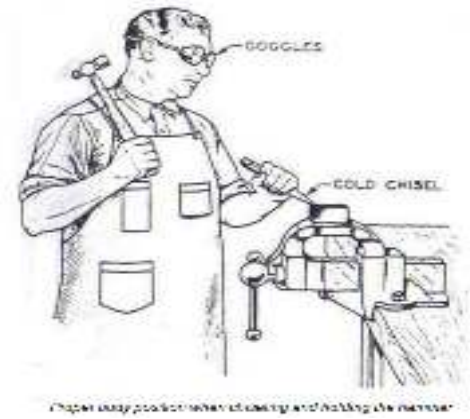


Figure 35Proper body position when chipping

- **Types of chisels:**

These are sometimes referred to as cold chisels because they are used to cut cold metals. They are made of cast steel or alloy steel, with a hardened and tempered cutting edge.

The common types of chisel (Figure 3.8) include:

1. **The flat chisel**: used for general-purpose chiseling;

2. **The cross-cut chisel**: used for cutting grooves such as keyways, and for chipping;

3. **The half-round-nosed chisel**: used for cutting grooves (which are either curved or half-round);

4. **The diamond-pointed chisel**: used for working into corners and cutting small grooves.

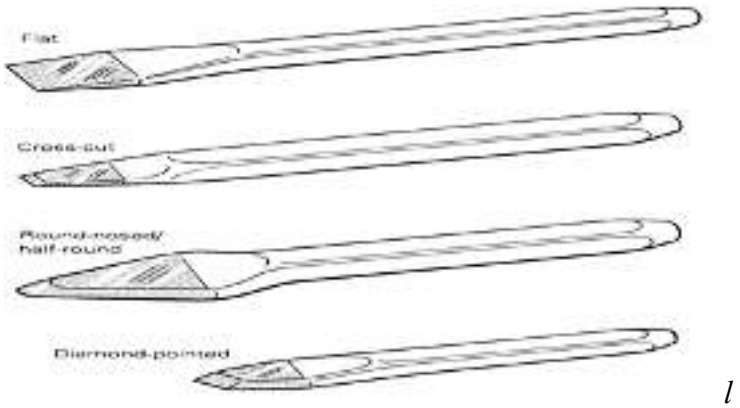


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Figure 36Common types of chisel

- **Filing**

Filing is a method of removing metal, and the file (Figure 3.9), which is the most widely used hand tool in the school workshop, is used for this cutting operation. It is made of carbon tool steel containing about 1.3 per cent carbon.

- **The Main Parts**

A file is a hand cutting tool made of high-carbon steel, having a series of teeth cut on the body by parallel chisel cuts. The parts of a file are shown in figure. 3.9. Files are used to remove surplus metal and to produce finished surfaces.

Figure 37• The Main Parts

2.3 Dull hacksaw blades

2.3.1 The blades of hack saw break or dull .

As a blade becomes dull, the kerf (slot made by the blade) becomes narrower. If you try to continue the cut in the same slot, the new blade will usually bind and be ruined in the first few strokes. If possible, **rotate the work and start a new cut on the other side**

2.4 Bench work operations

Bench work operations for the manual mill often occur before and after the machining of part. These operations are commonly performed on a standard workbench with the Part secured in a **vise**, or secured to the worktable depending on the operation. Bench work operations involve processes that allow the work piece to achieve the accuracies specified by the blueprint. These operations require operator skill and attention to detail.

Follow safety and correct working procedures to perform bench work operations.

Bench work operations performed prior to machining include the following: Layout

Cutting: in the metal work shop materials (especially metals) are cut to shape before filing. There are numerous types of cutting operations.

- ✓ Points to watch when using the hack saw:
    1. Hold the work securely in the vice.
    2. Grip the hack saw firmly, using both hands.
    3. Use the same stance as filing.
    4. Use the full length of the blade.

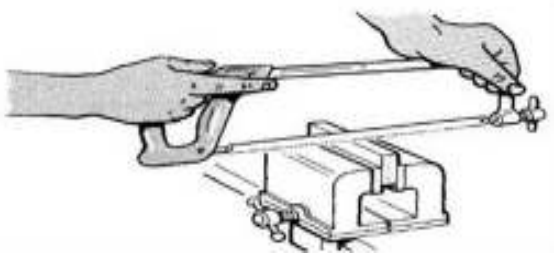

Figure 38Sawing operation

- Chipping operation
    - ✓ chipping metal (chiseling)

Chiseling is one of the methods of cutting materials.

-you can chip the metal to produce grooves or to reduce the width or thickness.

Procedures to chip metal:

1. hold the metal in the vice
2. Hold the chisel at an angle of about 45^0 to the work.
3. Hammer to remove the chip.
4. Filing: is a method of removing metal.
5. Filing: is a skill that is difficult to learn. It is not easy to explain how to use a file.

Self-check 2

Test-II choose the best answer .each alternative have 1 point

1. One of the following is the process of cut metal and other material

   .A) Hammer B) Vice C) Hack saw D None

2. _____is used for clamping work piece.

   A) Bench vice B) C-clump C) C- clump D) All

3. Removing the metal with a chisel is called_____

   A) Reaming B) Filling C) Chipping D) tapping

4. How many chisel are there.

   A) 2 B) 4 C) 3 D) 5

5. The most common tools used to cut metals

   A) Hack saw B) Band saw C) Cold chisel D) None

Test II: short Answer writing

1. **Instruction:** write short answer for the given question. You are provided 3 minute for each question and each point has 5Points.Explain at least three types of bench vice?
2. What is the difference between C- clamp and V- block?
3. Mention some part of hack saw?
4. List parts of veneer caliper?
5. Explain the difference between inside and outside caliper

Operation sheet 2

- **Operation title: Chisel natural stone**
- **Purpose:** in order to separate or chip material.
- **Instruction:** Using the given equipments measure the length of each line. You have given 30Minut for the task and you are expected to write the answer on the given line.
- **Tools and Equipment**
- Chipping hammer.
- Try square
- Tape

Procedures

Step 1. Preparing raw material

Step 2.Fixing or wedging raw material into place to ensure stable

Step 3.. Aligning chiseling blade

Quality criteria

Material type, machining speed, rake angle of the tool, friction between the tool and material as well as on the cooling fluid used to cools the material during the machining operation

Lab Test 2

Task 1. Preparing raw material

Task2. . Fixing or wedging raw material into place to ensure stable

Task 3. Aligning chiseling blade.

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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:

- Drill, ream, spot-face and lap 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:

- Identify Drill, ream, spot-face and lap Hole
- Perform drill, ream and lap Hole operations

3

3.1 Drilling, boring, reaming and honing Bore holes

3.1.1 Introduction to drilling

Drilling is a process of producing round holes in a solid material or enlarging existing holes with the use of multi tooth cutting tools called drills or drill bits. In other words it is the process of making holes of cylindrical shape on metals and other materials using drill bits and drilling machines.

Drilling machine**:** are driven either manual or by electrical power.

3.1.2 Classification of drilling machines

Drilling machines: are classified into hand and breast drill, portable electrical drill, bench drill, pillar dills and others.

- **The hand and breast drill:** are driven by hand and are commonly used where electricity is unavailable and are used for light work
- **Portable electrical drill:** are most suitable to work which cannot be done with bench drill.
- **Bench drill:** is one of the most common used machines in the work shop. This machine has the following parts. The base, the column, the head, the spindle, the pulleys, the motor, the belt, the safety swatch, the feed handle, the depth gauge, the head locking handle, the gear lever, the collar, the chuck and the main switch.
- **Pillar dills:** is similar in design to the bench drill. But it is floor mounted and usually much large.

Various cutting tools are available for drilling, but the most common is the *twist drill*.

- **Standard Operations**

Drilling machines may be used for performing a variety of operations besides drilling a round hole. A few of the more standard operations, cutting tools and work set-ups will be briefly discussed.

A. Drilling – 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.

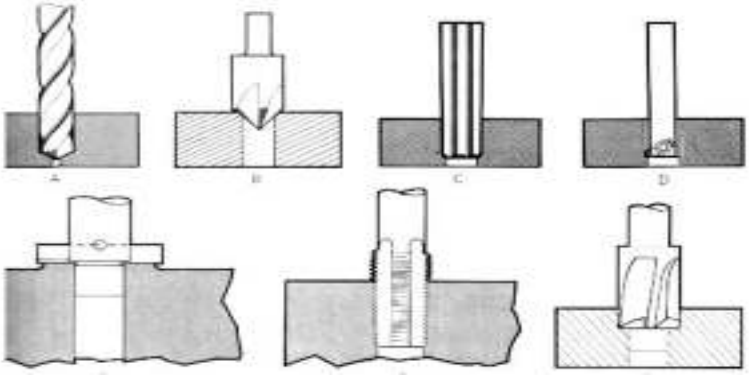

Figure 39. Variety of operations of drilling machine

B. Countersinking – is the operation of producing a tapered or cone shaped enlargement to the end of the hole.

C. Reaming – 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.

D. Boring – is the operation of enlarging and truing a hole by means of a single-point cutting tool which is usually held in a boring bar.

E. 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. For the spot facing operation, the work being machined should be securely clamped and the machine set approximately ¼ of the drilling speed.

Spot facing is a process of machining a flat surface around the mouth of a hole in order to provide a flat seat for the head of a bolt or a nut.

F. Tapping – is the operation of cutting internal threads in a hole with a cutting tool called a tap. Special machine or gun taps are used with a tapping attachment when this operation is performed by power in a machine.

G/ counter boring – is the operation of enlarging the top of a previously drilled hole to a given depth to provide a square shoulder for the head of a bolt or a cap screw.

Counter boring is used to form a flat, recessed seating for a cheese head bolt or cap screw.

Sensitive Drill Presses

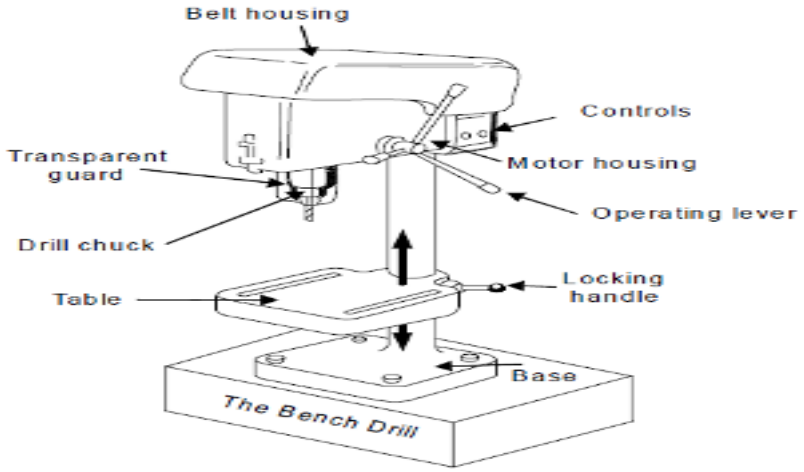

Figure 40Parts of drill Presses

3.2 Drill Bits

3.2.1 Introduction 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.

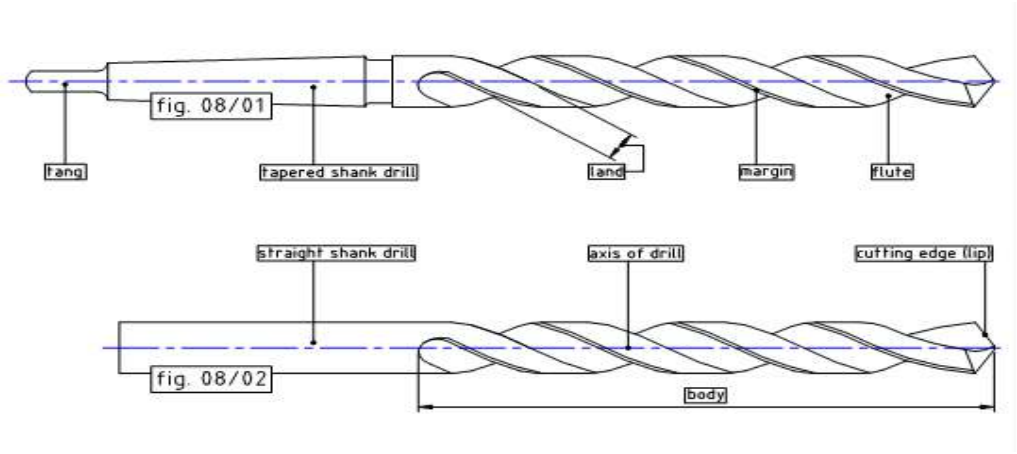

Figure 41Twist drills bit

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- **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.

- The margin is the narrow, raised section on the body of the drill. It is immediately next to the flutes and extends along the entire length of the flutes. Its purpose is to provide a full size to the drill body and cutting edges.
- The lip clearance is the undercut portion of the body between the margins and the flutes. It is made smaller to reduce friction between the drill and the hole during the drilling operation.
- The web is the thin partition in the center of the drill which extends the full length of the flutes. This part forms the chisel edge at the cutting end of the drill. The web gradually increases in thickness toward the shank to give the drill strength.
- Point The point of a twist drill consists of the chisel edge, the lips, the lip clearance angle and the heel.

  The chisel edge (web) is the chisel-shaped portion of the drill point.

- The lip (cutting edge) a formed by the intersection of the flutes. The lips must be equal length and have the same angle so that the drill will run true and will not cut a hole larger than the size of the drill.

Performing all operations using safety procedures

Perform basic drilling, reaming and honing operations applying safety procedures and using personal protective devices.

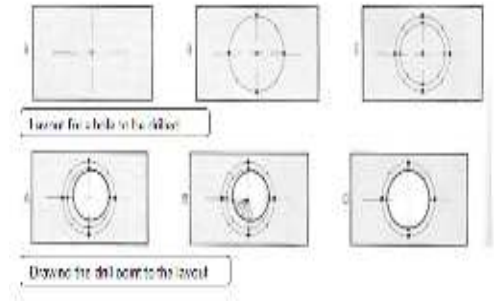
When performing drilling, reaming and honing operation safety precaution and personal protective equipment (PPE) is necessary to protect ourselves, machines, tools and equipment. Following the right safety procedures and personal protective device perform the operations listed below:

- **Drilling operations**

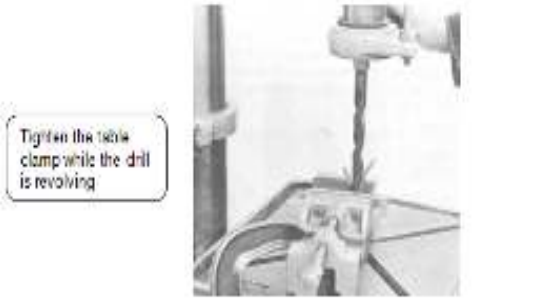
To practice drilling, counter boring, counter sinking, reaming.

PROCEDURE

- ✓ Prior to drilling a hole, locate the hole position and put a punch mark to aid the drill in starting the hole.
- ✓ Select the proper drill bit according to the size need.
- ✓ Select cutting fluid.
- ✓ Select the correct rpm.
- ✓ Use an interrupted feed, called peck drilling, to break up the chips being produced.
- ✓ Counter sinking and counter boring operations are performed with the same procedure by changing the tools.
- ✓ Select the reamer.
- ✓ Drill a pilot hole that is a bit smaller to a reamer.
- ✓ Drive the reamer at a slow, constant speed. The cutting speed for reaming should be 1/3 of drilling.



Lay out for a hole to be drilled.



Tighten the table clamp.

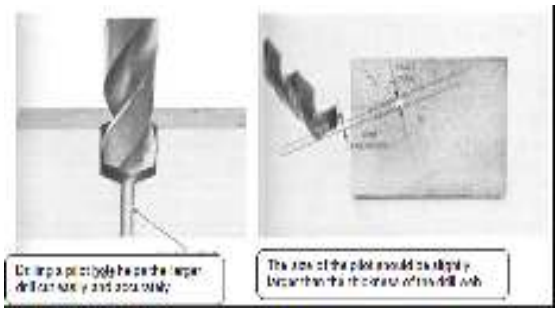


Figure 42Drilling a pilot hole table and drilling

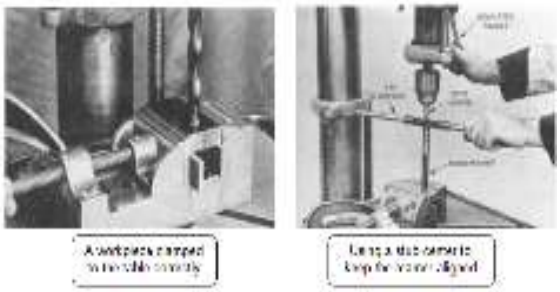


Figure 43clamping a work piece to the

.

Self- check-3

Test-I Matching

Instruction: select the correct answer for the give choice. You have given 1 Minute for each question. Each question carries 2 Point.

Column "A"	"Column B"
1. Commonly used where electricity is unavailable	A. Ream
2. Producing a smooth round hole	B. Hand drill
3. truing a hole by means of a single-point cutting tool	C. Spot-facing
4. Smoothing and squaring the surface around a hole	D. Fill
	E. Boring

Test II: short Answer writing

Instruction: write short answer for the given question. You are provided 3 minute for each question and each point has 4 Points

1. What is reaming?
2. What is the use of Tap?

3. List parts of thread?
4. What the difference between is die and die stock?

Operation sheet 3

- **Operation title: Drill**
- **Purpose: To cut holes into or through metal, wood, or other materials**
- **Instruction:** Using the figure below and given equipments measure the length of each line. You have given 30Minut for the task and you are expected to write the answer on the given line.

Tools & Equipment

- bench vice
- File
- hack saw
- Drilling machine

Procedures

Step 1.File permits.
Step. 2. Build Location.
Step. 3. Move rig on location and rig up.
Step. 4. Drill surface hole and set surface casing.
Step. 5. Complete drilling of the well.
Step 6. Log the well and run any other test that may be needed
.

Quality criteria

For any novice confused by cutting speeds, pressure and having to identify metal a good rule of thumb would be to: Drill at a slow speed. Use plenty of lubricant.

Lab Test 3

Task.1. Wear safety glasses or a face shield (with safety glasses or goggles).
Task. 2. Keep drill air vents clear to maintain adequate ventilation.
Task.3. Keep drill bits sharp always.
Task.4. Keep all cords clear of the cutting area during use

4 Unit Four: Cut threads using tap and stock and die

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

- Cut thread
- Cut thread tap sequence
- thread cut operations

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:

- Perform Cut thread
- Follow Cut thread tap sequence
- Perform thread cutting operations

4.1 Cut thread

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.

4.1.1 Threads using tap and stock and die

- **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 and dies**

Screwing is a temporary method of fastening parts together. Methods for cutting screw threads include the use of the centre lathe. For bench work, however, taps and dies are used.

✓ **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. The shank is smaller than the threaded portion. The tap has four rows of threads, cutting edges or teeth, which suit a particular thread form. They perform the cutting action. The grooves between the cutting edges are called flutes. They allow waste material (chippings) to escape. They also allow cutting oil into the work.

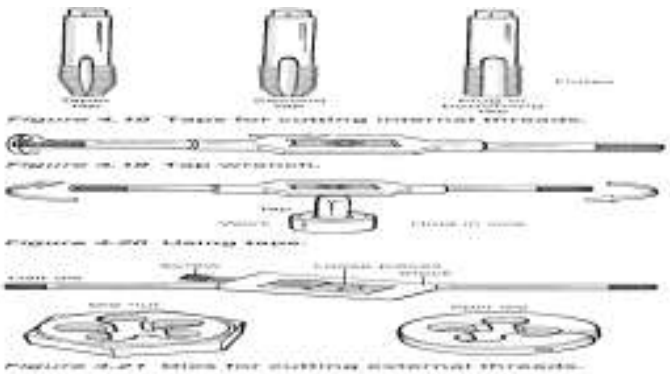


Fig.4.1.1. Taps and dies

4.1.2 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 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.

- **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.

- **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.

4.1.3 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 **countersink** both sides of the hole.

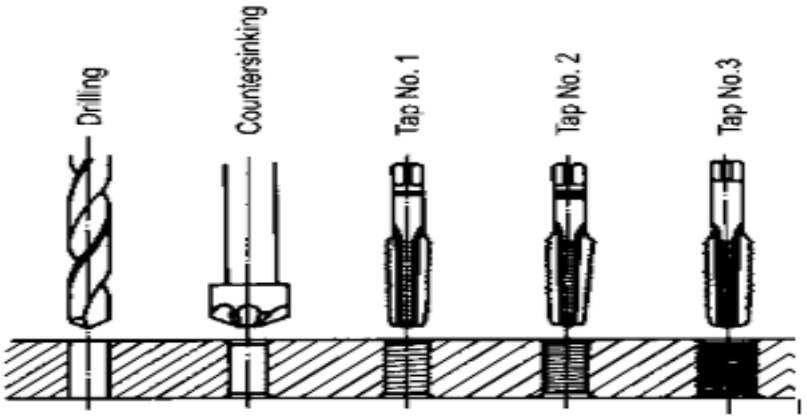


Figure 44Drill, Countersink and tapping a hole

4.1.4 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 squareness. 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 in the straightening process, otherwise the tap may be broken.
8. 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.

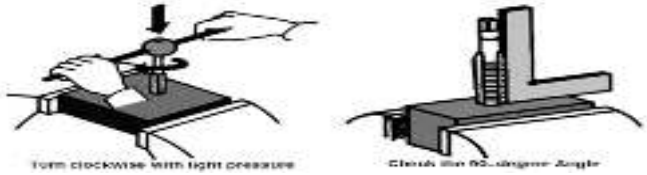


Figure 45Tapping operation

4.2 Threading Dies

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.

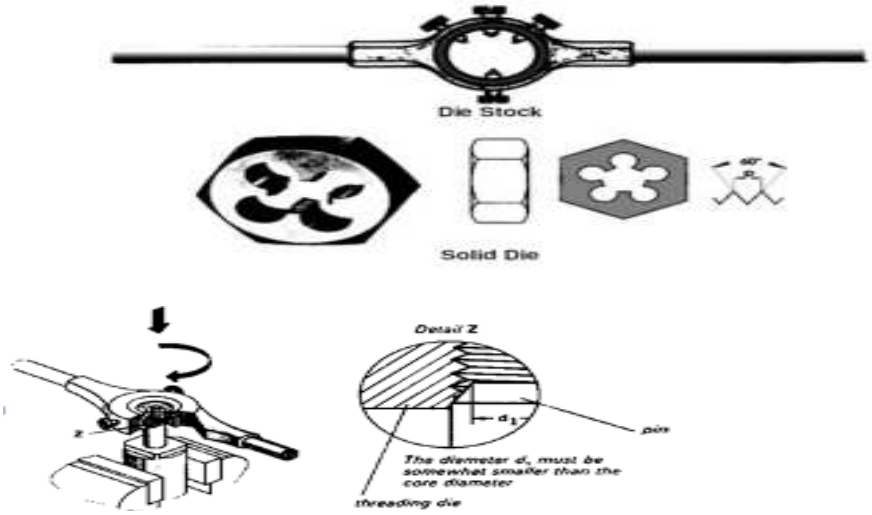


Figure 46Die and its operation

4.3 Thread cut operations

4.3.1 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.

1. 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”.
2. Fasten the work piece securely in a vise. Hold small diameter work short to prevent it from bending.
3. Select the proper die and die stock.
4. Lubricate the tapered end of the die with a suitable cutting lubricant.
5. Place the tapered end of the die squarely on the work piece.
6. Apply down pressure on both die stock handles and turn clockwise several turns.
7. Check the die to see if it has started squarely with the work.
8. 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.

9. 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

Self- check-4

Test-I Choose

Instruction: select the correct answer for the give choice. You have given 1 Minute for each question. Each question carries 2 Point.

1. _____Is the process of producing round hole in a solid material or enlarging existing holes.

   A. Reaming B. Drilling C. Honing D. Filling

2. Which one of the following is a finishing process of drilled holes?

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

3. ____is the process of enlarging a hole that has already been drilled.

   A. Drilling B. Honing C. Boring D. None

Test II: short Answer writing

a. **Instruction:** write short answer for the given question. You are provided 3 minute for each question and each point has 5Points.Explain at least three types of bench vice?

1. Write the steps to provide drilling operation.
2. Write the importance of PPE in the work shop.
3. List out the types honing tools.
4. Write the function of honing operation

4.4 Operation sheet

- **Operation title Threading**

Purpose: To form or cut a male thread on the outside of rods or bars.

Instruction: Using the figure below and given equipments measure the length of each line. You have given 30Minut for the task and you are expected to write the answer on the given line.

Tools & Equipment

- bench vice
- File
- hack saw
- tap
- Thread machine

Procedure:

Step 1. Select the work piece to be threaded and measure its diameter.

Step 2. Chamfer the end, either on a grinder or with a file.

Step 3. Select the correct die and mount it in a diestock.

Step 4. Mount the work piece in a bench vise.

Step 5. To start the thread, place the die over the work piece.

Step 6. Holding the diestock with one hand apply downward pressure and turn the die.

Step 7. When the cut has started, apply cutting fluid to the work piece and die, and start turning the diestock with both hands.

Step 8. Check to see that the thread is started square, using a machinist's square

.**PRECAUTIONS:**

- The trainees should be dress properly.
- The trainees should fulfill safety conditions.

QUALITY CRITERIA: -

- The specification should be prepared based on the given working drawing.
- The drawing should be easily interpreted.
- perform the given procedure properly

4.5 Lab test

Task 1. Always wear appropriate eye protection when using any of the thread cutting tools.

Task 2. Avoid misuse and abuse of these precision thread cutting tools.

Task 3. Use a suitable cutting lubricant for all tapping, threading and reaming operations.

5 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:

- Hone(sharp) cut edges
- Sharpe cutter.
- Grind cutters.
- Safety procedures

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:

- Perform Hone cut edges
- Use Sharpening cutter.
- Perform Grind cutters.
- Follow safety procedures

5.1 Hone (sharp) cut edges

5.1.1 Concepts of off-hand grinding

Off – hand grinding is the term used in engineering to describe the process where the work is held by hand material is removed using an abrasive wheel

This type of grinding is carried out in the workshop for such work as:

a. Removing excess materials
b. Smoothening surfaces
c. Preparing plates for welding
d. Sharpening cutting tools (drills, chisels, punches, shaper and lathe tools)

Off – hand grinding must be performed with great regard of safety. The principle of operation requires an exposed portion of the abrasive wheel to be in close proximity to the operator.

Hazard may be created by having relatively heavy abrasive wheels rotating a high speed. The wheels on all types of machines must be heavily guarded.

The guard exposes enough of the wheel surface to enable the operator to perform the work required.

NOTE: Wear safety goggles when performing any grinding operation.

- Potable Grander

  Portable grinders are handheld power tools that are used for **grinding, cutting or polishing**. These versatile tools can be used for a variety of tasks when used with the proper grinder wheels according to the manufacturer's recommendations, including: Removing paint, rust or mortar

Portable grinder

- Bench Grinder

  A bench grinder is an appliance that is used **to sharpen other tools**. It is a must-have for your home workshop. Bench grinder has wheels that you can use for grinding, sharpening tools, or shaping some objects. Depending on the types and shape of the wheel, the use of a bench grinder can vary.

- **Pedestal grinder**

  Pedestal grinders are used to sharpen high-speed steel cutting tools used on the lathes and milling machines, or used to remove surface imperfections and to work extremely hard materials.

5.2 Sharpen cutter.

5.2.1 Concept of Sharpening Cutters

The word sharpening is usually used for the final finishing of edge tools. Like all edge tools, a drill bit needs to have the right shape before you can start to sharpen it. Creating the initial shape often means that quite a lot of steel needs to be re-moved when for example, you change the point angle of a drill or you shape a broken or heavily worn drill. Once the geometry of the point is established, you maintain the sharpness by sharpening. With the T or make system you can exactly replicate an existing shape and therefore you just need to touch up the edges. Shaping and Sharpening

5.3 Grind cutters.

5.3.1 Functions of Grind Cutters using cooling agents

Cutting fluids are used in metal machining for a variety of reasons such as improving tool life, reducing work piece thermal deformation, improving surface finish and flushing away chips from the cutting zone.

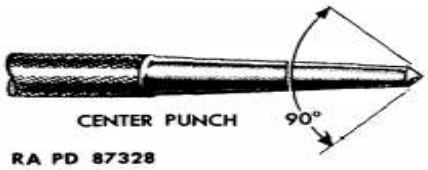
Cutting fluids consist of those liquids and gases that are applied to the tool and the material being machined to facilitate the cutting operation. Vast quantities are used annually to accomplish a number of objectives. (Boston, 1952)

1) To prevent the tool from overheating, i.e. so that no temperature is reached where the Tool's hardness and resistance to abrasion are reduced, thus decreasing the tool life.
2) To keep the work cool, preventing machining those results in inaccurate final dimensions.
3) To reduce power consumption, wear on the tool , and the generation of heat, by

Affecting the cutting process. This investigation wishes to establish a relationship between the surface chemistry of the lubricants involved and how they can accomplish reducing the contact length on the rake face of the tool where most of the heat during cutting is produced.

Cone-pointed Punches

Center punches and prick punches are ground to cone points. Correct point angle for center punches is about 90 degrees. Right point angle for prick punch is approximately 30 degrees. These angles may be altered for special work.



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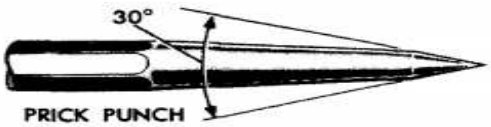

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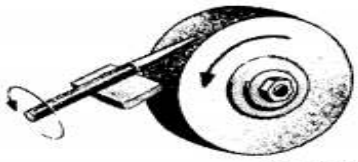
Correct Punch Point Angles

Adjust rest so punch meets face of wheel at desired angle (see illustration). Rotate punch during grinding to make point symmetrical. Dip punch in water at frequent intervals to avoid "burning." Do not grind away more material than necessary to secure satisfactory point.



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5.4 Safety procedures

5.4.1 Preparations for thread cutting by dies and taps

To thread cutting by dies and taps, position in readiness and in proper order all required tools and auxiliary means, allowing so quickest possible access times.

In this connection, pay attention to the following rules:

- ✓ Check that all tools function properly; does not use defect tools.
- ✓ Working means to be used must not be stacked one above the other.
- ✓ Place all measuring and testing tools at the places provided therefore.
- ✓ Lay aside tools only when properly cleaned.

- ✓ Select all necessary auxiliary means in line with the work assignment and position solely on the provided supports.

Self- check-5

Test-I Matching

Instruction: select the correct answer for the give choice. You have given 1 Minute for each question. Each question carries 2 Point.

Column "A"	"Column B"
1. The purpose of off- hand grinder	A. Sharpe cutter
2. used for the final finishing of edge tools.	B. Removing excess materials
3. used **to sharpen other tools**	C. Pedestal grinder
4. Used to sharpen high-speed steel cutting tools	D. Bench grinder

Test II: short Answer writing

Instruction: write short answer for the given question. You are provided 3 minute for each question and each point has 5Points.Explain at least three types of bench vice?

Write the main use of Bench grinder?

Write the main function of sharpening cutter?

Explain the difference between the sharpening tools and Grinding tools

5.5 Operation sheet 5

5.6 Operation Title: - Grinding

- **Purpose: the capability to machine hard materials and very precise process in terms of size and shape**.
- **Instruction:** Using the figure below and given equipments measure the length of each line. You have given 30Minut for the task and you are expected to write the answer on the given line.

Procedures

Step 1. Ensure the proper wheel for the stock is being used. ...

Step 2. Clean the bed before placing the work piece onto it. ...

Step 3. Place magnetic parallels around the work piece to ensure the work piece does not shift during grinding.

Step 4. Turn the magnetic chuck on to secure the pieces onto the bed.

Quality criteria

a process used to smoothen and finish of metal parts, most often used for finishing edges, de burring, smoothening welding joints, creating a sharp edge, and for certain custom edge finishes.

5.7 Lab Test 5

Task 1. Check grinding wheels for cracks before mounting.

Task 2 Do not exceed recommended depth of cut for the grinding wheel or machine.

Task 3. Remove work piece from grinding wheel before turning machine off.

Task 4. Use proper wheel guards on all grinding machines.