AIRCRAFT MATERIALS AND PRODUCTION TECHNOLOGY

LAB MANUAL

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Regulations	**:**	**IARE - R16**
Class	**:**	**II B.Tech II Semester**
Branch	**:**	**AERONAUTICAL ENGINEERING**

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Certificate

This is to certify that it is a bonafied record of practical work done by Sri/Kum. ____ bearing the Roll No. ________________________ of _____________ class ____ branch in the Engineering Physics laboratory during the academic year _____________________ under our supervision.

Head of the Department **Lecture In-Charge**

External Examiner **Internal Examiner**

VISION AND MISSION OF THE INSTITUTE

Vision

To build a strong community of dedicated graduates with expertise in the field of Aeronautical science and Engineering suitable for Industrial needs having a sense of responsibility, ethics and ready to participate in Aerospace activities of National and Global interest.

Mission

To actively participate in the Technological, Economic and Social development of the Nation through academic and professional contributions to Aerospace and Aviation areas, fostering academic excellence and scholarly learning among students of Aeronautical engineering.

PROGRAM OUTCOMES	
PO1	**Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems (**Engineering Knowledge**).
PO2	**Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design/Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	**The Engineer and Society** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice **.**
PO7	**Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

	PROGRAM SPECIFIC OUTCOMES
PSO1	**Professional skills:** Able to utilize the knowledge of aeronautical/aerospace engineering in innovative, dynamic and challenging environment for design and development of new products
PSO2	**Problem solving skills:** Imparted through simulation language skills and general purpose CAE packages to solve practical, design and analysis problems of components to complete the challenge of airworthiness for flight vehicles
PSO3	**Practical implementation and testing skills:** Providing different types of in house and training and industry practice to fabricate and test and develop the products with more innovative technologies
PSO4	**Successful career and entrepreneurship:** To prepare the students with broad aerospace knowledge to design and develop systems and subsystems of aerospace and allied systems and become technocrats.
	PROGRAM EDUCATIONAL OUTCOMES
PEO1	To prepare and provide student with an academic environment for students to excel in postgraduate programs or to succeed in industry / technical profession and the life-long learning needed for a successful professional career in Aeronautical Engineering and related fields (Preparation & Learning Environment).
PEO2	To provide students with a solid foundation in mathematical, scientific and engineering fundamentals required to solve engineering problems and also to pursue higher studies (Core Competence).
PEO3	To train students with good scientific and engineering breadth so as to comprehend, analyze, design, and create novel products and solutions for the real life problems (Breadth).
PEO4	To inculcate in students professional and ethical attitude, effective communication skills, teamwork skills, multidisciplinary approach, and an ability to relate engineering issues to broader social context (Professionalism).

Exp. No	List of Experiments	Page No.	Date	Remarks
1	PREPARATION AND STUDY OF PURE MATERIALS AND HARDENABILITY OF STEELS BY JOMINY END QUENCH TEST	**1**		
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S. No.	**Name of the Experiment**	**Program Outcomes Attained**	**Program Specific Outcomes Attained**
1	PREPARATION AND STUDY OF PURE MATERIALS AND HARDENABILITY OF STEELS BY JOMINY END QUENCH TEST	PO1, PO9	PSO3
2	STUDY OF MICROSTRUCTURES OF NON FERROUS ALLOYS AND STEELS	PO1, PO9	PSO3
3	LATHE OPERATIONS	PO1, PO2, PO4, PO5, PO8, PO9, PO10, PO11	PSO1, PSO2, PSO3
4	SHAPING AND SLOTING	PO1, PO2, PO9	PSO1, PSO3
5	MILLING AND GRINDING	PO1, PO2,PO9, PO11	PSO1, PSO2, PO3, PO4
6	DRILLING	PO1, PO2, PO3, PO8, PO9	PSO1, PSO2, PSO3
7	CNC MACHINING	PO1, PO2, PO3, PO8, PO9	PSO1, PSO2, PSO3
8	WELDING OPERATIONS I	PO1, PO9	PSO3
9	WELDING OPERATIONS II	PO1, PO9	PSO3
10	BASIC CASTING	PO1, PO2, PO4, PO5, PO8, PO9, PO10, PO11	PSO1, PSO2, PSO3
11	RIVITING OF ALUMINIUM SHEETS	PO1, PO4, PO12	PSO1

Aircraft Materials and production Laboratory

OBJECTIVES:

Basic Exercises in Lathe, Shaper, Milling, Slotting, CNC and Grinding machines welding equipment and metallurgy equipment comprising Microscopes polishing disc grinders as under.

OUTCOMES:

1. **Implement** specific advanced and engineering manufacturing technologies employed in industry with an emphasis on aircraft structures and components fabrication.
2. **Analysis** of the capabilities, limitations, and productivity of these manufacturing technologies.
3. **Understand** the merits and limitations of the taught technologies, in terms of product properties, flexibility, productivity, quality, etc.
4. **Identify** suitable manufacturing technologies for the production of some high-value added engineering products with an emphasis on aircraft structures and components.
5. **Knowledge** on fundamentals of manufacturing technology.
6. The laboratory **opportunities** for student to **learn** and practice with guiding materials

1. PREPARATION AND STUDY OF PURE MATERIALS AND HARDENABILITY OF STEELS BY JOMINY END QUENCH TEST

AIM:

a) To prepare the given specimen for metallographic examination.

b) To study the constructional details of Metallurgical Microscope and observe the micro structure of the prepared specimen.

APPARATUS AND MATERIALS REQUIRED:

Metallurgical microscope, emery belt, 1/0, 2/0, 3/0, 4/0 emery papers, lapping cloth, alumina powder, etchants, sample of metal.

THEORY:

The microstructure of metal decides its properties. An optical microscope is used to study the microstructure. A mirror polished surface of the metal is required for metallographic study.

PROCEDURE OF SPECIMEN PREPARATION:

a) Cut the specimen to the required size (small cylindrical pieces of 10 to 15mm diameter with 15mm height (Or) 10mm cubes)

b) The opposite surfaces (circular faces in case of cylindrical pieces) are made flat with grinding or filling. A Small chamfer should be ground on each edge for better handling. (If the sample is small it should be mounted)

c) **Belt grinding:** One of the faces of the specimen is pressed against the emery belt of the belt grinder so all the scratches on the specimen surface are unidirectional

d) **Intermediate polishing: -** The sample is to be polished on 1/0, 2/0, 3/0, 4/0 numbered emery papers with Increasing fineness of the paper. While changing the polish paper, the sample is to be turned by 90^0 so that New scratches shall be exactly perpendicular to previous scratches.

e) **Disc polishing** (fine polishing):- After polishing on 4/0 paper the specimen is to be polished on disc Polishing machine (Buffing machine). In the disc-polishing machine a disc is rotated by a vertical shaft. The disc is covered with velvet cloth. Alumina solution is used as abrasive. Alumina solution is sprinkled Continuously over the disc and the specimen is gently pressed against it. In case of Non-ferrous metals Such as Brass, Brass is used instead of Alumina and water. The polishing should be continued till a Mirror polished surface is obtained.

f) The sample is then washed with water and dried.

g) **Etching:-** The sample is then etched with a suitable etching reagent, detailed in article 5.

h) After etching the specimen should be washed in running water and then with alcohol and then finally dried.

i) The sample is now ready for studying its microstructure under the microscope.

ETCHING:

Except for few cases a polished metallic surface can't reveal the various constituents (phases). Hence specimen should be etched to reveal the details of the microstructure i.e. a chemical reagent should be applied on the polished surface for a definite period of time. This reagent preferentially attacks the grain boundaries revealing them as thin lines. Thus under the microscope the grain structure of the metal becomes visible after etching i.e. grain boundary area appears dark and grains appear bright. The rate of etching not only depends on the solution employed and composition of the material but also on the uniformity of the material. A few etching reagents, their composition and their application are given below.

Sl.No	Name of Etchant	Composition	Application
1.	Nital	Nitric. acid (5ml) and	General structure of iron and steel
	a) 5% Nital	Abs. Methyl alcohol (95ml) Nitric acid (2ml)	
	b) 2% Nital	Abs. Methyl alcohol (98ml) Picric acid (4gm)	
2.	Picral	Abs ethyl alcohol (96 ml) Copper sulphate (4 gm)	General structure of iron and steel
3.	Marbel's reagent	Hydrochloric acid (20ml) and water (20ml) Potassium ferri cyanide, (10grms)	General structure of iron and steel
4.	Murakami's reagent	KOH (10grms) and water (100ml)	Stainless steels
5.	Sodium hydroxide	Sodium hydroxide (10gm), Hydro fluoric acid (20ml)	Stainless steels
6.	Vilella's reagent	Nitric acid (10ml) and Glycerene (30ml) Hydro fluoric acid (1 ml),	Aluminium alloys
7.	Kellers reagent	Hydro chloric acid (1.5 ml), Nitric acid(2.5 ml) and Water (95 ml)	Aluminium & its alloys
8.	Ammonium persulphate Solution	Ammonium persulphate (10gm) Water(90ml) FeCl (5gm)	Duralumin

METALLURGICAL MICROSCOPE:

Metallurgical microscope is used for micro and macro examination of metals. Micro examination of specimens yields valuable metallurgical information of the metal. The absolute necessity for examination arises from the fact that many microscopically observed structural characteristics of a metal such as grain size, segregation, distribution of different phases and mode of occurrence of component phases and non metallic inclusions such as slag, sulfides etc., and other heterogeneous condition (different phases) exert a powerful influence on mechanical properties of the metal. If the effect of such external characteristics on properties or the extent of their presence is known, it is possible to predict as to how metal will behave under gone by the metal. Study of structure of metals at magnifications ranging from 50X to 2000X is carried out with the aid of metallurgical microscope.

A Metallurgical microscope (shown in **fig)** differs with a biological microscope in a manner by which specimen of interest is illuminated. As metals are opaque their structural constituents are studied under a reflected light. A horizontal beam of light from an appropriate source is directed by means of plane glass reflectors downwards and through the microscope objective on to the specimen surface. A certain amount of this light will be reflected from the specimen surface and

that reflected light, which again passes through the objective, will form an enlarged image of the illuminated area. A microscope objective consists of a number of separate lens elements which are a compound group behave as positive and converging type lens system of an illuminated object. Specimen is placed just outside the equivalent front focus point of objective. A primary real image of greater dimension than those of object field will be formed at some distance beyond the real lens element. Objective size of primary image w.r.t object field will depend on focal length of objective and front focus point of objective. By appropriately positioning primary image w.r.t a second optical system, primary image may be further enlarged by an amount related to magnifying power of eyepiece. As separation between objective and eyepiece is fixed at same distance equivalent to mechanical tube length of microscope, primary image may be properly positioned w.r.t eye piece. By merely focusing microscope i.e. increase or decrease the distance between object plane and front lens of objective the image is located at focal point. Such precise positioning of primary image is essential in order that final image can be formed and rendered visible to observer when looking into eyepiece. If now entrance pupil of eye is made to coincide with exit pupil of eyepiece, eyepiece lens is in conjunction with cornea lens in eye will form a second real image on retina. This retrieval image will be erect, unreversed owing to the manner of response of human brain to excitation of retina. The image since it has no real existence, known as virtual image and appears to be inverted and reversed with respect to object field

PRINCIPLE:

MAGNIFICATION:

The total magnification is the power of objective multiplied by power of eyepiece (Power of eye piece) (Distance from eye piece to object) / Focal length of object the magnification is marked on the side of objective.

CONSTRUCTION

The microscope consists of a body tube (refer Fig 1.1), which carries an objective below, and an eyepiece above with plane glass vertical illuminator immediately above the objective.

Incident light from a source strikes illuminator at 45^0, part of which is reflected on to the specimen. Rays after reflection pass through the eye again. Working table is secured on heavy base. The microscope has compound slide to give longitudinal and lateral movements by accurate screws having scale and venires. Vertical movement of specimen platform is made by a screw to proper focusing. For getting perfect focusing fine adjustment of focusing can be made use of.

Light filters: These are used in metallurgical microscope and are essentially of three types

a. Gelatin sheets connected between two planes of clean glass

b. Solid glass filters

c. Liquid dye solution

Solid glass filters are more preferable as they are more durable. Usually light filters are used principally to render a quality of illumination. Hence filters improve degree of resolution. A METZ - 57 model microscopes is used in the laboratory.

Optical compilation:

Eye pieces and objectives of different magnifications are available.

Huygens eyepieces:	5X,	10X
Achromatic objectives:	5X,	10X, 45X

HARDENABILITY OF STEELS BY JOMINY END QUENCH TEST

AIM:

To determine the hardenability of a given steel.

APPARATUS:

Jominy test apparatus, furnace, Rockwell hardness tester and a grinder.

THEORY;

Jominy end quench test is used to determine hardenability of steels. The process of increasing the hardness of steel is known as Hardening. Specific specimen with standard dimensions, used for the test is given in fig.8.1. The hardness of hardened bar is measured along its length.

Hardenability:

The depth up to which steel can be hardened is defined as hardenablity. A steel having high hardness need not have high hardenability. Hardenability may be defined as susceptibility to hardening by quenching. A material that has high hardenablity is said to be hardened more uniformly throughout the section that one that has lower hardenability. M.A Gross man devised a method to decide hardenablity.

Critical diameter:

The size of the bar in which the zone of 50% martensite occurs at center is taken as critical diameter. This is a measure of harenablity of steel for a particular quenching medium employed.

Severity of Quench:

The severity of quench is indicated by heat transfer equivalent.

$$H = f/k$$

f = Heat transfer factor of Quenching medium and the turbulence of the bath.

k = Thermal conductivity of bar material.

The most rapid cooling is possible with severity of quench as infinity.

IdealCritical Diameter;

The hardenbility of steel can be expressed as the diameter of bar that will form a structure composed of 50% martensite at the center when quenched with H = infinity. This diameter is defined as ideal critical diameter.

Description of Apparatus:

The apparatus consists of a cylindrical drum. At the top of the drum provision is made for fixing the test specimen. A pipe line is connected for water flow, which can be controlled by means of a stop cock.

Procedure:

PRECAUTIONS:

I. The specimen is to be handled carefully while transferring from furnace to test apparatus.
II. Proper water flow (at high pressure) over the bottom end of specimen is to be ensured.
III. Ensure mirror polished surface of specimen before etching.
IV. Fine focusing should be done only after correct focusing has been done.

RESULTS:

2. STUDY OF MICROSTRUCTURES OF NON FERROUS ALLOYS AND HEAT TREATED STEELS

AIM:

To determine the phases present and to draw the microstructure of Copper, Aluminium

& Magnesium.

APPARATUS AND SPECIMENS REQUIRED:

Metallurgical microscope, Specimens of Aluminum, Copper and Magnesium.

THEORY:

INTRODUCTION TO NON FERROUS METALS

Nonferrous metals don’t contain iron as base. A wide range of nonferrous metals are employed for various engineering applications. Most Nonferrous metals possess good corrosion resistance, formability, cast ability and special electrical and magnetic properties. Important Non-ferrous metals, their melting points and crystal structures are tabulated here under.

S.No	Name	Melting Zincpoint Degrees C
1.	Aluminium (Al)	660
2.	Antimony (Sb)	630
3.	Bismuth (Bi)	271
4.	Cadmium (Cd)	321
5.	Chromium (Cr)	1900
6.	Copper (Cu)	1083
7.	Gold	1064
8.	Lead	327
9.	Magnesium (Mg)	650
10.	Manganese	1250
11.	Nickel (Ni)	1453
12.	Silver (Ag)	232
13.	Tin (Sn)	232

The microstructure of following specimen are studied in this experiment.

a. Copper:

Specimen	
Heat treatment	
Etchant	
Etching time	

The micro structure shows equi axed grains of copper.

b. Aluminium:

Specimen	
Heat treatment	
Etchant	
Etching time	

The micro structure shows grains of Aluminium.

c. Magnesium:

Specimen	
Heat treatment	
Etchant	
Etching time	

The micro structure shows grains of magnesium.

RESULT:

3. LATHE OPERATIONS

FUNCTION: The function of a lathe is to remove excess material in the form of chips by rotating the work Piece against a cutting tool to produce cylindrical shapes. The tool material should be harder than the work piece. The tool may be given liner motion along work piece in any direction.

Lathe Machine

SIZE (OR) SPECIFICATION OF LATHE:

1. The height of the centers measured form the lathe bed.
2. The swing diameter over bed.
3. Maximum job length held between the two centers.
4. The swing diameter over carriage.

TYPES OF LATHES:

1. Bench Lathe.
2. Speed Lathe.
3. Engine Lathe.
4. Tool Room Lathe.
5. Capstan and turret Lathe.
6. Automatic Lathe.

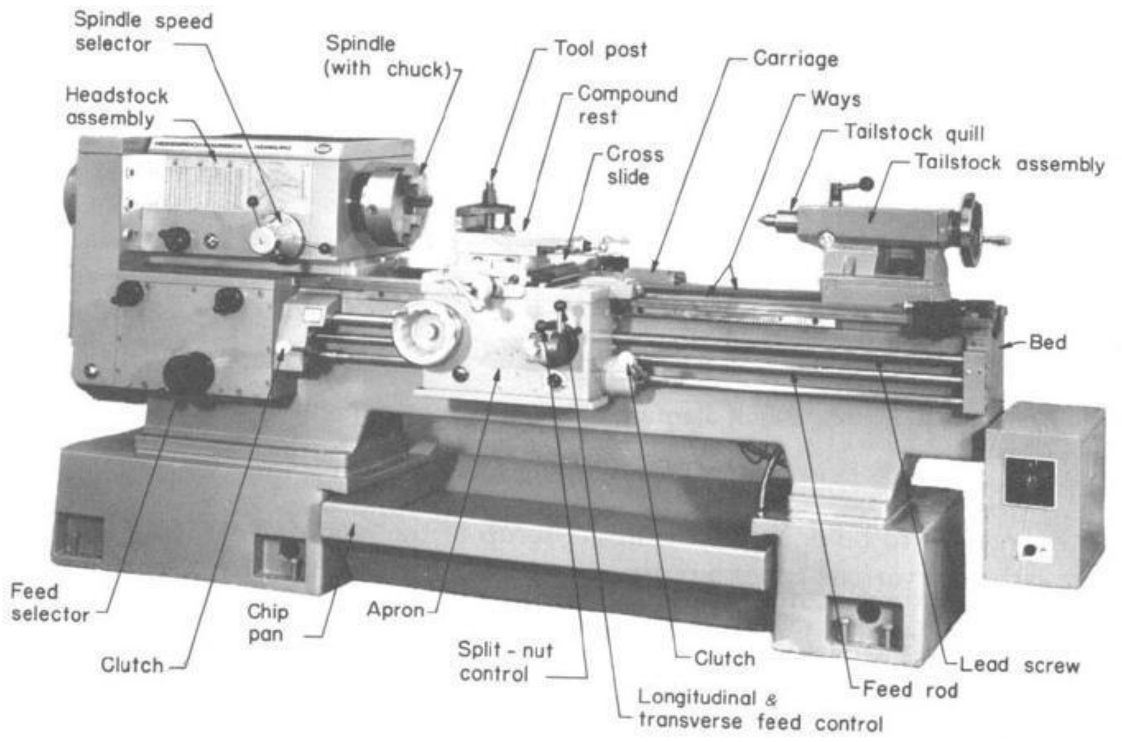
PARTS OF LATHE:

1. Base or Bed
2. Head stock
3. Tail stock
4. Carriage
5. Cross Slide.
6. Compound rest
7. Apron
8. Lead Screw
9. Tool Post.

LATHE OPERATIONS:

S.NO.	Sequence of operation	Cutting tool.
1.	Facing	H.S.S.Single point tool
2.	Plain Turning	H.S.S.Single point tool
3.	Step& Under cut.	Single point tool / Parting tool.
4.	Taper Turning.	H.S.S.Single point tool
5.	Knurling.	Knurling Tool.
6.	Chamfering	H.S.S.Single point tool
7.	Thread cutting	V- Thread cutting tool.

LATHE MACHINE PARTS



FACING: Facing is the operation of machining the end of a piece of work to produce flat surface with axis. This is also used to cut the work to the required length. The operation involves Feeding the tool perpendicular to the axes of rotation of work piece.

PLAIN TURNING: The plain turning operation requires high cutting speed, small feed and a very small depth of cut to generate a smooth surface. Copious supply of coolant and lubrication should be used to produce a smooth finish.

STEP AND UNDERCUT: Step turning is the operation of making different diameters of desired length. Under cut is the operation of making a slot over the periphery of a circular job.

TAPER TURNING: Taper turning may be defined as a uniform increase or decrease in diameters of a piece of work, measured along its length. In a lathe, taper turning means to produce a conical surface by gradual reduction in diameter from a cylindrical work piece.

Tan α = D-d / 2L

D= large diameter of taper in mm.
d = small diameter of taper in mm
L = Length of tapered part in mm.

2 α = full taper angle.
α = half taper angle.

CHAMFERING: It is the operation of beveling the extreme end of the work piece. This is done to remove burrs, to protect the end of the work piece from being damaged and to have a better look.

KNURLING: Knurling is the process of embossing a diamond shaped pattern on the surface of a work piece. The purpose of knurling is to provide an effective gripping surface on a work piece to prevent it from slipping when operated by hand.

THREAD CUTTING: Thread cutting is one of the important operations performed on a lathe. Both and External and internal threads can be cut. There should be a certain relation between job revolution and revolution of lead screw to control liner movement engaged with the screw. The tool should be grounded to a proper shape on profile of thread to be cut. In all modern lathe quick change gear box is provided with different ratios of spindle and lead screw revolution can be easily obtained by simply shifting the change gear lever. The longitudinal feed should be equal to the pitch of the thread to be cut per revolution of the work piece.

$$\text{Velocity ratio} = \frac{\text{Pitch of the threads to be cut}}{\text{Pitch of the lead screw}}$$

But velocity ratio = (Driver teeth / Driven teeth.)

METAL CUTTING PARAMETERS:

CUTTING SPEED: The cutting speed (V) of a tool is the speed at which the metal is removed by the tool from the work piece. In a lathe it is the peripheral speed of the work past the cutting tool expressed in meters / min.

V= π d n / 1000

Where,
d —The diameter of the work in mm.
n —The rpm of the work.

FEED: The feed of a cutting tool in a lathe work is the distance the tool advances for each revolution of the work. Feed is expressed in terms of mm / revolutions.

DEPTH OF CUT: The depth of cut is the perpendicular distance measured machined surface to the uncut surface of the work piece. In a lathe the depth of cut is expressed as follows.

Depth of cut = d_1 - d_2/ 2

LATHE MACHINE

AIM: To perform various lathe operations such as Facing, Plain turning, Step-turning. Taper turning, Knurling, grooving and Thread cutting on a given material made of mild steel.

MATERIAL REQUIRED: A mild steel bar of 25mm diameter and 200mm long.

Tools used: H.S.S. single point cutting tool, parting tool, V-tool for threading , Knurling tool, Chuck key, tool post key.

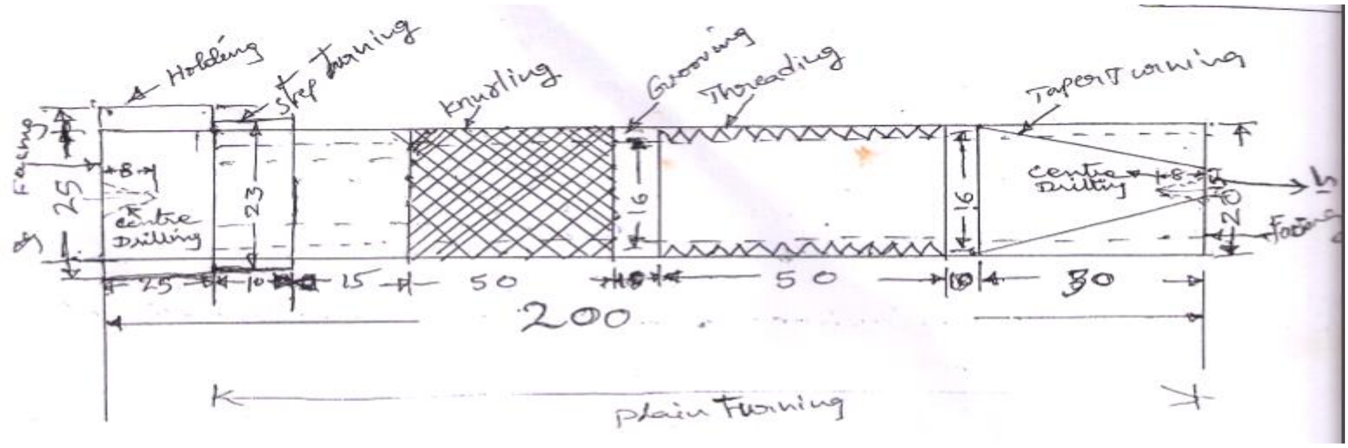
MEASURING INSTRUMENTS: Verniercaliper, steel rule, pitch gage etc

PROCEDURE:

PRECAUTIONS:

1. Operate the machine at specific speed.
2. Do not depth of cut more than 2mm.
3. Apply lubricating oil while all operations
4. Make sure that the work place is neat and clean.

RESULT:

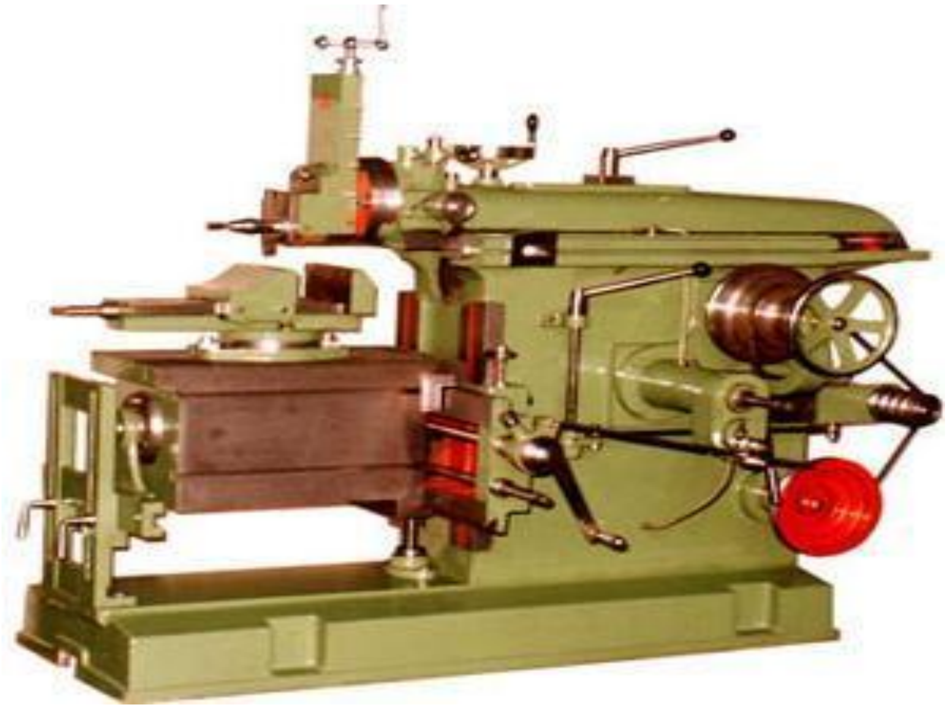


Lathe Operations

4. SHAPING & SLOTING

INTRODUCTION:

The shaping machine is used for producing flat surfaces. Machining on shaper more economical with easier work setting and cheaper tooling. On a shaper job is fixed on table and the cuing tool reciprocates across the work piece. The tool cuts on forward stroke and the return stroke remain idle. As there is no cutting action in return stroke, we deploy quick return mechanism to reduce cutting time. To produce flat surfaces, channel sections, V-channels and gear teeths.etc.



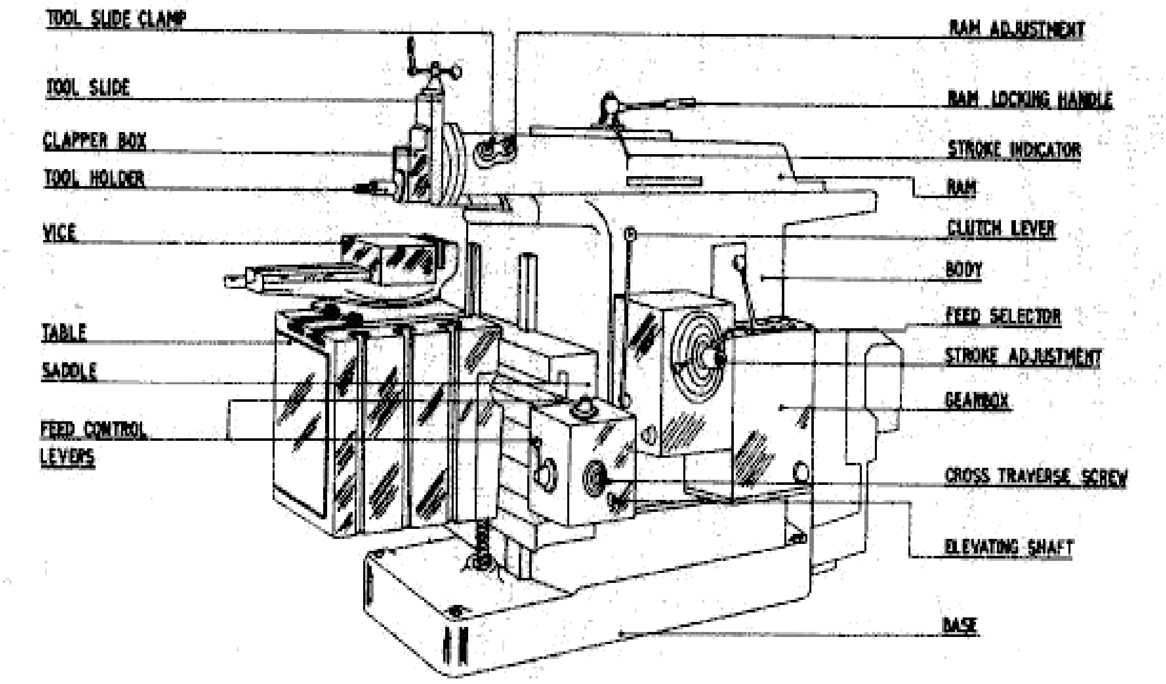
SHAPING MACHINE

TYPES OF MECHANISMS:

CRANK SHAPER: In construction the crank shaper employs a crank mechanism to change circular motion of the bull gear to reciprocating motion of the ram. The bull gear receives power either from an individual motor from an over head line shaft if it is a bell drive shaft.

GEAR TYPE SHAPER: this type of shaper carries a rack under it is ram which is driven by a spur gear. The pinion (spur gear) machining with the rack is driven by a gear drive. The speed and the direction in which the machine traverse depend on the number of gears in the gear train.

HYDRAULIC TYPE: In these shapers hydraulic pressure is used for driving the ram .it has become very popular and is also more efficient than the both of the above tool.



PARTS OF A SHAPER

PARTS OF THE SHAPER:

1. Base.
2. Column
3. Cross slide
4. saddle
5. Table
6. Clapper box
7. Ram
8. Tool head.
9. Feed disc.
10. Elevating screw. Etc.

DRIVING MECHANISMS:

1. Crank a slotted lever mechanism
2. Whit-worth quick return mechanism
3. Hydraulic shaper mechanism

SHAPER OPERATIONS:

1. Horizontal machining.
2. Vertical machining
3. Angular machining
4. Slots, grooves and key ways cutting
5. Cutting gears or splines.

CUTTING SPED: In a shaper the cutting action is intermittent and is considered only during the forward cutting stroke.

$$\text{Cuttingspeed} = \frac{\text{Length of cutting stroke. Cutting}}{\text{Time required by the cutting stroke}}$$

FEED: It is the relative movement of the tool or work in a direction perpendicular to the axis of reciprocation of the ram for double stroke. In is expressed in mm. The feed is always given at the end of return stroke when the tool is not cutting the metal.

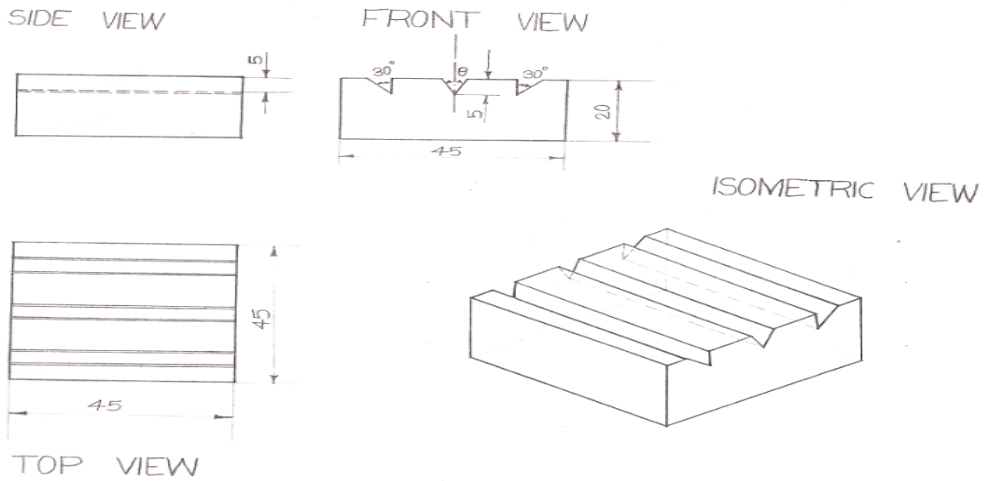
6.8 DEPTH OF CUT: It is the thickness of metal that is removed in one cut. It is the perpendicular distances measured between machined surface and non machined surface of the work piece

SHAPING MACHINE:

AIM: to machine a V- groove and angula groove on the given square block

TOOLS REQUIRED: side tool, V- tool, try square, vernier caliper, steel rule

MATERIEL: M.S. square block



All dimensions are in mm tolerances±0.05mm

PROCEDURE:

PRECAUTIONS:

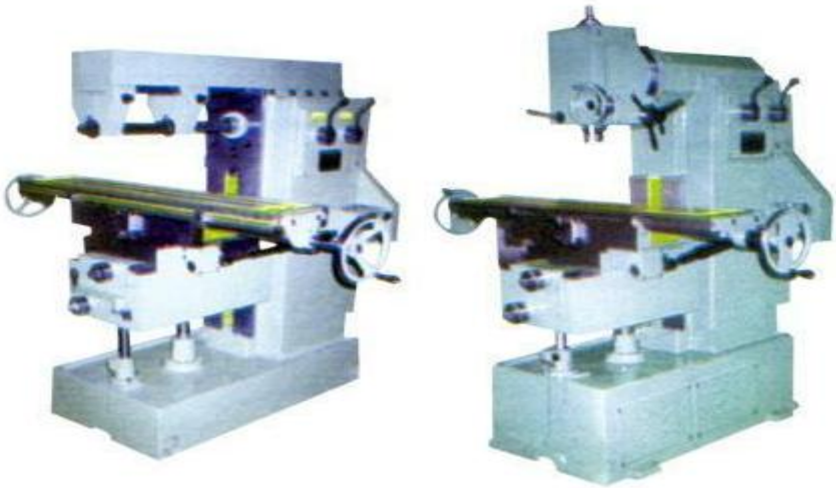
1. The tool should be properly fixed.
2. Proper movement of tool must be entered.
3. Select proper cutting speeds.
4. Don‘t touch and measure the job during the process of machining.

RESULT:

5. GRINDING & MILLING

INTRODUCTION:

Milling is a machining process in which metal is removed by rotating multi-edge cutting tool called milling cutter, while the work piece fed against to it. A milling machine is a machine tool that removes metal chips. Work is fed against a rotation multipoint cutter. It removes metal at a very fast rate. The job movement is horizontal, vertical and cross feeding.



GENERAL MILLING MACHINES

TYPES OF MILLING M/C.: Column and knee type.
1. Horizontal milling. 2. Vertical milling. 3. Universal milling.
4. Omniversal milling.

PARTS OF MILLING M/C:

1. Base.
2. Column.
3. Knee.
4. Saddle.
5. Table.
6. Spindle.
7. Arbor.
8. Elevating screw.
9. Overhanging arm. Etc.

MILLING M/C. MECHANISM:

The spindle drive mechanism is incorporated in the column. All modern machines are driven by individual motors housed within the column, and the spindle reeves power from a combination of gears and clutch assembly. Multiple speeds of the spindly may be obtained by altering the gear ratio.

WORK HOLDING DEVICES:
T- bolts and clamps, V-blocks, Angle plate, Vices, etc.

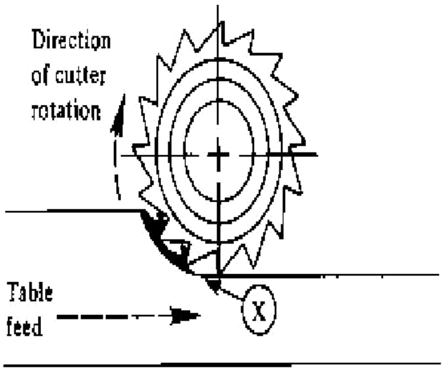
CUTTER HOLDING DEVICES: Arbors, collets, Adapters, Spring collets, Bolted cutters, Screw on cutters.

STANDARD MILLING CUTTERS:

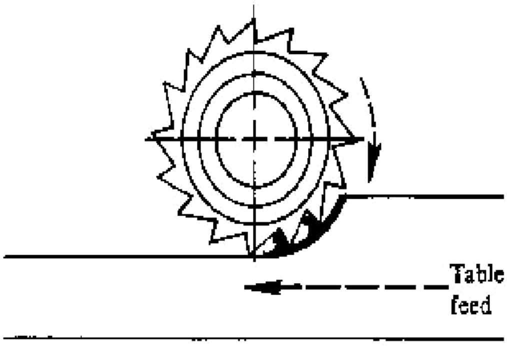
Plain milling cutter. Side milling cutter, Angle milling cutter,

End milling cutters. T- Slot milling cutter. Fly cutter.
Formed cutters, (Convex, concave, corner rounding, gear cutter.) Face milling cutter or T max cutter, Saw milling cutter.

TYPES OF MILLING PROCESSES:



UP MILLING



DOWN MILLING

Fig: MILLING METHODS

UP MILLING: The up milling which is also called conventional milling is the process of removing the metal by a cutter which is rotated against the direction of travel of the work piece.

DOWN MILLING: The down milling which is also called climb milling is the process of removing the metal by a cutter which is rotated in the same the direction of travel of the work piece.

Cutting speed: The cutting speed of a milling cutter is its peripheral linear speed resulting from rotation. It is expressed in meters per minute. The cutting speed can be derived formula.

V= Π d n / 1000 minutes per min.
V= the cutting speed in inch per min. d= the diameter of the cutter in mm.
n= the cutter speed in rpm.

Feed: The feed in a milling machine is defined as the rate with which the work piece Advances under the cutter.

Depth of cut: The depth of cut in milling is the thickness of the material moved in one pass of the work under the cutter.

GEAR CUTTING

GEAR CUTTING METHODS: toothed gears are indispensable elements in mechanical transmission of power, and their accurate production necessitated the development of ingenious tools and process. Gears made may be manufactured by casting, stamping, machining or by powder metallurgical processes. Out of all such process, the most, and accurate method of production of gears is by machining.

SPUR GEARS:

The cutting of spur gear in a milling machine involves the following procedure,

1. To determine the important dimensions and proportions of the gear tooth element.
2. To control the spacing of the gear teeth accurately on the periphery of the gear blank.
3. To select the correct number of cutter for the required number of teeth on the gear.
4. To determine the proper speed of the cutter, fed of the table, and the depth of cut.
5. To set the cutter and the work and to perform the actual operation.

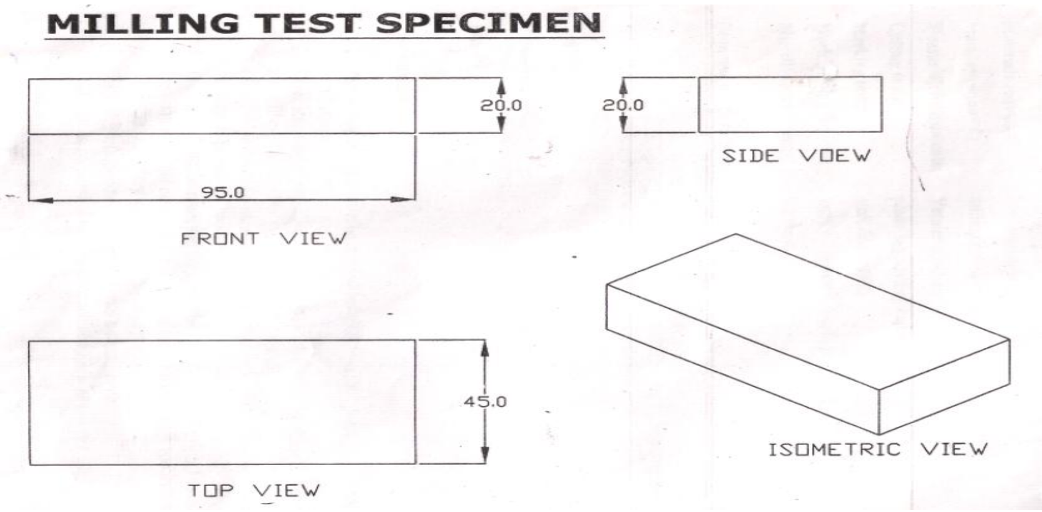
MILLING MACHINE

AIM: To machine a rectangular m.s. block to prepare plain milling, Step milling, and slot milling.

TOOLS REQUIRED: Vernier calipers, steel rule, scriber, dot punch, hammer, file. Accessory in **Machine:** parallels, tri. Square, end milling cutter, plain milling cutter,

MATERIAL REQUIRED: M.S. block.(75x75x 25mm^3.)

PROCEDURE:



PRECAUTIONS:

1. The cutter should be properly fixed.
2. Select proper cutting speed, feed and depth of cut. Apply proper coolant during machining.
3. Safety devices like goggles, apron and shoes must be wear.
4. Don‘t touch and measure the job during the process of machining.

RESULT:

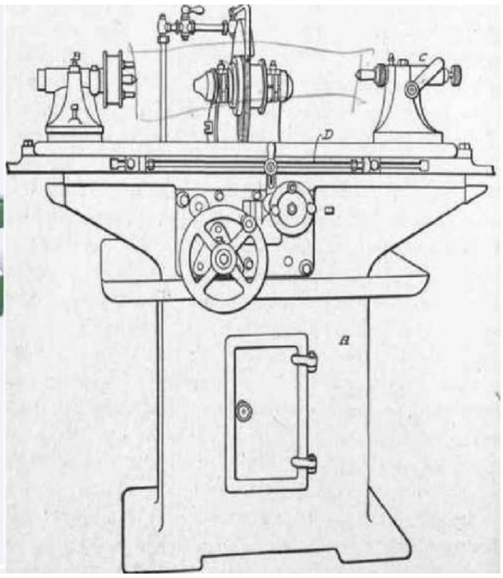
GRINDING

CYLINDRICAL GRINDING

INTRODUCTION:

Grinding is a metal cutting operation performed by means of a rotating abrasive wheel that acts as a cutting tool. This is used to finish work pieces which must show a high surface quality, accuracy of shape and dimension. In grinding process, work piece is brought into contact with revolving grinding wheel. Each abrasive grain will act as an individual cutting tool and removes the metal in the form of small or tiny chips. Hence grinding wheel has a self-sharpening action.

Cylindrical Grinding



Cylindrical Grinding Line Diagram

TYPES OF GRINDING M/S:

1. Cylindrical grinders
2. Surface grinders
3. Center type (plain and universal)
4. Tool and cutter grinder

CYLINDRICAL CENTER TYPE GRINDERS: Center type cylindrical grinders can be used for grinding contoured cylinders, types, faces and shoulders, fillets, and even cams and crankshafts.

MAIN FEATURES: The work piece is usually held between dead centers and rotated by a dog and driver on the faces plate. The work may also be rotated about its own axis in a chuck. There are 4 types in a Cylindrical Center type grinder: 1.The work must revolve, 2. The work must revolve. 3. The work must pass the wheel, 4. The work must pass the work.

EXTERNAL CYLINDRICAL GRINDING: This is produces a straight or tapered surface on a work piece. The work piece must be rotated about its own axes between centers as it passes lengthwise across the face of a revolving grinding wheel.

INTERNAL CYLINDRICAL GRINDING: This is produces internal cylindrical holes and tapers. The work pieces are chucked and precisely rotated about their own axes. The grinding wheel or, in the case of small bore holes, the cylinder wheel rotates against the sense of rotation of the work piece.

SURFACE GRINDING

SURFACE GRINDER: Surface grinding m/cs, are machines that are employed to finish plain or flat surfaces. But they are also capable of grinding irregular, curved, tapered, convex, and concave surface.

PARTS OF S.G: 1. Base, 2 columns. 3wheel head, 4 .Table, 5. Wheel, 6. Saddle 7. Magnet table.

TOOL & CUTTER GRINDER: Tool cuter grinders are used mainly to Sharpe and recondition multiple tooth citter like reamers, milling cutters, drills, taps, hobs and other types of tools used in shop. With various attachments they can also do like surface, cylindrical, and internal grinding to finch such items as jig, fisher, dies and gauge detail and sharpen single point tools.

PARTS OF T& C GRINDER:

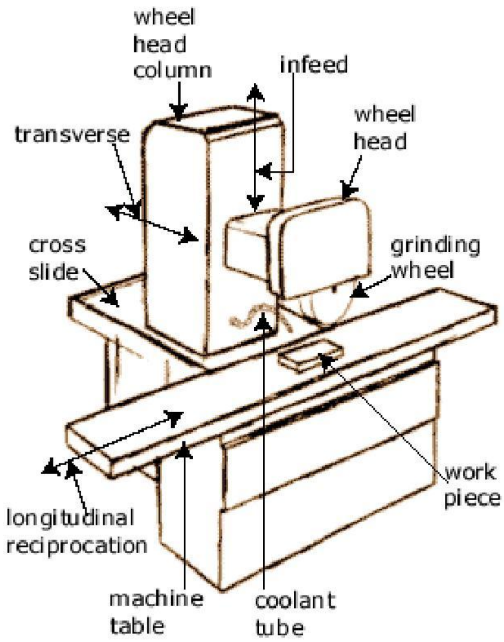
1. Base, 2 columns. 3wheel head, 4.Table 5.Wheel. (cup & shaped wheels) 5. Saddle.

THE GRINDING WHEEL: It is a many hard particles known as abrasives. The abrasives grains are mixed with a suitable bond, which acts as a matrix or holder when the wheel is in use. Abrasives in two principal groups.

NATURAL ABRASIVE, like as sandstone or solid quartz, emery, corundum,, and diamond.

ARTIFICIAL ABRASIVES are two types

(A) Silicon carbide (Sic) abrasive.
(B) Aluminum oxide (Al_2O_3).

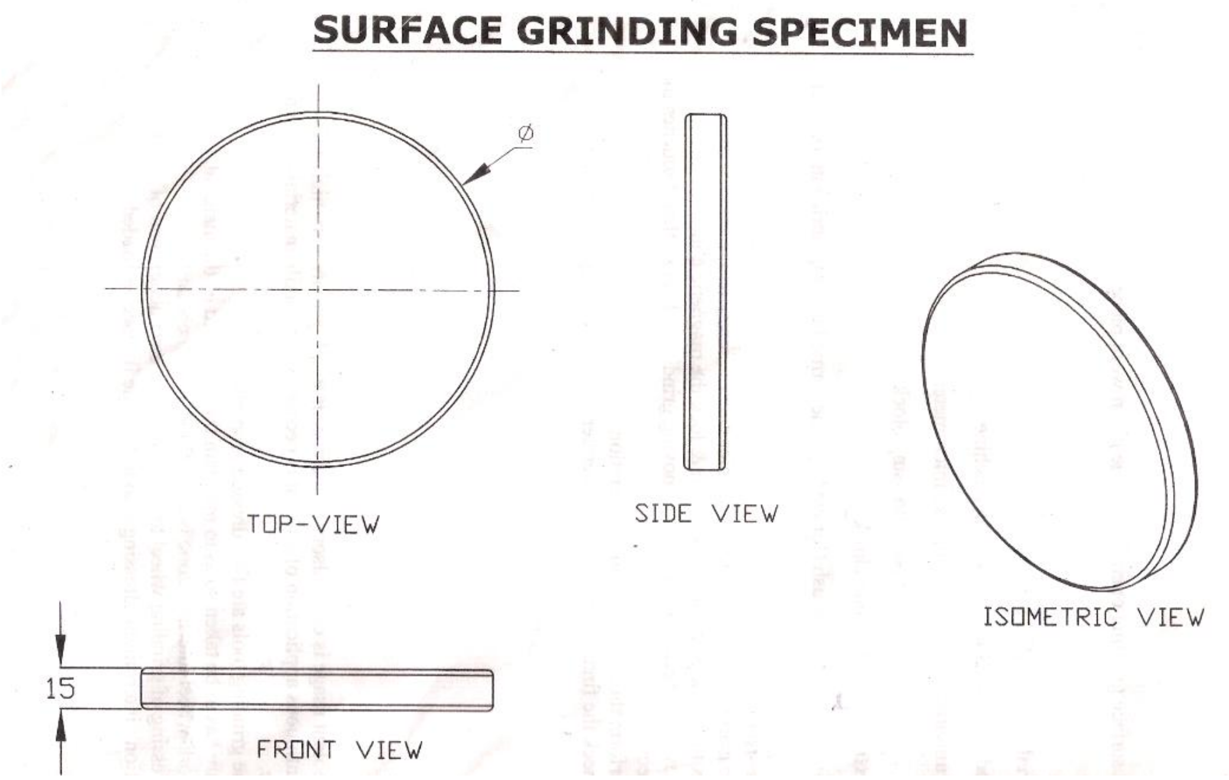


SURFACE GRINDING MACHINE

AIM: To perform surface grinding on a given work piece.

TOOLS REQUIRED: micro meter, oil stone, and diamond dresser

PROCEDURE:



View of Grinding Specimens

PRECAUTIONS:

1. Use always proper coolant.
2. Depth of cut should be minimum.
3. Do not touch the running grinding and work piece when the machine is in running.
4. Use safety goggles.

RESULT:.

6. DRILLING

INTRODUCTION:

Drilling is a process of making a hole in an object by forcing a rotating tool called drill. The same operation can be performed in a lathe by holding the drill stationary and rotating work.

RADIAL DRILLING MACHINE

TYPES OF DRILLING MACHINES:

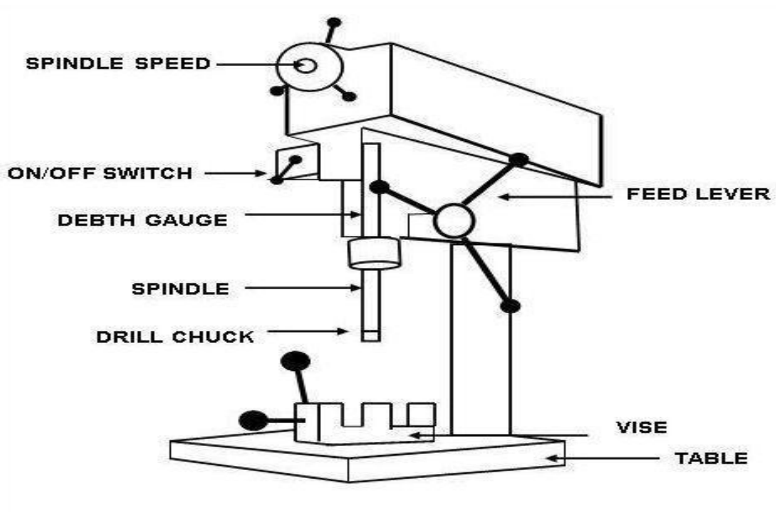
1. Portable drilling m/c.
2. Sensitive drilling m/c.
3. Gang drilling m/c.
4. Radial drilling m/c.
5. Automatic drilling m/c. Etc.

RADIAL DRILLING MACHINE:

It is intended for drilling small and large holes on a heavy work piece. This consists of a heavy round vertical column, mounted on a large base. The column supports a radial arm which can be raised and lowered to accommodate work piece of different heights. The arm may be swung around to any position over work bed. The three movements in radial drilling machines when combined together permit to be located at any desired point on a large work piece for drilling.

5.4 PARTS OF A DRILLING M/C.:

Base, column, Radical arm, Elevating screw, Drill head, Drill spindle, Table, Motor for elevating the arm, Motor for driving spindle.



PARTS OF A DRILLING MACHINE

SPINDLE DRIVE AND FEED MECHANISM:

There are two common methods of driving a spindle.

a) Contact speed motor is mounted at extreme end of radial arm.
b) Train of gearing within the drill head.

SEQUENCE OF OPERATION AND TOO USED

S.No.	Sequence of operation	Tool used
1.	Marking	Vernier height gauge, Surface plate.
2.	Punching	Dot punch, hammer.
3.	Pilot-holed drill	Drill bit.
4.	Drilling	Drill bit.
5.	Reaming	Reamer
6.	Boring	Boring tool.
7.	Counter Boring	Counter bore drill.
8.	Counter Sinking	Counter Sink drill

MARKING: Before drilling any hole on the given work piece, the center of the hole is located by drawing two lines at angles to each by means of venire height gauge placed on surface plate.

PUNCHING: After locating a center, identification is made at the point where the hole is to be drilled. Pinching is done by means of center punch and ball peen hammer

PILOT-HOLED DRILL: Before drilling a hole of a larger diameter, a pilot hole of Ø3mm which is slightly Grater then the width of the chisel edge must be drilled. The reason is that the action of the chisel edge during drilling is more or less an extrusion process. So 80 to 85% of total thrust, i.e., vertically upward force will come on chisel edge which increases the power required and decreases the tool life. This refers to eliminate the thrust acting on the chisel edge pilot hole is made prior to drilling.

DRILLING: It is the operation of producing a cylindrical hole by removing metal by the rotating edge of a cutting tool called the drill. The drilling is the one of the simplest methods of producing a hole. Drilling does not produce an accurate hole.

REAMING: It is an aureate away of sizing and finishing a hole which has been already drilled. In order to finish a hole and bring it to the accurate size. The hole reamer is made half that of drilling and used for reaming is known as reamer, which has multiple cutting edges, reamer can not originate a hole, its simply follows the path, which has been previously drilled and removes small amount of metal, the materiel removed by this process is around 0.395mm and for the accurate work, this should not exceed 0.125mm.

BORING: To enlarge a hole by means of an adjustable cutting tool with only one cutting edge, this is necessary where suitable sized drilled is not available or whole diameter is so large that it can be ordinary drilled. To finish a hole accurately and to bring it to the required size. To machine the internal surface of the hole already producing. To correct all of roundness of the hole. To correct the location of hole as be boring tool follows as independent path with respect to the hole.

COUNTER BORING: The enlarged hole forms a square shoulder with the original hole. This is necessary is some cases to accommodate the heads of bolts, studs and pins. The tool used for this is called counter bore. The counter bores are made with straight or tapered shank to fit in the drills spindle. Counter boring can give accurately of about Ø 0.005mm. The cutting speed for counter boring is 25% less than that of drilling operations.

COUNTER SINKING: It is the operation of making a cone shaped enlargement of the end of a hole to provide a recess of a flat head screw or counter sink rivet fillet in the hole. The Tool used for counter sinking is called counter sink standard counter sinkers have 60^{0}, 82^{0} and 90^{0} inclined angle that the cutting edges of tool are formed at the conical surface. The cutting speed in counter sinking is 25% less than that of drilling.

DRILL CHUCKS: A drill chuck is a device intended for holding smaller size drills. It has two or more adjustable jaws set radially to hold straight shank drills. It is provided with a taper shank which is fitted in the tapered hole of the spindle. These are made in various sizes.

TWIST DRILLS: It is an end cutting tool. It is the most common type of tool used in drilling. It consists of a cylindrical piece of steel with special grooves called flutes

TYPE'S TWIST DRILLS:

1. Parallel shank twist drill.
2. Taper shank twist drill.

DRILLS MATERIALS:

Cutting portion-	High speed steel
Shank portion. ----	Carbon steel.

CUTTING SPEED: It is a measure of peripheral speed of the drill in operation expressed in m/min.

Cutting speed (S) = Π D N / 1000 m/min.

D is the diameter of the drill in mm N is the r.p.m of the drill spindle.

Feed = the feed of a drill is the distances the drill moves into the work at each revolution of the spindle. It is expressed in mm/ revolution or per min

The feed for min. = Feed per revolution X rpm

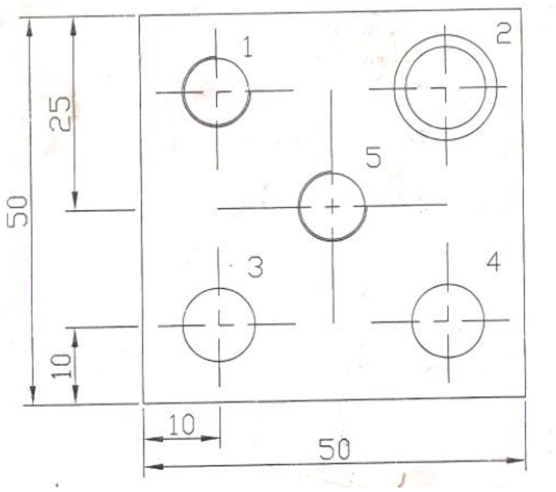
Depth of cut = the depth of cut in drilling is equal to one half of the drill diameter

DRILLING OPERATIONS

AIM: To perform Drilling, Reaming, Boring, Counter boring, Counter sinking and tapping.

TOOLS: Drill bit, Tap set with all the sizes of drill bits, vernier caliper, steel rule, scriber, hammer, metal brush

MATERIAL REQUIRED: Mild steel specimen



		Dia in mm
1	DRILLING	8.5 or 7.5
	TAPPING	9 or 8
2	DRILLING	10.5
	COUNTER BORING	13.5
3	DRILLING	9.5
	REAMING	10 H7
4	DRILLING	9.5
	COUNTERSUNK	12.5
5	DRILLING	8.5 or 7.5
	TAPPING	9 or 8

PROCEDURE:

PRECAUTIONS:

1. The drill bit must be properly fixed,
2. Centers must be correctly marked.
3. Slightly lower speeds of the order of 25% less than drilling should be used to counter boring, counter sinking operations.
4. Holes of larger diameter should never be drilled without a pilot hole
5. Apply proper coolant during drilling operation.

RESULT:

7. COMPUTER MACHINING (CNC)

XL TURN: A2 axes CNC slant bed lathe with Fanuc emulated control programming software. The software ware incorporates major functions and facilities used on industrial controls with further option of linking the machine to CAD/ CAM and FMS (Flexible manufacturing System. XL Turn that performs drilling, boring, reaming, grooving, threading, parting, roughing, chamfering, tapping of circular work pieces, using CNC programming .

INTRODUCTION:

CNC program is define as a program which contains various codes which have to be followed according to the given dimensioning methodology operating software.

There are two types of diminishing systems.

1) Absolute Dimension system

2) Incremental Dimension system.

<u>Example:</u> Absolute Dimension system

	X	Y
P1	0	0
P2	20	0
P3	20	20
P4	70	20
P5	70	0
P6	100	0
P7	100	40
P8	70	70
P9	0	70

Incremental Dimension system

	X	Y
P1	0	0
P2	20	0
P3	0	20
P4	50	0
P5	0	-20
P6	30	0
P7	0	40
P8	-30	30
P9	-70	0

A standard billet (raw material) can be represented for a diameter of 20mm and length of 70mm in CNC program methodology is given by various types of codes.

VARIOUS TYPES OF CODES:

G- CODES: They are instructions described in the machine tool movement in a program.

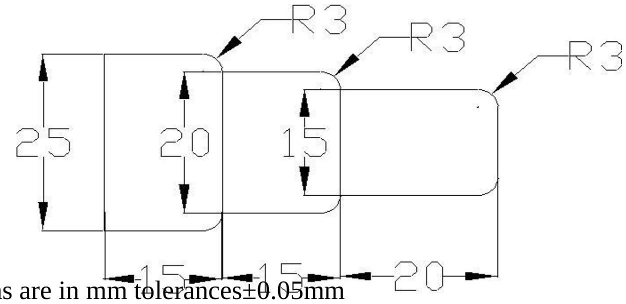
a)	G00	--	Rapid travel.	
b)	G01	--	Linear interpolation	(cutting feed)
c)	G02	--	Circular interpolation	(clock wise)
d)	G03	--	Circular interpolation	(anti- clock wise)
e)	D well 04 --		Idle period to the cutter.	
f)	G20	--	Input data in inches.	
g)	G21	--	Input data in metric units.	
h)	G28	--	Go to reference point. (home portion to the tool)	
i)	G70	---	Finishing of the cycle.	
j)	G71	--	stock removal is turning. (Multiple turning cycle)	
k)	G72	--	multiple facing cycles.	
l)	G73	--	Pattern repeating cycle.	
m)	G74	--	drilling cycle (peck drilling cycle)	
n)	G75	--	grooving cycle.	
o)	G76	--	Multiple threads cutting cycle.	
p)	G90	--	Box turning cycle.	
q)	G92	--	Thread cutting	
r)	G94	--	Box facing.	
s)	G98	--	Feed/ min.	
t)	G99	--	Feed / revolution.	

M. CODES: These are also called miscellaneous codes.

1. M00 -- Program stop.
2. M03 -- Spindle forward.
3. M05 -- Spindle stop.
4. M06 -- Automatic tool charge.
5. M30 -- Program stop & rewind.

GENERATION OF COMPUTER NUMERICAL CONTROL (CNC) PROGRAM

AIM: To generate a plain & step turning program using CNC software



All dimensions are in mm tolerances±0.05mm

SOFTWARE REQUIRED: CNC train

TOOLS REQUIRED: Single point cutting tool, Align key and spanner

PROGRAM:

RESULT:

8. WELDING

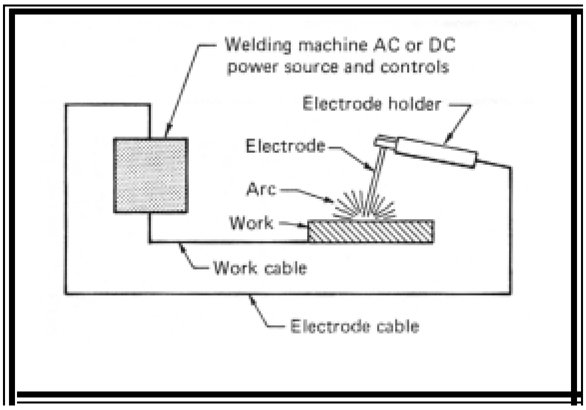
INTRODUCTION: Welding is a process of joining metals by heating them to a suitable temperature at which they melt and fuse together.

ARC WELDING

INTRODUCTION

These processes use a welding power supply to create and maintain an electric arc between an electrode and the base material to melt metals at the welding point. They can use either direct (DC) or alternating (AC) current, and consumable or non-consumable electrodes. The welding region is sometimes protected by some type of inert or semi-inert gas, known as a shielding gas, and filler material is sometimes used as well.

1. Arc welding is one of several fusion processes for joining metals.
2. By applying intense heat, metal at the joint between two parts is melted and caused to intermix - directly, or more commonly, with an intermediate molten filler metal. Upon cooling and solidification, a metallurgical bond is created.
3. In arc welding, the intense heat needed to melt metal is produced by an electric arc.
4. The arc is formed between the actual work and an electrode (stick or wire) that is manually or mechanically guided along the joint.
5. The electrode can either be a rod with the purpose of simply carrying the current between the tip and the work. Or, it may be a specially prepared rod or wire that not only conducts the current but also melts and supplies filler metal to the joint.

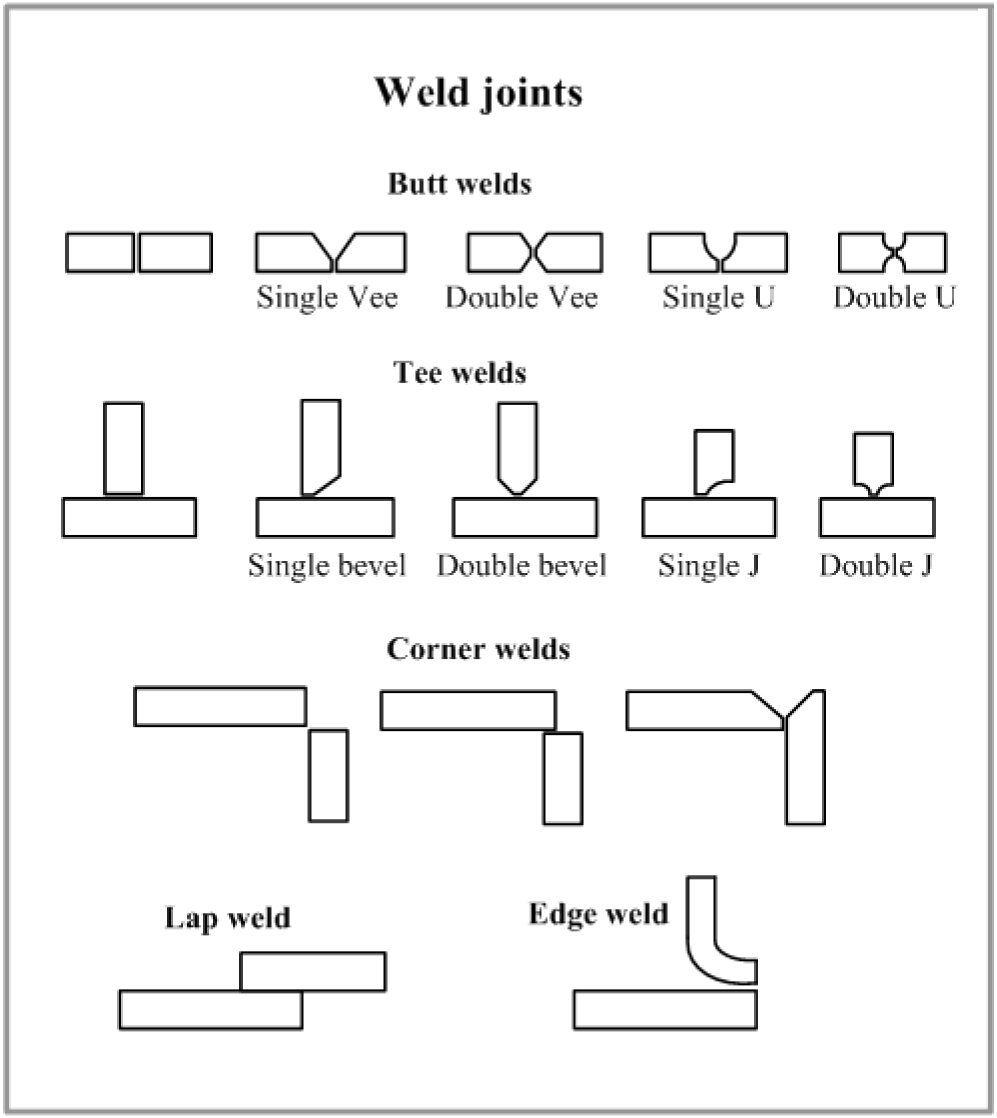


The basic arc-welding circuit

BASIC WELDING CIRCUIT:

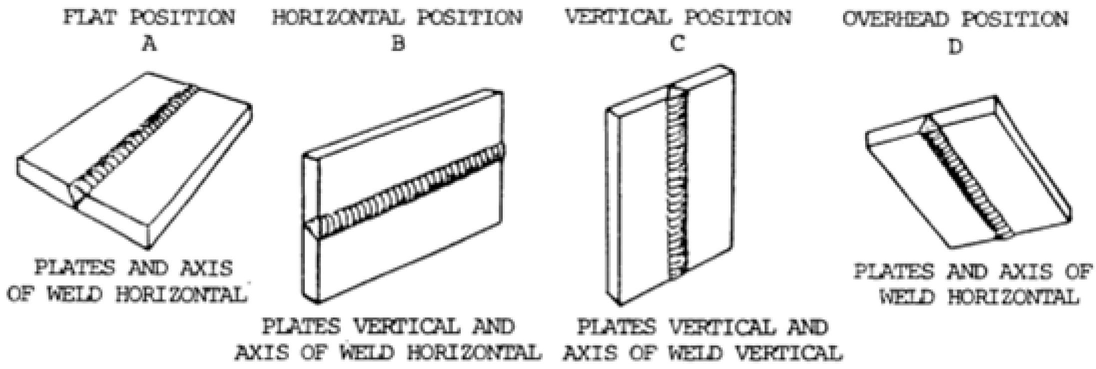
The basic arc-welding circuit is illustrated in Fig. 1. An AC or DC power source, fitted with whatever controls may be needed, is connected by a work cable to the work piece and by a "hot" cable to an electrode holder of some type, which makes an electrical contact with the welding electrode. An arc is created across the gap when the energized circuit and the electrode tip touches the workpiece and is withdrawn, yet still with in close contact. The arc produces a temperature of about 6500ºF at the tip. This heat melts both the base metal and the electrode, producing a pool of molten metal sometimes called a "crater." The crater solidifies behind the electrode as it is moved along the joint. The result is a fusion bond.

WELDING JOINTS:

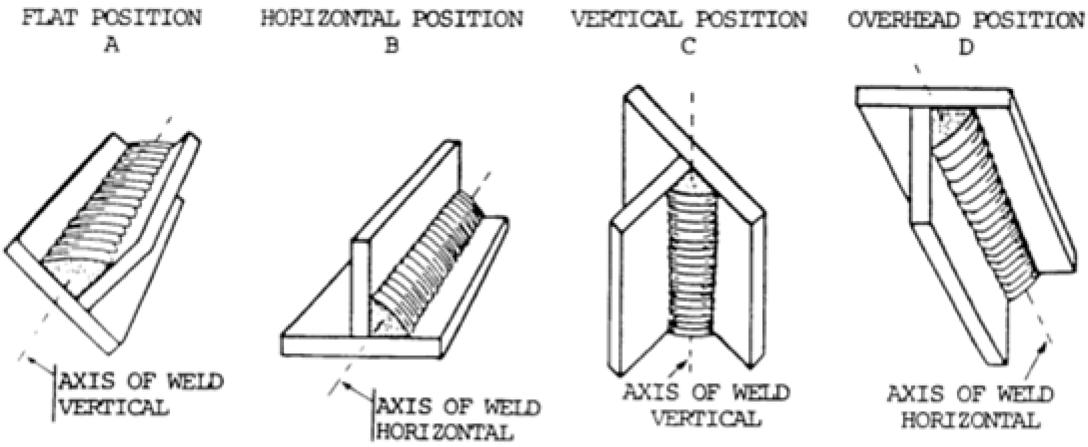


DIFFERENT WELDING POSITIONS

1. Flat
2. Vertical
3. Horizontal
4. Overhead



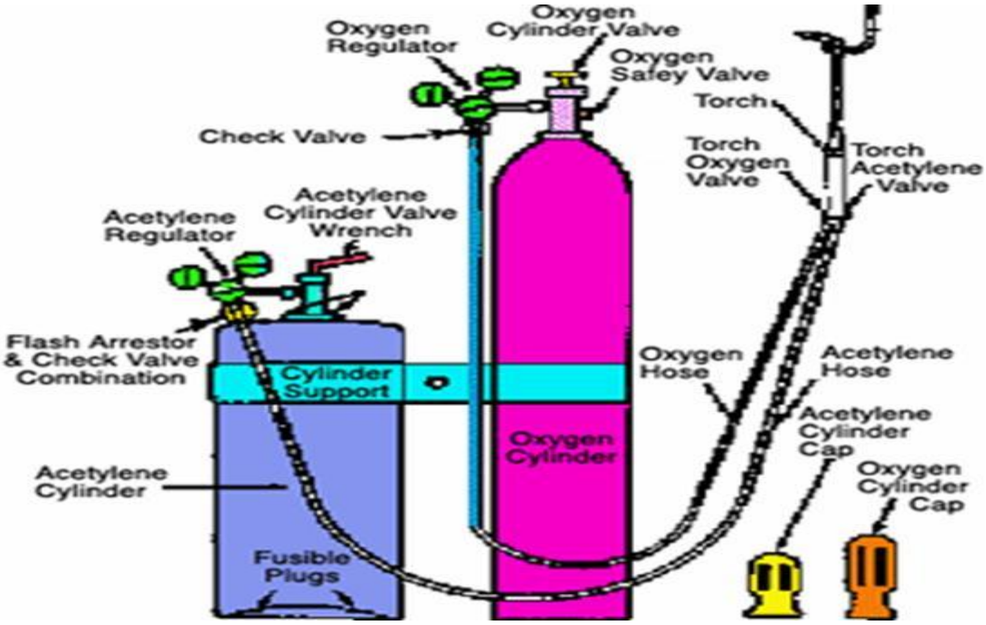
Welding operations groove weld



Welding positions

GAS WELDING

Gas welding is a welding in which combinations of gases are used to obtain a concentrated flame hot enough to melt and fuse the ends of the parts to be joined. It is the gas welding process where the parts to be joined are heated with a flame produced by the combination of OXYGEN and ACETYLENE gas.



Note:

1. In oxygen, acetylene welding, the flame must be supplied by a correct balance of oxygen and acetylene so that it is neither oxidizing nor carburizing, since either of these flames would weaken the weld.
2. Oxygen regulators have ―Right hand‖ threads with plain nuts and

Acetylene regulators have ―Left hand‖ threads with notched hexagon nuts so that they cannot be confused. The Regulator is closed by unscrewing the regulating screw.

TYPES OF FLAMES: The correct adjustment of the flame is important for efficient welding.
The neutral flame is widely used for welding steel, stainless steel, cast iron, copper, aluminium, etc. The carburizing produced with an excess of acetylene, is needed for welding lead. The Oxidizing flame with excess of oxygen is used for welding brass.

TECHNIQUE OF WELDING:
Select the proper size tip for the job and insert it carefully into the torch.
Open the acetylene cylinder valve slightly, say ¼ to ½ turn. Open the oxygen cylinder valve slowly, till it is fully open.
Open the acetylene valve on the torch and turn the acetylene regulator screw clockwise, until the gauge reads 0.5 to 1kg /cm^2 of pressure. Then close the valve on the torch.
Open the oxygen valve on the torch to check the flow and close it. Put-on the welding goggles, gloves and apron.

WELDING PROCESS:

- Prepare the work pieces to be welded and place them in proper position on the welding table.
- Select proper size tip for the job and fix it to the torch.
- Adjust the welding equipment and light the torch.
- Adjust the torch for neutral flame.

GENERAL SAFETY:

1. Always welding in a well ventilated place. Fumes given off from welding are unpleasant and in some cases may be injurious, particularly from galvanized or zinc coated parts.
2. Do not weld around combustible or inflammable materials, where sparks may cause a fire.
3. Never weld containers which have been used for storing gosling, oil or similar materials, without first having them thoroughly cleaned.

AIM: To make simple exercises like butt, lap, corner an TEE joints in Gas welding, and Arc welding.

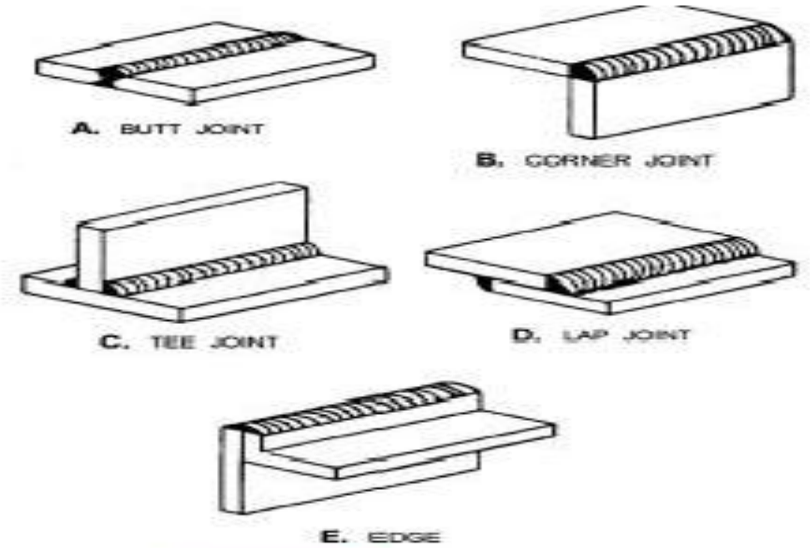


Figure 3-6.—Basic weld joints.

MATERIALS: MS flats, welding electrodes/filler rods and welding machine

PROCEDURE:

RESULT:

BRAZING

Brazing is similar to silver soldering but it is used when a much stronger joint is needed. The basic principle of brazing is the same whichever method is used. Sodium fluoride or sodium silicate mixed with water is used as a stopping off compound to prevent the splitter form sticking to areas of to work. The temperature of the work must be high enough to melt the smelter. The two surfaces to be joined must be at the same temperature. The work should cool evenly to prevent distortion and cracking.

Three kinds of oxygen, acetylene flames:-

1. Neutral flame.
2. Carburizing flame
3. Oxidizing flame

AIM: To join two sheets by brazing process.

EQUIPMENT & MATERIAL REQUIRED: Filler rod, flux, Oxyacetylene torch & two mild steel specimens.

TOOLS REQUIRED: Wire brush, hand gloves, chipping hammer, spark lighter.

SEQUENCE OF OPERATIONS:-

a) Cleaning and preparing the surface.
b) Aligning the base metal parts to joined.
c) Fleeting the joint which is used for brazing.
d) Remove flux reside from joint
e) Fluxing both the base metal and filler metal.

THEORY: It is the process of joining 2 pieces of metals in which a non – ferrous is introduced in a liquid state between the pieces of metal to be joined & allow it solidly. The filler metal is distributed between the closely filled surfaces of the joint by caliper action. The melting point of filler metal is above 4200^0c, but lower than melting point temp. of parent metal . During the process no forging action is present & also the parts don't melt. The bond is produced either by formation of solid solution or intermetallic compound of parent metal. The strength of the joint is provided by metallic bonding. Good brazing process involves preloading, fluxing, proper alignment, heating &post clearing. The following are the metals & alloys used for the brazing process.

1. Cu having melting point of 1080^0c.Joint clearance is of order 0 – 0.05mm & shear strength of material is 3400 – 3800 kg / cm^2.
2. Cu alloys, brass, bronze having melting point varying from 850 to 950^0c. They are
3. Mostly used for joining ferrous metals. Joint clearance is 0.08 to 0.25mm & shear strength is 2500 – 3100 kg /cm^2.
4. Sliver alloy, sliver & Cu or silver, Cu, Zn, having melting point of 600 – 850^0c.The
5. Joint clearance is 0.05 to 0,13mm & strength of joint material is 1500 to 1850 kg / cm^2.
6. Al alloys having melting point 550^0c to 780^0c.
7. Soft solders :- These having melting point of 70-300^{o}C & the joint clearance is 0.075 to 0.2mm and strength of joint material 350-450 kg/cm^2 . Depending on source of heating the brazing process may be classified as touch brazing, furnace brazing, inductive brazing, resistance brazing, and dip brazing and infrared brazing.

DESCRIPTION:

Oxy-acetylene torch is produced by mixing of oxygen & acetylene in proper ratios. The oxygen and acetylene are stored in the red and yellow colored tanks respectively for easy identification. The tanks contain gases subjected to pressure. They have valves which indicate the outlet pressure as well as inlet pressure. The rubber tubes from two tanks are connected to hand held device with nozzle. It consists of valve for regulating gases flow and a mixing chamber the gases flow rate can be regulated using this value which there by helps in obtaining reducing flame, natural flame and oxygen flame. The nozzle is made of a high temperature resistant material.

PROCEDURE:

PRECAUTIONS:

1. The surfaces to be brazed thoroughly cleaned.
2. Align the base metal parts to be joined carefully.
3. Regulators must be operated carefully

RESULT:

SOLDERING

Soft soldering is the process of joining metals by the use of filler metal of low melting point (450^0c). The filler metal is an alloy of lead and tin is called solder. Melting point of solder as less than the base metals. Doping up on the proportions of each constituent, its melting point varies from 150^0c to 350^0c. The percentage of lead increases the malting point of soldering.

Soldering Gun

1) Soft solder ----- Lead 37% & tin 63%.
2) Medium solder ----- Lead & tin 50% each.
3) Electrical solder ---- Lead 58% & Tin 42%.
4) Plumber solder ----- Lead 70% & Tin 30%.

AIM: To solder the given G. I. using Black smithy & wire. (using electric soldering)

MATERIAL REQUIRED: G.I. sheets & electric wire, kerosene, coal (both wood coal & railway coal), cotton waste, filler material, flux.

MACHINE REQUIRED: Open hearth furnace, hot iron with a wooden handle, electric air blower.

SEQUENCE OF OPERATIONS (BLOCK SMITHY SOLDERING)

1. Fire the open hearth furnace
2. Soldering iron is placed.
3. A few minutes the electric air blower is switched on the coal starts burning.
4. Clamped firmly the metals to be soldered in a bench vice and apply layer of flow after cleaning.
5. Solder is applied using red hot soldering iron.
6. Remove irregularities with the hot iron.

ELECTRIC SOLDERING:

1. Start the electric solder leaves it for heating.
2. Remove the insulation for the wire to be soldering.
3. Clean & twist then together apply flux.
4. Filler material wire rubbed slowly against the heated soldering iron.
5. Spread the metal uniformly on wire & make a uniform joint.

PROCEDURE:

RESULT:

9. WELDING OPERATIONS II

ARC WELDING OPERATION

AIM: To conduct arc welding on M.S. Plates of given dimensions.

EQUIPMENT AND MATERIAL REQUIRED: D.C Welding machine, Bench vice, M.S. Plates of 50x50x5(2),

TOOLS REQUIRED:

1. Hack saw,
2. Chipping hammer,
3. Wire brush,
4. Safety goggles,
5. Hand gloves,
6. Face shield,
7. Files.

WELDING TERMINOLOGY:

1. **BACKING:** It is the material support provided at the root side of the weld to aid in the control of the penetration.
2. **BASE METAL:** The metal to be joined or cut.
3. **BEAD OR WELD BEAD:** It is the metal added during a single pass of welding. The bead appears as strikers.
4. **CRATER:** In arc welding, a crater is the depression in the weld metal pool at the where the arc strikers.
5. **DEPOSITION RATE:** Rate at which weld metal is deposited per unit time and expressed in kg/hr.
6. **FILLET WELD**: The metal fused into the corner of a joint made of two pieces placed at approximately 90 degrees to each other.
7. **PENETRATION**: Depth up to which the weld metal combines with the base metal as measured from the top surface.
8. **PUDDLE:** Portion that is melted by the heat of welding.
9. **ROOT:** The point at which the 2 pieces to joined are nearest.
10. **TACH WELD**: A small weld used to temporarily hold the two pieces together during actual welding.
11. **WELD FACE:** Exposed surface of the weld.
12. **WELD PASS:** A single movement of the welding torch or electrode along the length of the joint, which results in beats, is weld pass.

DESCRIPTION:

PRINCIPLE OF ARC WELDING: An arc is generated below 2 conductor cathode and anode. When they are touched to establish flow of current. An arc is sustained electric discharge through ionized gas column called plasma b/w 2 electrodes. Electrons liberated from cathode move towards anode at high speed large amount of heat is generated. To produce are potential diff b/w 2 electrodes should be sufficient.

STRAIGHT AND REVERSE POLARITY: The positive terminal of DC supply is connected to work piece and the negative terminal to electrode and known as DCSP. The positive terminal of DC supply is connected to electrode and negative to work piece and is known as DCSP.

PROCEDURE:

PRECAUTIONS:

1. Edge preparation should be done very carefully.
2. Before welding ensure that the surfaces are extremely clean.
3. While welding always use face shields or goggles.

RESULT:

SPOT WELDING

AIM: To perform spot welding process on given metal pieces.

EQUIPMENT: Spot welding machine

MATERIAL REQUIRED: Two metal pieces of size 4”x2”

DESCRIPTION OF THE EQUIPMENT:

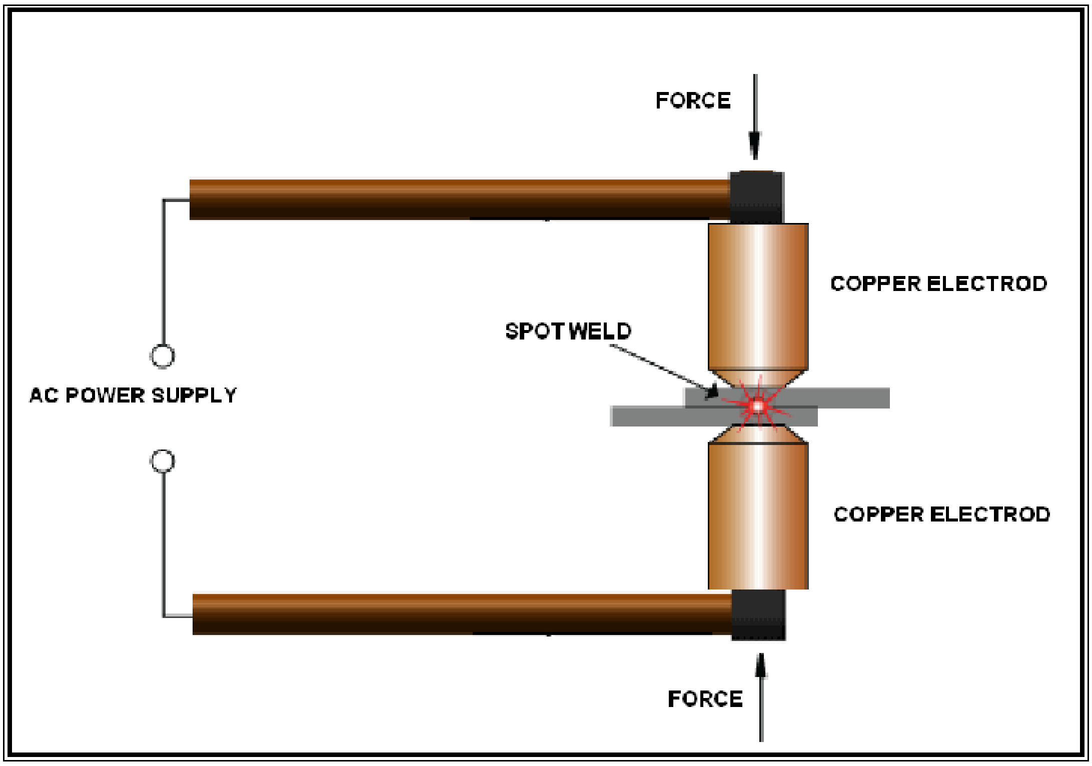


FIG: PRINCIPLE OF SPOT WELDING

A typical resistance spot welding machine essentially consists of two electrodes, out of which one is fixed. The other electrode is fixed to a rocker arm (to provide mechanical advantage) for transmitting mechanical force from a pneumatic cylinder. This is simplest type of arrangement. The other possibility is that of a pneumatic or hydraulic cylinder being directly connected to the electrode without any rocker arm.

For welding large assemblies such as car bodies, portable spot welding machines are used. Here the electrode holder and the pneumatic pressurizing system is present in the form of a portable assembly which is taken to the place, where the spot is to be made. The electric current, compressed air and the cooling water needed for the electrodes is supplied through cable and hoses from the main welding machine to the portable unit.

In spot welding, a satisfactory weld is obtained when a proper current density (A/Sq mm) is maintained. The current density depends on the contact area between the electrode and the work piece. With the continuous use, if the tip becomes upset and the contact area increases, the current density will be lowered and consequently the weld is obtained over a large area. This would not but able to melt the metal and hence there would be no proper fusion.

A resistance-welding schedule is the sequence of events that normally take place in each of the welds. The events are the squeeze time is the time required for the electrodes to align and clamp the two work pieces together under them and provides the necessary electrical contact.

The weld time is the time of the current flow through the work pieces till they are heated to the melting temperature. The hold time is the time when the pressure is to be maintained on the molten metal without the electric current. During this time, the pieces are to be forge welded.

The off time is time during which, the pressure on the electrode is taken off so that the plates can be positioned for the next spot. The off time is not normally specified for simple spot welding, but only when a series of spots are to be made in a predetermined pitch.

THEORY:

Resistance welding: the category resistance welding (RW) covers a number of processes in which the heat required for welding is produced by means of electrical resistance across the two components to be joined. These processes have major advantages, such as not requiring consumable electrodes, shielding gases, or flux. The heat generated in resistance welding is given by the general expression

$$\mathbf{H = I^2RT,}$$

Where

H = heat generated (in joules (watt-seconds))

I = current (in amperes),

R= resistance (in ohms), and

T= time of current flow (in seconds)

The actual temperature rise at the joint depends on the specific heat and on the thermal conductivity of the metals to be joined.

The tips of two opposing solid cylindrical electrodes touch a lap joint of two sheet metals, and resistance heating produces a spot weld. In order to obtain a strong bond in the **weld** nugget, pressure is applied until the current is turned off. Accurate control and timing of the electric current and of the pressure are essential in resistance welding.

The strength of the bond depends on surface roughness and on the cleanness of the mating surface. Oil, paint, and thick oxide layers should, therefore, be removed before welding. The presence of uniform, thin layers of oxide and of other contaminants is not critical.

The weld nugget is generally 6 to 10 mm in diameter. The surface of the weld spot has a slightly discolored indentation. Currents range from 3000 A to 40000 A: the level depends on the materials being welded and on their thicknesses.

PROCEDURE:

ADVANTAGES OF SPOT WELDING:

1. Low cost.
2. Less skilled worker can do it.
3. Higher productivity.
4. Operation may be made automatic or semiautomatic.
5. No edge preparation is needed.

APPLICATION OF SPOT WELDING:

1. Welding of low carbon steels, high speed steels, stainless steels, AI, Cu, nickel, nickel alloys etc.
2. In automobile and aircraft industries.
3. Steel household furniture.
4. Containers.

PRECAUTIONS:

1. Ensure that the electrodes should not be touched.
2. Don't touch the welded potion by hand immediately after the welding is done.

RESULT:

10. BASIC CASTING

AIM: To prepare a casting model of plaster of paris using different dies.

RAW MATERIAL REQUIRED: Moulding sand, Parting sand, facing sand, baking sand, pattern, bottom board, moulding boxes.

TOOLS REQUIRED:

1. Molding board

2. Drag and cope boxes

3. Molding sand

4. Parting sand

5. Rammer

6. Strike-off bar

7. Bellows

8. Riser and sprue pins

9. Gate cutter

10. Vent rod

11. Draw spike

12. Wire Brush

SEQUENCE OF OPERATIONS:

1. Sand preparation

2. Placing the mould flask(drag) on the moulding board/ moulding platform

3. Placing the split pattern at the centre of the moulding flask

4. Ramming the drag

5. Placing the pattern at the centre of the moulding flask (Cope box)

6. Placing runner and riser

7. Ramming the cope

8. Removal of the pattern, runner, riser

9. Gate cutting

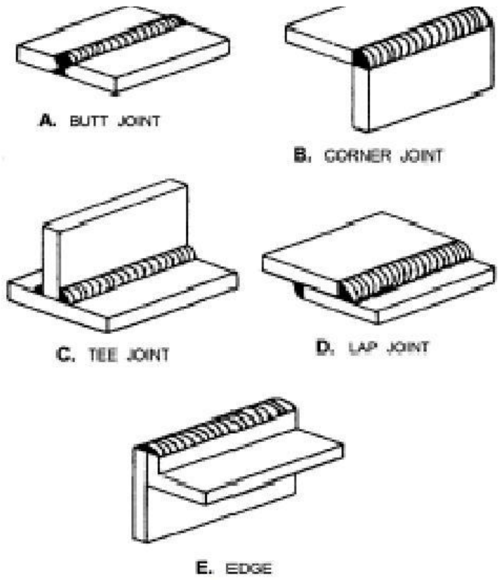
PROSEDURE:

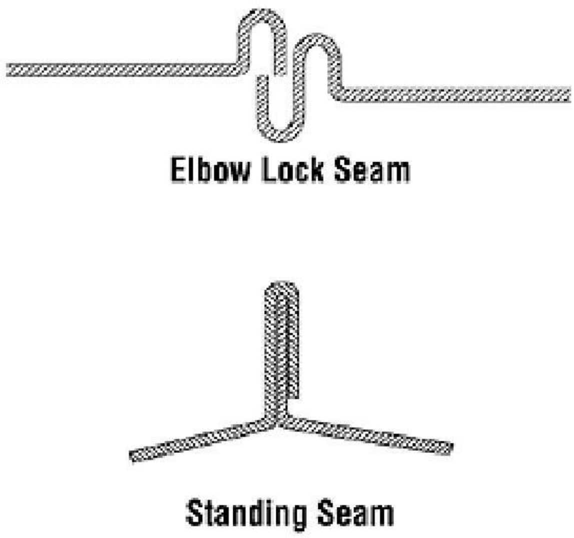
RESULT:

11. RIVITING OF ALUMINIUM SHEETS

RIVETING:

Rivets are used to fasten two or more sheets of metal together. Tin men‘s rivets with flat heads are used on sheet metal work. Light sheet metal is usually punched for riveting, while the heavier sheets are drilled. A solid punch, rivet- set, snap and hammers are the tools required for the job. The shapes of rivets used in sheet metal work.





The following rules must be observed while riveting sheet metal work:

1. Diameter of rivet = 1.2 x thickness of one plate.
2. Distance from the edge of the hole to the edge of the plate = 1.5 x diameter of rivet.
3. Length of the projecting shank = diameter of rivet.

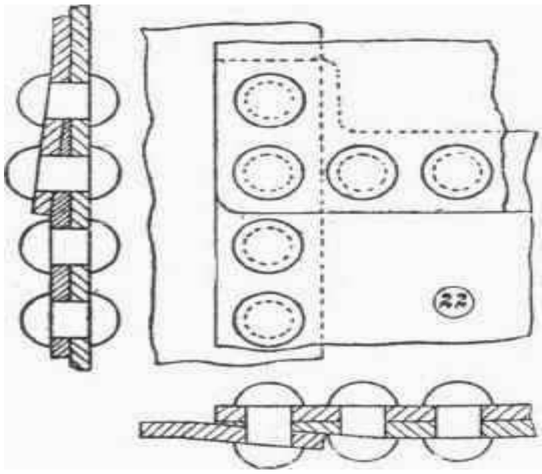
SHAPES OF RIVETS:

Flat Head or Tin Man‘s Rivet - For thin metal. Bifurcated Rivet - For soft materials.
Snap Head Rivet - Used for general engineering works. Countersunk Head rivets - 90^0 for general work.
120^0 for thin sheet metal.

For better results, it is advisable to drill all the holes in one plate and only one in the other. Secure the plates with one rivet and then complete the drilling of the remaining holes.

SHEET METAL JOINING BY RIVETS

AIM: To make semi permanent joint by riveting. 1) Solid riveting. 2) Blind riveting



MATERIAL REQUIRED: Aluminum sheets2 (5mm) , Rivets (solid& blind).

MACHINE REQUIRED: Sheet metal cutter, hand drill, rivet gun. Measuring
INSTRUMENTS: Steel rule, vernier calipers.

TOOLS: Drill, Hand vice, Bench vice, Smooth file, Snap, Spacer& Dolly.

SEQUENCE OF OPERATIONS:

1. Aluminum sheet is cut into required dimensions.
2. Using a smooth file, the corners are filed.
3. The plate is hammered using a mallet in order to minimize universes in them.
4. Marking is done according to standard.
5. The holes are drilled, using drilling machine & the extra mat near the holes is filed using a smooth file.
6. Riveting is done.

PROCEDURE:

PRECAUTIONS:

1. Snaps& dolly should be closer properly.
2. Gaps bet plate or plates or rivets should be hammered well.
3. Holes should be drilled of correct size of rivet shank.
4. Rivets dist from the plate’s edge should be properly maintained.

RESULT:

VIVA QUESTIONS

EXPERIMENT-1

1.1 PRE - LAB QUESTIONS:

2. What is the difference between Hardness & Hardenability?
3. What is severity of quench?
4. What is critical diameter?
5. What is the ideal critical diameter?
6. What is the quenching medium employed in the test?
7. What are the important precautions to be observed in the test?
8. Why a flat is to be ground on the test specimen?
9. What is the equipment used to measure the hardness of specimen in the experiment?

1.2 POST - LAB QUESTIONS:

1. What is lapping?
2. What are the different abrasives used in lapping?
3. Why the specimen has to be etched before micro structural study?
4. What is the etchant used for brass?
5. What is the etchant used for mild steel?
6. In a microstructure how the gain boundary area appears?
7. Why specimen is to be rotated through 90(between polishing on 1/0 and 2/0 emery papers?
8. What is etching reagent used for duralumin?
9. Why should a specimen be prepared following the set procedure before its observation under a microscope?

1.3 ASSIGNMENT QUESTIONS:

1. Is the specimen preparation necessary at all? If so why? If not why not?
2. What is the difference between Metallurgical microscope and Biological microscope?
3. What is the magnification of the microscope?
4. What are the different magnifications available in the microscope of our laboratory?
5. What are the precautions to be observed while studying, microstructure under microscope?

EXPERIMENT II

1.1 PRE - LAB QUESTIONS:

1. What are the important properties of Non-Ferrous metals and alloys?
2. List out some important Non-Ferrous metals?
3. What is melting point temperature of Aluminium?

1.2 POST - LAB QUESTIONS:

1. What is the crystal structure of Magnesium?
2. FCC metals are usually ductile and have high strain hardening tendency. Explain.

1.3 ASSIGNMENT QUESTIONS:

1. In a microstructure how the gain boundary area appears?
2. Why specimen is to be rotated through 90(between polishing on 1/0 and 2/0 emery papers?

EXPERIMENT 1II

1.1 PRE - LAB QUESTIONS:

1. Write application of lathe?
2. Draw and describe cutting tool of lathe?
3. Differentiate between continuous and discontinues chips?

1.2 POST - LAB QUESTIONS:

1. What are the operations done in lathe?
2. What are work holding devices in lathe?
3. Explain formulates involved in lathe cutting?

1.3 ASSIGNMENT QUESTIONS:

1. Draw and explain each and every part of lathe?
2. Draw and explain parts of lathe cutting tools?
3. What are the types of lathe machines?

EXPERIMENT IV

1.1 PRE - LAB QUESTIONS:

1. What are the types of drilling operations?
2. What is cutting tool of drilling machine?
3. What are the applications of drilling?

1.2 POST - LAB QUESTIONS:

1. Draw and explain parts of drilling machine?
2. Write the geometry of twist drill?
3. What is meant by lip, helix and rake angle in drilling?

1.3 ASSIGNMENT QUESTIONS:

1. Explain differences between drilling reaming and taping?
2. Explain problems faced in drilling operation with causes and remedies?
3. What are different types of drilling machines with its applications?

EXPERIMENT V

1.1 PRE - LAB QUESTIONS:

1. What do you mean by shaping?
2. Which type of tool is used in shaper?
3. What is difference between shaper and planer?
4. Name the parts of shaper?
5. How the shapers are classified?

1.2 POST - LAB QUESTIONS:

1. What is quick written mechanism?
2. What are the mechanisms of shaping machine?
3. How to calculate "cutting speed" in shaping operation?

1.3 ASSIGNMENT QUESTIONS:

1. What are the driving mechanisms of shaping machine?
2. Explain all the mechanisms of shaping machine?
3. Sketch the shaping machine parts and explain the parts?

EXPERIMENT VI
MILLING

1.1 PRE - LAB QUESTIONS:

1. Explain the characters of milling that distinguish from other process?
2. How is milling machine specified?
3. What are the types milling cutters?

1.2 POST - LAB QUESTIONS:

4. Explain and sketch helix angle and direction of cut in case of milling?
5. Differentiate between up-milling and down milling?
6. Sketch various types of milling down-milling?

1.3 ASSIGNMENT QUESTIONS:

7. Sketch and explain parts of milling machine?
8. Differentiate between compound and differential indexing?
9. What are differences in grinding and milling?

EXPERIMENT VII

1.1 PRE - LAB QUESTIONS:

1. Define Grinding
2. Name the elements which are considered in the construction of a grinding wheel?
3. Name some natural abrasives, artificial abrasives in Grinding?
4. Define grain size in connection with grinding wheel?

1.2 POST - LAB QUESTIONS:

5. Name different types of grinding wheels.
6. Define dressing of grinding wheels.
7. Explain testing of grinding wheels.

1.3 ASSIGNMENT QUESTIONS:

8. Explain balancing of grinding wheels.
9. Name different types of rough grinders.
10. Write the advantages of internal centre less grinding.
11. Explain Roll Grinder.

EXPERIMENT VIII

1.1 PRE - LAB QUESTIONS:

1. What do you meant by Reverts, soldering and brazing?
2. What are the applications of Soldering, and Reverts, Brazing?
3. What is reverting & name the types of shapes?

1.2 POST - LAB QUESTIONS:

4. Explain soldering techniques?
5. Investment soldering. (b) Free hand soldering.
6. What are the advantages and failures in metal joining process?
7.

1.3 ASSIGNMENT QUESTIONS:

8. What are the steps involved in soldering?
9. Write the procedure for metal joining by reverts?
10. What are the techniques involved in soldering?

EXPERIMENT IX

1.1 PRE - LAB QUESTIONS:

1. Mention the major components of CNC machine.
2. What is mean by codes in CNC machine?
3. How many types of codes are there in CNC machine?

1.2 POST - LAB QUESTIONS:

1. What is ATC in CNC machine?
2. Write down the functions of few G-codes like G01, G002, G003, G004 etc.
3. What are the different components of CNC machine tool?

1.3 ASSIGNMENT QUESTIONS:

1. Clearly explain with figure point to point motion and continuous path motion control used in CNC machine? Which control system is generally used to perform machining on the work pieces?
2. What is closed loop control system and open loop control system used in CNC machine? What is the difference between them?
3. What are the different types of tools used in CNC machine?

EXPERIMENT X

1.1 PRE - LAB QUESTIONS:

1. Define welding & classify the different types of welding process?
2. Names the welding tools used for experiment?
3. Identify the major parts of arc welder?

1.2 POST - LAB QUESTIONS:

1. What are the different welding positions?
2. What is the principle of arc welding?
3. What are joints can we do b using welding?

1.3 ASSIGNMENT QUESTIONS:

1. What is spot welding and explain?
2. What are the applications of welding in aircraft industry?
3. What are the advantages of spot welding?

EXPERIMENT X

1.1 PRE - LAB QUESTIONS:

1. Name welding tools used in the lab?
2. What is gas welding?
3. Name the types of gases are used in gas welding?

1.2 POST - LAB QUESTIONS:

1. Which technique can be used in gas welding?
2. What are the limitations of gas welding?
3. What precautions need to be taken when you are doing arc welding?

1.3 ASSIGNMENT QUESTIONS:

1. What are the advantages of gas welding?
2. Write the Applications of arc welding?
3. Explain the principle of gas welding?

EXPERIMENT XI

1.1 PRE - LAB QUESTIONS:

1. What is brazing and soldering?
2. What is the difference between brazing and soldering?
3. How does brazing works?
4. What are the brazing fillets?

1.2 POST - LAB QUESTIONS:

1. Describe the procedure of brazing and soldering process?
2. Identify the brazing equipment and materials used?
3. What are the applications and uses of brazing and soldering?

1.3 ASSIGNMENT QUESTIONS:

1. What is the difference between brazing and soldering, and welding?
2. What is the strength of brazed joints?
3. What safety could be taken by brazing and soldering