

ISO 9001:2008 Certified) AUTOMOBILE ENGINEERING DEPARTMENT SHAVIGE MALLESWARA HILLS , KUMARASWAMY LAYOUT BENGALURU-560078

Vision of the Institute

To impart quality technical education with a focus on Research and Innovation emphasising on Development of Sustainable and Inclusive Technology for the benefit of society.

Mission of the Institute

- To provide an environment that enhances creativity and Innovation in pursuit of Excellence.
- To nurture teamwork in order to transform individuals as responsible leaders and entrepreneurs.
- To train the students to the changing technical scenario and make them to understand the importance of Sustainable and Inclusive technologies.



WORKSHOP PRACTICE LABORATORY MANUAL I/IISemester (WSL16/26)

(Name of the Student	:	
	Semester /Section	:	
	USN	:	
	Batch	:	

DAYANANDA SAGAR COLLEGE OF ENGINEERING

(An Autonomous Institution affiliated to Visvesvaraya Technological University, Belagavi)

MECHANICAL ENGINEERING DEPARTMENT SHAVIGE MALLESWARA HILLS KUMARASWAMY LAYOUT BENGALURU-560078

DAYANANDA SAGAR COLLEGE OF ENGINEERING

(An Autonomous Institution affiliated to Visvesvaraya Technological University, Belagavi) DEPARTMENT OF MECHANICAL ENGINEERING, BENGALURU-560078

VISION OF THE DEPARTMENT

To prepare world class mechanical engineers having technical competency, and managerial skills, driven by human values and ignites the young minds capable of addressing ever-changing global issues by research and innovation.

MISSION OF THE DEPARTMENT

- To provide a platform that imparts scientific knowledge and technical skills .
- To train students to demonstrate their technical and managerial skills.
- To engage students in professional activities through research , higher education and lifelong learning..

PROGRAMME EDUCATIONAL OBJECTIVES [PEOs]

Graduating students from Mechanical Engineering will have :

PEO 1: graduates shall acquire the knowledge .and competency for careers in and related to Mechanical Engineering.

PEO 2: Graduates shall acquire the necessary skills to lead and manage professional teams.

PEO 3: Graduates shall demonstrate their Engineering Profession by addressing Scientific and Social challenges.

PEO 4: Graduates shall engage in professional and Intectual development through Higher Education ,Research and Lifelong learning in Engineering or related fields

PROGRAMME OUTCOMES [PO's]

- Student should practice Mechanical Engineering and apply same by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- Student should recognize, investigate, formulate and use the suitable techniques in Mechanical Engineering to obtain solution for various problems.
- Student should understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- Student should 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.

DAYANANDA SAGAR COLLEGE OF ENGINEERING (An Autonomous Institution affiliated to Visvesvaraya Technological University, Belagavi) DEPARTMENT OF MECHANICAL ENGINEERING, BENGALURU-560078

SEMESTER - I/II				
Subject name: WORKSHOP PRACTICE		CREDITS -02		
Subject Code	WSL 16/26	CIE Marks	50	
Hours/ Week	1 I & 2P	SEE Marks	50	
Total Number of Lecture Hours	50	Exam Hours	03	
Course objectives: It is essential for students of 1st year to undergo basic workshop practical training. The topics include practical works in welding and sheet metal shop and demonstration of various aspects: 1. Workshop Practice helps the student to know how the work on shop floor is carried out. 2. To impart knowledge and skill to use tools, machines, equipment, and measuring instruments. • Educate students of Safe handling of machines and tools.				
<u>Syllabus</u>				
 1.Introduction: Demonstration on use of hand Too ,Hacksaw, drill taps , use of surfac 2.Welding: Study of electric arc we Models: Butt Joint, Lap joint and 3.sheet metal & soldering work: Development & soldering of th &pentagon),Truncated square priss 4. study and demonstration of pow 	ols used in fitt e plate . elding tools & T- joint. ne models: F m. Funnel an er tools in Me	ing: V-block, Marking C equipment. rustum of cone, prism d tray. chanical Engineering.	Gauge, files	3 Hours per week (1hour instruction and 2 hours practice)
	Course o	ut comes:		
 At the end of the ,the student will be able to: Gain knowledge of development of sheet metal models with an understanding of their applications. Perform soldering and welding of sheet metal & welded joints. Understand the Basic of workshop Practices. Gaining the knowledge of power Tools and Tools. 				

SEE EXANINATION :

Sheet Metal Work :30 marks Welding :10 marks Viva Voce: 10 marks Total marks: 50 marks

Note :

No mini Drafters and drawing boards required .Drawings (Developments) can be done on sketch sheets using scale , pencil and geometrical Instruments.

Reference Books

S k Hajra Choudhry, A K Hajra choudry , " Elements of Workshop Technology: Vol I : Manufacturing Processes ", Media promoters & publishers Pvt Ltd.,Mumbai. 15th Edition reprinted 2013

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INSTRUCTION FOR WRITING THE RECORD

Students should follow the instructions given below to write the Lab Record Right Hand Page in the Record book

- 1. Serial number and Date of Experiment
- 2. Name of the Experiment
- 3. Aim of the Experiment
- 4. Tools required
- 5. Marking tools and cutting tools required
- 6. Procedures for preparation of model
- 7. Result obtained

Left Hand Page in the Record book

- 1. Neat drawings of materials and prepared models.
- 2. Dimensions of drawings and models prepared.

Note :

- 1. Students should maintain their observation notebook and record the reading neatly
- 2. Given Models to be prepared on the day has to be written in the observation notebook and submitted to the faculty for the correction and initials on the same day.
- 3. Students should submit the record of the previous experiments(models prepared) when they come for the next practical classes
- 4. All the suggestions given or defects by the faculty should be attended to when the records are taken back
- 5. All measurements, results etc, must be expressed in S.I. Units only.

DO's

DO'S

- > Students must always wear uniform and shoes before entering the lab.
- > Proper code of conduct and ethics must be followed in the lab.
- > Windows and doors to be kept open for proper ventilation and air circulation.
- > Note down the specifications/drawings before working on the preparation of models.
- Receive the tools and materials required for preparation of models with signing in register.
- > Properly fix hacksaw blade in frame with help of instructor.
- > Use of safety goggles/ face shield during welding.
- Do the models under the supervision/guidance of a lecturer/lab instructor only.
- > Keep the sufficient distance from other students while preparing models.
- > In case of fire use fire extinguisher/throw the sand provided in the lab.
- > In case of any physical injuries or emergencies use first aid box provided.
- Any unsafe conditions prevailing in the lab can be brought to the notice of the lab Be away from power tools while demonstrating.

DONT's

- > Do not touch electrical circuits of welding machine.
- > Be cautious while fixing hacksaw blade in frame , that may cause injuries to hand.
- > Don't touch /operate power tools without aid from instructors.
- > Don't gather while preparing models, that may hurt other with tools.
- Don't unlock snip/sheet metal cutter lock, without use.
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Workshop Practice Lab

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FITTING (study and demonstration only) INTRODUCTION TO FITTING

In engineering, particularly in heavy and medium engineering, even today with the use of automatic machines, bench work and fitting have important roles to play to complete and finish a job to desired accuracy.

"Bench work" generally denotes the production of an article by hand on the bench.

"Fitting" is the assembling together of parts and removing metals to secure the necessary fit, and may or may not be carried out at the bench. There is no clear meaning between these two terms hence it is used rather loosely. Both these two types of work require the use of large number of tools and equipments and involve number of operations to finish the work piece to desired dimensions, shape.

The operations that are carried out are:

Marking out Sawing Chipping Filing Scraping Grinding Drilling Reaming Tapping Dieing, etc.

Marking out:

Marking out consists of marking out on the job a series of definite lines or positions. All marking should be done with reference to true edge or surfaces, preferably low at right angles or with reference to certain datum lines. These edges or positions of datum line can be determined from the drawing which is necessary for each job.

The surfaces of work to be marked out are usually treated with chalk, or with Copper sulphate solution, which leaves a thin film of copper on iron or steel.

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After the solution is dried then it is ready for marking out. It is either placed in 'V' block if it is round, or laid on a surface plate if it is flat job or work piece.

Horizontal or vertical lines are scribed by Try-Square, provided a true surface on the edge of the job to be marked is available. The required dimensions of the job based on design is marked using a steel rule or spring calipers, hermaphrodite calipers, divider etc. Boundary marks, which later are to be cut away, are made permanent by light dot punching along the part out wards to which the part has to be removed. Leading to the scribed line as a reference of comparison after the job is finished.

Measuring Instruments:

There are difference types of measuring instruments but for workshop purpose these different types of tools are used.

Steel rule:

It is one of the most useful tools in the workshop for taking linear measurements of blanks and articles to an accuracy of from 1.0 to 0.5 mm.



Calipers:

Calipers are used to transfer and compare a dimension from one object to another or from a part to a scale or micrometer, where the measurement cannot be made directly.

Types of calipers

Outside spring calipers Inside spring caliper Vernier caliper Micro meter Divider

Outside spring caliper:

An outside spring Caliper is a two-legged Steel instrument with its legs bent inwards as shown in figure. It is used for



measuring and comparing thickness, diameters and other outer dimensions. A steel rule must be used in conjunction with them if direct reading is desired.

Inside spring caliper:

Inside spring Caliper is exactly similar to outside Caliper. In this type of a caliper the legs are bent outward. This type of Caliper is used for comparing or measuring hole diameter, distance between shoulders, or other parallel surfaces of any inside dimensions.

Divider:

It is similar in construction to a caliper except that both the legs are straight with sharp hardened points at the end. It is used for transferring dimensions, scribing circles and doing general layout work.

Divider

Vernier calipers:

It is intended for measuring inside and outside diameters and thickness of parts etc. to an accuracy of 0.02 mm by a Vernier scale attached to the caliper.



- 2 Upper Jaws for Measuring Inner Dimensions
- **3** Thin Strip for Measuring Depths
- **6** Vernier Scale (for 'cm' main scale)
- 7 Vernier Scale (for 'inches' main scale)

Workshop Practice : [2016]



4 Main Scale in 'cm'

8 Button for Fixing Vernier at Desired Position

Principle of Vernier calipers – N divisions on the Vernier scale is equal to (N-1) divisions on the main scale.

Calculation of least count of Vernier caliper

The main division divided into millimeters .in this case 49 main scale divisions' i.e.49mm is divided into 50 Vernier scale divisions. Then the value of 49msd is divided into 50 divisions.

The value of each division on the main scale = 1 mm= 1 msd Value of 1 m.s.d =1mm Value of 1 v.s.d = $\frac{(N-1)}{N}$ M.S.D = 49/50 mm (usually N = 50) Least count =1 m.s.d - 1 v.s.d = (1 - 49/50) mm = 0.02 mm

Micrometers:

Micrometer can be further classified as external, internal, depth and screw thread micrometers. An external micrometer is used for measuring external diameters and thickness of parts up to an accuracy of 0.01 mm.



Calculation of least count of Micrometer

There are fifty divisions around the thimble. For one rotation of the thimble the movement on barrel is 1 division or ½ millimeter. Therefore the value of each division on thimble is 1/50 of half millimeter.

Value of each division on thimble:

=1/50*1/2=1/100mm

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The Vernier height gauge

The Vernier height, clamped with a scriber, is shown in figure. It is used for layout work. An offset scriber is used when it is required to take measurements from the surface; on which gauge is standing .the accuracy and working principle same as those Vernier calipers the capacity of height gauge is specified by the maximum height it can measure .it varies from 150mm to 1000mm. It is made of Nickel-Chromium Steel.



The main parts of a vernier height gage.

Marking tools:

Marking tools are used for lay outing the work or marking for further processing or the job. Some of the marking tools are:

- 1. Surface plate4. 'V' block2. Scriber5. Angle plate
- 3. Punch 6. Try square

1. Surface plate:

It is square or rectangular in shape, made of grey cast iron of solid design. It is used for testing the flatness of work or for measuring or layout the work. The surface is ground and scraped to very high accuracy.



Surface gauge:

It has ground flat base carrying scriber arm, which is fitted with an adjustable scribble point, so that lines can be inscribed on the work at a predetermined distance from the surface plate.



Scriber:

It is used for drawing lines in the metal parts to layout the job. It is made of hardened steel.



It is used for making punch marks on the layout of parts for further processing. It is made of hardened steel rod.

Twist Drill

Twist drills are used for making holes. These are made of High speed steel. Both straight and taper shank twist drills are used. The parallel shank twist drill can be held in an ordinary self – centering drill check. The tapper shank twist drill fits into a corresponding tapered bore provided in the drilling machine spindle.

Twist drills



Taps and Tap wrenches

A tap is a hardened and steel tool, used for cutting internal thread in a drill hole. Hand Taps are usually supplied in sets of three in each diameter and thread size.

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Each set consists of a tapper tap, intermediate tap and plug or bottoming tap. Taps are made of high carbon steel or high speed steel.



Taps and tap wrench

V block:

V blocks are made of mild steel with v shaped grooves. When circular bar needs lay outing or for drilling, V-block can be used.

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 900. V-block with a clamp is

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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



It consists of beam to which blade is fixed. It is used to check the flatness and trueness of the surface.



Try square:

It is a woodworking or a metal working tool used for marking and measuring a piece of wood The *square* refers to the tool's primary use of measuring the accuracy of a right angle (90 degrees); to *try* a surface is to check its straightness or correspondence to an adjoining surface. A piece of wood that is rectangular flat, and has all edges (faces, sides, and ends) 90 degrees is called four square. A traditional try square has a broad blade made of steel that is riveted to a wooden handle or 'stock'. The inside of the wooden stock usually has a brass strip fixed to

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it to reduce wear. Some blades also have graduations for measurement. Modern try squares may be all-metal, with stocks that are either die-cast or extruded

Angle plate:

It is made of grey cast iron. It has two planed and ground surface at right angles to each other. It is used along with surface plate to hold the vertically for marking.

CUTTING / SAWING TOOLS

- 1. Hacksaw Frame
- 2. Hacksaw Blade

Sawing:

Hack sawing is the quickest method of serving, shaping and slotting cold mild steel. The work to be sawn should be held tightly in the vice. As a rule, the work piece must hold in such a way that the marking line is situated few millimeters to the left of the jaws as shown in figure. The saw blade is fixed with the teeth facing forward for work to be done on forward stroke or push. During normal saw operation it should be made almost all the blade do the cutting operations around 50 strokes/ m

Hacksaw Frame:

It is used for sawing all metal except hardened steel. A hacksaw consists of frame, handle, and prongs, tightening screws and nut with blade attached to prongs.

Hack Saw

The Hack Saw is used for cutting metal by hand. It consists of a frame, which holds a thin blade, firmly in position. Hacksaw blade is specified by the number of teeth for centimeter. Hacksaw blades have a number of teeth ranging from 5 to 15 per centimeter (cm). Blades having lesser number of teeth per cm are used for cutting soft materials like aluminum, brass and bronze. Blades having larger number of

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teeth per centimeter are used for cutting hard materials like steel and cast Iron. Hacksaw blades are classified as (i) All hard and (ii) flexible type. The all hard blades are made of H.S.S, hardened and tempered throughout to retain their cutting edges longer. These are used to cut hard metals. These blades are hard and brittle and can break easily by twisting and forcing them into the work while sawing. Flexible blades are made of H.S.S or low alloy steel but only the teeth are hardened and the rest of the blade is soft and flexible. These are suitable for use by un-skilled or semi-skilled persons.



Chipping: Chipping is the process of removing thick layers of metal by means of cold chisels. In chipping job is held firmly in vice and the metal is removed by striking the chisel on the work piece by a hammer.



Chipping tools

- 1. Hammer
- 2. Chisel

Hammers:

Hammers are used to strike a

job or a tool. They are made of

forged steel of various sizes (weights) and shapes to suit various purposes. For light work suitable range would be from 0.11 to 0.33 kg for clinching small rivets and dot punching. For chiseling 0.45 kg, for heavier work like chipping 0.91 kg for bench work around 0.33 and 0.45 kg is used.

a. Ball Peen Hammer: Mainly used for chipping and riveting



b. Straight Peen Hammer: Used for stretching the metal

c. Crossed Peen Hammer: Used for bending, stretching, hammering shoulders, curves

Chisels:

Chisels are used for cutting and chipping away pieces of metal and are made of carbon steel usually rectangular, hexagonal or octagonal cross section. They are forged to shape, roughly ground then hardened and tempered. After this process it is then ground sharp to required correct cutting edge.





Cross cut chisel:

The cross cut chisel is used for cutting grooves and key ways in shaft and pulleys. The length of this chisel varies from 100 to 400 mm and width varies from 4 to 12 mm.

Half round chisel:

The half round chisel is used for cutting semi circular grooves in bearings for oil ways, shafts, pulley etc. The shank is reduced to half round taper, which is believed at the end to give a semi circular cutting edge.

Diamond point chisel:

The diamond point chisels are useful in cutting square holes, truing corners and edges, cutting v grooves etc. The chisel is drawn to tapered square section and end is ground off at an angle producing the diamond shape.





Files:

Filing is an important operation. It is carried out as an after treatment and done after chipping. It serves to remove the burr from the cut and clean the face of the cuts, and to finish the final shape of a work piece. Files can be classified, according to size, cut of teeth, sectional shape.

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Files length varies from 100 mm – 400 mm. excluding tang.

Single cut files have the teeth cut in parallel in 70° to one edge.

Double cut files have teeth at 70° to an edge and another set running across those at 45° to other edge.

The shape of the file is the general outline and cross sectional shape and shapes are classified as flat, hand, square, pillar, round, triangular, half round, and knife edge.

Flat file:

It is used commonly for general work; it is double cut on face and single cut on sides.



Hand file:

It is used for finishing flat surfaces.



Square file:

It is used for filling square corners, square and rectangular openings splines and keyways.



Square File

Pillar file:

It is used for narrow works such as slots and grooves.



Pillar File

Round file:

It is used for filing curved surfaces and enlarging holes of circular cross section.



Round File

Triangular file:

It is triangular in cross section, double cut and tapers towards the point, used for filing corners, which have less than 90°.



Triangular File

Half round file:

It is less than half round used in filing curved surfaces. It is tapered and double cut.



Half Round File

Files with the greatest spacing between teeth are called rough; with the least spacing between the teeth are known as dead smooth.

Grades of files:

Rough having	8 teeth/cm
Coarse	10 teeth/cm
Bastard	12 teeth/cm
Second cut	16 teeth/cm
Smooth	20 to 24 teeth/cm
Dead smooth	40 teeth/cm

Vice:

Vice is the most common tool for holding the work. Different types of vices are used to various purposes. They include bench wise leg vice, pipe vice, hand vice, pin vice, and toolmaker's vice.

Bench vice:

Bench vice also called as fitter's vice, essentially consists of a cast iron body, a fixed jaw and a movable jaw, a handle, a square thread screw and a nut made of mild steel. Separate cast steel plates known as jaw plates are fixed to the jaws by means of set screws And they can be replaced when worm out. The movement of the movable jaw is caused by rotating the screw with handle through the nut fixed under the movable jaw. The size of a vice is specified by the width of its jaws, which ranges from 60 to 140 mm.



Leg vice:

Leg vice is most suitable for heavy hammering, chipping, and cutting in fitter's work. It is secured to top of the bench and the long leg is fastened to the bench leg with staples. This construction of the vice makes it suitable for heavy work. The main disadvantage of leg vice is that it does not provide a firm grip as in bench wise. Other vices (pipe vice, toolmakers vice, Hand vice, pin vice etc) are used in workshop and tool room applications.



WELDING

Welding is the metallurgical process of joining two metals by application of heat with or without pressure and filler material.

The **weldability** is defined as the capacity of being welded into inseparable joints having specified properties. If the chemical, physical, thermal and metallurgical properties are undesirable in welded joints then they can be corrected by using proper shielding atmosphere, fluxing material, proper filler material, proper welding procedure and heat treatment before and after welding. The following metals have good weldability in descending order. Iron, carbon steels, cast steels, cast iron, low alloy steels, and stainless steel.

Welding processes can be broadly classified under two broad sub classes.

Plastic welding / pressure welding

Fusion welding / non pressure welding

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Arc welding process:

Arc welding is a group of welding process where in coalescence is produced by heating with an electric arc or arcs, mostly without the application of pressure and with or without the use of filler metal depending upon the base plate thickness. There are different arc welding process of which the one in workshop is flux shielded metal arc welding.

Flux shielded metal arc welding:

Definition: It is an arc welding process where in coalescence by heating the work piece with an electric arc setup between a flux coated electrode and the work piece. The flux covering decomposes due to arc heat and performs many function, like arc stability, weld metal protection etc. the electrode itself melts and supplies the necessary filler metal.

Principle of the process:

Heat required for welding is obtained from the arc stuck between a coated electrode and the work piece. The arc temperature produced by the heat is about 4000 deg C and thus the arc heat can be increased or decreased by employing higher or lower arc currents. A high current with a smaller arc length produces a very intense heat. Both DC and AC may be used. For current over 750 amperes A.C equipment is preferred as it has high efficiency negligible loss at peak load and minimum maintenance.

The arc melts the electrode end and the job. Material droplets are transferred from the electrode to the job, through the arc, and are deposited along the joint to be welded. The flux coating melts produces a gaseous shield and slag to prevent atmospheric contamination of the molten weld metal.



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Arc welding process

Various types of edge preparation can be used, and the choice of the most suitable is influence by a number of factors. Some of these, not necessarily in order of importance, are

- Type of process
- Type of work
- Position of welding
- Access for arc and electrode
- Volume of deposited weld metal
- Dilution
- Cost of preparing edges
- Shrinkage and distortion



STEP 1. EDGE PREPARATION

STEP 2. HOLDING WORK IN POSITION

Arc welding Procedure:

- The surface to be welded is cleaned and the edges of the plates may be filed for perfect joint and for more strength.
- The welding electrode is held in an electrode holder and the ground clamp is clamped to the surface plate and the work piece is placed on it for welding.
- The plates to be welded are positioned overlapping and tag weld is done on the ends to avoid the movement from one end of the plates.
- Now start welding from one end of the plates. The electric arc is produced melts the electrode and joins the two metal plates.
- Maintaining a gap of 3mm between the plates and the electrode for proper arc length. Complete the welding process by removing slag using wire brush and chipping hammer.

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Tools and safety equipments in welding process

- Ac or Dc machines
- Electrode
- Electrode holder
- Cable and cable connectors
- Chipping hammer
- Earthing clamps
- Wire brush
- Helmet
- Safety goggles
- Hand gloves
- Apron
- Tongs
- Anvil etc.

Arc welding machines:

Both Alternate current and direct current are used for electric arc welding, each having its particular application.



The most commonly used power source for welding is AC supply. The equipment used is a Transformer, which changes high voltage, low amperage power to low voltage, high amperage welding power. The transformer used can be connected to single, two and three phase connection. They are either aircooled or oil cooled depending upon their ampere rating. Generally current is in

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the range of 150 – 400 Amps with open circuit voltage varying from 30 to 100 volts.

Advantages of AC Arc welding

- 1. Fewer moving parts .no wear and tear
- 2. Little maintenance
- 3. The welding transformer and its controller are very much cheaper than the d.c. set of the same capacity
- 4. Suitable for ferrous metals, especially heavy steel sections.

Disadvantages

- 1. covered electrode must be used The a.c arc cannot be used satisfactorily for bare wire or light rods as with the d.c .arc
- 2. AC. uses higher voltage than d.c. shock risk is greater with AC
- 3. welding of cast iron ,bronze, and aluminum cannot be done as successfully as with d.c

Current requirements

20-200 amperes for thin materials

20-300 amperes for general work

Up to 600 amperes for heavy work.

Welding Electrodes

The types of electrodes that are generally used for welding are

- **Consumable Electrode** it melts and supplies filler metal to the weld
- Non Consumable Electrode it does not melt but separate filler metal is to be added to the weld.



Consumable Electrodes

Bare electrodes: which consist of metal or alloy wire without any flux coating.

Flux covered (coated) electrodes: which have flux covering the metal or alloy. The flux acts as a shield to protect the arc and also to protect the weld pool.

Specification of electrode:

The coated electrodes are further classified in to light coated and heavy coated. Heavy coated has layer of 1mm to 3 mm of coating, Heavy coatings are composed of ionizing (chalk), deoxidizing (aluminum, Ferro magnetic et.), gas generating (starch), slag forming (kaolin), alloying and binding material. For hand arc welding the electrodes has diameter up to 12 mm and 450 mm long are used.

Coated electrode has several purposes:

- To facilitate the establishment and maintenance of arc
- To protect the molten metal from oxygen and nitrogen of air by producing gas shielded around the arc and weld pool.
- To assist in the formation of slag so as to prevent the rapid cooling of the weld seam.
- To provide the alloying element that is not present in cold wire.

Electrode holder:

A metal electrode is the device used for holding the electrode mechanically. It conveys electric current from welding machine to the electrode; it has an insulated handle to protect the operator's from heat.



Chipping hammer:

Chipping hammer is used for chipping the slag coating on weld surface. It consists of a long handle with head made of cast steel.

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Earthing Clamps:

It is connected to the end of the ground cable. It is normally clamped to the welding table or the job itself to complete the electric current.

Wire brush:

The wire brush is used to clean the surface to be welded.



Helmet:

It is known as face shield or helmet. It is used to protect the eyes of the welders from the light sparks produced during welding. It is normally held in hand.

Safety goggles:

Goggles with glasses are used to protect the eyes of the welder from the light sparks produced during welding.



Safety Goggles

Flat tongs:

When welding smaller pieces together, for moving the pieces to different welding angles and shifting of pieces for chipping. It is advisable to use a flat tongs.

Anvil:

It is a solid casting of mild steel. Used for supporting the work for hammering, punch marking, chipping of welded parts etc.

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WELDING DEFECTS:

- Cracks
- Distortion
- Incomplete penetration
- Inclusions
- Porosity and Blow holes
- Poor fusion
- Spatter
- Under cutting

Gas Welding

- Oldest methods of fusion welding process
- Most widely used method of metal melting
- The equipment is relatively simple and cheap
- Heat is generated by the combustion of combustible gas with oxygen
- Combustion takes place at the nozzle or the outlet of the torch
- This process of welding is generally known as Oxygen Fuel Gas welding (OFT)
- Commercial gases used for gas welding: acetylene, hydrogen, propane, butane and commercial LPG.

Oxy – Acetylene Gas welding

- Common gas welding process.
- Acetylene is the fuel gas used, produces high heat content in the range of 3200°C
- Acetylene gas has more available carbon (92.3%) and hydrogen (7.7%) by weight.
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Heat is released when the carbon breaks away from hydrogen to combine with O₂ and burn.

 $C_2H_2+O_2 = 2CO+H_2+Heat$

GAS WELDING EQUIPMENT



Advantages of gas welding

- 1. The equipment is inexpensive, uncomplicated.
- 2. It is portable.
- 3. Useful for welding light metals and for repair jobs.
- 4. Gas welding can be used with all the common metals.

Disadvantages

- 1. Acetylene is explosive.
- 2. Gas welding is slower than electric arc welding.
- 3. Heated areas are larger and cause more distortions.
- 4. The process is not satisfactory for heavy section.
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Experimental Models

Model 1: Lap joint

Aim: To join two given metal plates to obtain a **Lap joint** by arc welding process **Tools Required:** Welding transformer, welding electrodes, safety gloves, hand shield, chipping hammer, wire brush etc.



(All dimensions in mm)

Procedure:

- The surface to be welded is cleaned and the edges of the plates may be filed for perfect joint and for more strength.
- The welding electrode is held in an electrode holder and the ground clamp is clamped to the surface plate and the work piece is placed on it for welding.
- The plates to be welded are positioned overlapping and tag weld is done on the ends to avoid the movement from one end of the plates.
- Now start welding from one end of the plates.
- The electric arc is produced melts the electrode and joins the two metal plates.
- Maintaining a gap of 3mm between the plates and the electrode for proper arc length
- Complete the welding process by removing slag using wire brush and chipping hammer.

Result: The two metal plates are welded to form a lap joint.

Model 2: Butt joint

Aim: To join two given metal plates to obtain a **Butt joint** by arc welding process **Tools Required**: Welding transformer, welding electrodes, safety gloves, hand shield, chipping hammer, wire brush etc



(All dimensions in mm)

Procedure:

- The surface to be welded is cleaned and the edges of the plates are grinded in such a way that it forms a V and an inverted V shape when the plates butt each other.
- The welding electrode is held in an electrode holder and the ground clamp is clamped to the surface plate and the work piece is placed on it for welding.
- The plates to be welded are positioned overlapping and tag weld is done on the ends to avoid the movement from one end of the plates.
- Now start welding from one end of the plates.
- The electric arc is produced melts the electrode and joins the two metal plates.
- Maintaining a gap of 3mm between the plates and the electrode for proper arc length.
- Complete the welding process by removing slag using wire brush and chipping hammer.

Result: Thus the two metal plates are welded to form a double V butt joint.

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Model 3: 'T' joint

Aim: To join two given metal plates to obtain a **'T' joint** by arc welding process **Tools Required**: Welding transformer, welding electrodes, safety gloves, hand shield, chipping hammer, wire brush etc.



(All dimensions in mm)

Procedure:

- The surface to be welded is cleaned and the edges of the plates may be filed for perfect joint and for more strength.
- The welding electrode is held in an electrode holder and the ground clamp is clamped to the surface plate and the work piece is placed on it for welding.
- The plates to be welded are positioned overlapping and tag weld is done on the ends to avoid the movement from one end of the plates.
- Now start welding from one end of the plates.
- The electric arc is produced melts the electrode and joins the two metal plates.
- Maintaining a gap of 3mm between the plates and the electrode for proper arc length.
- Complete the welding process by removing slag using wire brush and chipping hammer.

Result: Thus the two metal plates are welded to form a 'T' joint.

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Model 4: 'L' joint

Aim: To join two given metal plates to obtain a **'L' joint** by arc welding process **Tools Required:** Welding transformer, welding electrodes, safety gloves, hand shield, chipping hammer, wire brush etc.



(All dimensions in mm)

Procedure:

- The surface to be welded is cleaned and the edges of the plates may be filed for perfect joint and for more strength.
- The welding electrode is held in an electrode holder and the ground clamp is clamped to the surface plate and the work piece is placed on it for welding.
- The plates to be welded are positioned overlapping and tag weld is done on the ends to avoid the movement from one end of the plates.
- Now start welding from one end of the plates.
- The electric arc is produced melts the electrode and joins the two metal plates.
- Maintaining a gap of 3mm between the plates and the electrode for proper arc length.
- Complete the welding process by removing slag using wire brush and chipping hammer.

Result: Thus the two metal plates are welded to form an 'L' joint.

SHEET METAL (Development & Soldering of the models)

Introduction to sheet metal work:

Sheet metal work is working with metal sheets from 16 – 30 gauge, using hand tools and simple machines. By marking, development, cutting, forming in to shape and joining to fabricate many domestic utility items, machine covers, hoppers, guards, tanks, stacks, duct work, pipes, bend, boxes, etc. common metals used in sheet metal work are black iron, galvanized iron, stainless steel, copper, brass, zinc, aluminum, tin plate and lead.

The material, which is used in workshop, is galvanized iron. It is zinc coated hence it is known as galvanized iron. This sheet can withstand contact with water and exposure to atmosphere.

Development: It is method of laying out surfaces of the pattern with suitable allowances in full size on metal sheet.

Methods of development: There are four methods of development

- 1) Parallel line development : This is used to develop cubes , prisms, cylinders, and similar objects
- 2) Radial line development : This is used to develop pyramids, cones and similar objects
- 3) Triangular development : This is used to develop transition piece, pipes and objects of various shapes
- 4) Approximate Development: This is to develop sphere, ellipsoid etc.

Sheet metal operations:

- 1) **Shearing**: shearing is a cut in straight line across the strip, sheet or bar. This procedure leaves a clean edge on the metal that is sheared or cut
- 2) **Punching** : punching is the operation of producing circular holes on sheet metal by punch or die
- 3) **Drawing:** this is operation of producing thin walled hollow or vessel shaped parts from sheet metal.
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- 4) Notching: this is process of removal metal to the desired shape from the side or edge of sheet or strip to prevent overlapping and bulging of seams, hems and edges.
- 5) **Flattering**: It is the operation in which the sheet is made flqt by heating the metal down where it stands up from the sheet.

Sheet metal joints: Hem sand seams

Sheet metal working incorporates a wide variety of hems and seams. A **hem** is an edge made by folding. It stiffens the sheet metal and does away with the sharp edge.

A seam is a joint made by fastening two edges together.

Gauge: gauge is only a number to know the thickness of sheet and diameter of wire.

GAUGE number	Thickness or diameter
10 G	3.25mm
12G	2.64mm
14 G	2.03mm
16 G	1.63mm
18 G	1.22mm
20 G	.91mm
22 G	.71mm
24 G	.56mm
26 G	.46mm
28 G	.38mm
30 G	.30mm

Tools used in sheet metal work:

- Ball peen hammer
- Snip

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- Straight edge
- Stake
- Rivets
- Steel rule
- Scriber
- Mallet
- Trammel etc.

Some of these are mentioned in fitting section.

Trammel point:

It is used to draw large circles and arcs. The trammel has two removable pointed legs and mounted on a separate holder.



Cutting tools:

Snips are used to shear or cut the metal sheets to the sheets to the required size and shape. Snips are used to cut thin sheet metal. The following snips metals are used in sheet metal work.

Straight snip:

It is used to cut or trim along a straight line. The blades in this snip are straight.

Bend snip:

It is used to trim or cut along inside curves. The blades in this snip are curved back from the cutting edge, which permits the sheet to slide over the top blades while cutting.

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Prick punch:

It is sharply pointed tool. The tapered point of the punch has an angle of 40°. It is used to make small punch marks on layout lines in order to make them last longer.

Center punch:

Looks like a prick punch. Its point has an angle more obtuse than that of prick punch. The angle is around 60°.

Stakes:

The stakes are the supporting tools in sheet metal work to form a shape. And it is used when the sheet metal bending, riveting, punching etc.

Hand stake:

It is used for pressing the inner sides of straight joint in the sheet. It has a flat surface with two straight edges, a concave and a convex edge.

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Half round stake:

It is used to form a round seam joint on the inner side of the job.

Horse stake:

It has tow square holes for holding one or two stakes to carry out different operations on the job.

Taper stake:

It is used to form a conical or tapering job.

Hammers:

Hammers are used for forming shapes by hollowing, stretching or raising. There are many types of hammers in use in sheet metal shop. (Some other hammer mentioned in fitting).



Mallets:

Mallets are soft hammers and are made of raw hide, hard rubber, copper, brass, Lead, or wood. It is mostly used to strike soft metal and give light blow on sheet metal.



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SOLDERING

- A joining process wherein coalescence is produced by heating to a suitable temperature and by using a filler metal having a melting point not exceeding 427⁰C and below the solidification temperature of the base metals"
- The filler metal fills in the gap of the joint by capillary action.
- Soldering uses fusible alloys to join metals know as solder
- Ordinary gas flames or electric soldering iron is used to supply the heat to melt the solder.
- Fluxes are used with solder in soldering process.
- Fluxes are defined as any solid, liquid or gaseous material when heated accelerates the wetting of metal with the solder
- Due to wetting molten solder flow into the joint and fills the space between the two pieces to be soldered
- At elevated temperature flux is highly reducing in nature preventing the formation of metal oxides
- Fluxes that are generally used in soldering are Rosin, Zinc Chloride and Aluminum Chloride

Soldering iron:

Soldering iron is used for soldering work and it consists of a copper bit held by a steel rod and wooden handle. They are many types of soldering iron like copper bit, hatchet adjustable and soldering iron.





ELECTRIC SOLDERING IRON

COPPER BOX SOLDERING IRON

Composition of solder:

Usually tin 60% and lead 40% used for electrical work.

Tin 50% and lead 50% used machine soldering.

Tin 30% and lead –70% used for plumber solder.

Brazing:

Brazing is a joining process, which produces coalescence of materials by heating to a suitable temperature and using a filler metal having a melting temperature above 427°C and below the solidification temperature of the base metals being joined. The filler metal is distributed between the closely fitted surfaces of the joint by capillary attraction. Brazing is distinguished from soldering in that soldering employs a filler metal having a melting point below 427°C.

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EXPERIMENTAL MODELS (6 Models has to be prepared)





PROCEDURE FOR PREPARING PENTAGONAL PRISM

- 1. Draw the orthographic view as shown in above figure
- 2. Layout the five rectangular vertical faces of pentagonal prism
- 3. Set 5mm extra allowance for joining at the ends.
- 4. Trace the development on given G.P.sheet (galvanized plain sheet 28 gauge) and mark all bending lines
- 5. Cut the sheet along the line according to the development shape
- 6. Bend the seam line using bending dies
- 7. Finish all rectangular faces and longer edges using rectangular faced stakes
- 8. Dress by mallet and join the ends
- 9. Solder the end joint using electric soldering

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Model 2: Hexagonal Prism



PROCEDURE FOR PREPARING HEXAGONAL PRISM

- 1. Draw the orthographic view as shown in above figure
- 2. Layout the five rectangular vertical faces of pentagonal prism
- 3. Set 5mm extra allowance for joining at the ends.
- 4. Trace the development on given G.P.sheet (galvanized plain sheet 28 gauge) and mark all bending lines
- 5. Cut the sheet along the line according to the development shape
- 6. Bend the seam line using bending dies
- 7. Finish all rectangular faces and longer edges using rectangular faced stakes
- 8. Dress by mallet and join the ends
- 9. Solder the end joint using electric soldering

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PROCEDURE FOR PREPARING TRUNCATED SQUARE PRISM

- 1. Draw the orthographic view as shown in above figure
- 2. Layout the five rectangular vertical faces of square prism
- 3. Set 5mm and 10mm extra allowance for joining at the ends.
- 4. Trace the development on given G.P.sheet (galvanized plain sheet 28 gauge) and mark all bending lines
- 5. Cut the sheet along the line according to the development shape
- 6. Bend the seam line using bending dies
- 7. Finish all rectangular faces and longer edges using rectangular faced stakes
- 8. Fold extra allowances in clockwise and anticlockwise directions by keeping hacksaw blade thickness and pressed
- 9. Remove hacksaw blade, and bend main body using rectangular stake and lock end joint and lock





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PROCEDURE FOR PREPARING A FRUSTUM OF CONE

1. Draw the front view of of right circular cone OAB of base dia .is 50mm.A section plane cuts perpendicular to the axis of cone at 50mm height

2. With "O" as center radius equal to slant generator length (OA or OB) draw an arc. With same center "O" radius equal to (OC or OD) draw another arc.

3. Find

$$\theta = \frac{360 \, x \, r}{R}$$

Where

r= radius of base circle of cone R= Length of slant generator of cone

 θ = Angle subtended to cut arc.

4. Set an angle at point of vertex it cut arc at the points EFGH .set off 5 and 5+5 mm extra for seam joint

5. Trace the development part on given G.P. sheet. Mark all necessary lines.

6. Cut the sheet along line according to shape of development.

7Fold extra allowances in clockwise and anticlockwise directions by keeping hacksaw blade thickness and pressed

8. Remove hacksaw blade, and bend main body using cone stake and lock end joint and lock

Model No 5: CYLINDER



PROCEDURE FOR PREPARING CYLINDER

- 1. Draw the orthographic view as shown in above figure
- 2. Layout the five rectangular vertical faces of square prism
- 3. Set 5mm and 10mm extra allowance for joining at the ends.
- 4. Trace the development on given G.P.sheet (galvanized plain sheet 28 gauge) and mark all bending lines
- 5. Cut the sheet along the line according to the development shape
- 6. Bend the seam line using bending dies
- 7. Finish all rectangular faces and longer edges using rectangular faced stakes
- 8. Fold extra allowances in clockwise and anticlockwise directions by keeping hacksaw blade thickness and pressed
- 9. Remove hacksaw blade, and bend main body using rectangular stake and lock end joint and lock

Model 6: Funnel



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PROCEDURE FOR PREPARING A FUNNEL

Part -A

Draw the front view of right circular cone OAB of base dia .is 50mm.A section plane cuts perpendicular to the axis of cone at 50mm height
With "O" as center radius equal to slant generator length (OA or OB) draw an arc. With same center "O" radius equal to (OC or OD) draw another arc.

3. Find $\theta = \frac{360 x r}{R}$	$\theta = \frac{360 \ x \ r}{R}$	Where
		r= radius of base circle of cone
	R= Length of slant generator of cone	
	heta = Angle subtended to cut arc.	

4. Set an angle at point of vertex it cut arc at the points EFGH .set off 5 and 5+5 mm extra for seam joint

Part -B

- 1. Draw the full scale cylinder as its stand perpendicular
- 2. The length of cylinder development equal to circumference of cylinder i.e. πD in millimeter +allowance is equal to 5mm
- 3. Trace the development part A and B on given G.P. sheet. Mark all necessary lines.
- 4. Cut the sheet along line according to shape of development.
- 5. Fold extra allowances in clockwise and anticlockwise directions by keeping hacksaw blade thickness and pressed
- 6. Remove hack blade ,and bend main body using cone stake and lock end joint and lock
- 7. Repeat same for part B .solder the two parts with electric soldering

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Model no 7: Tray



PROCEDURE FOR PREPARING TRAY

- 1. Draw the orthographic view as shown in above figure
- 2. Trace the development on given G.P.sheet (galvanized plain sheet 28 gauge) and mark all bending lines
- 3. Cut the sheet along the line according to the development shape
- 4. Bend the seam line using bending dies
- 5. Finish all rectangular faces and longer edges using rectangular faced stakes
- 6. Dress by mallet and join the ends
- 7. Solder the end joint using electric soldering

POWER TOOLS (DEMONSTRATION ONLY)

A **power tool** is a tool that is actuated by an additional power source and mechanism other than the solely manual labor used with hand tools.

The most common types of power tools use electric motors. Internal combustion engines and compressed air are also commonly used. Other power sources include steam engines, direct burning of fuels and propellants or even natural power sources like wind or moving water. Tools directly driven by animal power are not generally considered power tools.

Power tools are used in industry, in construction, and around the house for purposes of driving (fasteners), drilling, cutting, shaping, sanding, grinding, routing, polishing, painting, heating and more.

Power tools are classified as either stationary or portable, where portable means hand-held. Portable power tools have obvious advantages in mobility. Stationary power tools however often have advantages in speed and accuracy and some stationary power tools can produce objects that cannot be made in any other way. Stationary power tools for metalworking are usually called *machine tools*.

The term *machine tool* is not usually applied to stationary power tools for woodworking, although such usage is occasionally heard, and in some cases, such as drill presses and bench grinders, exactly the same tool is used for both woodworking and metalworking

Benefits of Portable Power Tools

With the increasing number of individuals interested in performing home improvement projects by themselves, portable power tools are also becoming more available in local hardware stores. These gadgets, which look like miniature construction machineries for homeowners, are very beneficial for you.

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For one, they can let you save time because they can instantly hammer nails, quickly drive screws, and rapidly cut wood and virtually other materials effortlessly. With traditional tools, you have to do everything manually and more often than not, your project would not get finished in just a few days. Aside from reducing project time significantly, the use of portable power tools also allows you to finish your task with minimal energy. Thus, after doing the job, you still have strength to do more important projects or to spend quality time with your family.

You can also save money when using portable power tools because these gadgets can drive screws and nails flawlessly, drill holes accurately, and cut wood and metals neatly. This means that you reduce the occurrence of wasted materials due to inappropriate drilling or cutting as well as doing your projects all over again because you are not satisfied with how the nails or screws are driven.

Moreover, many portable power tools are designed to allow you to do various tasks conveniently even in limited spaces where using traditional tools can be difficult. Among these tasks include driving nails in tight corners.

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Various Types Power Tools

Impact Driver:

An **impact driver** is a tool that delivers a strong, sudden rotational and downward force. In conjunction with toughened screwdriver bits and socket sets, they are often used by mechanics to loosen larger screws (bolts) and nuts that are corrosively "frozen" or over-torque. The direction can also be reversed for situations where screws have to be tightened with torque greater than a screwdriver can reasonably provide.



Chain Saw:

A **chainsaw** (or **chain saw**) is a portable mechanical saw, powered by electricity, compressed air, hydraulic power, or most commonly a two-stroke engine. It is used in activities such as tree felling, limbing, bucking, pruning, by tree surgeons to fell trees and remove branches and foliage, to fell snags and assist in cutting firebreaks in wild land fire suppression, and to harvest firewood. Chainsaws with specially designed bar and chain combinations have been developed as tools for use in chainsaw art. Specialist chainsaws are used for cutting concrete.

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Angle Grinder:

An **angle grinder**, also known as a **side grinder** or **disc grinder**, is a handheld power tool used for cutting, grinding and polishing.

Angle grinders can be powered by an electric motor, petrol engine or compressed air. The motor drives a geared head at a right-angle on which is mounted an abrasive disc or a thinner cut-off disc, either of which can be replaced when worn. Angle grinders typically have an adjustable guard and a side-handle for two-handed operation. Certain angle grinders, depending on their speed range, can be used as sanders, employing a sanding disc with a backing pad or disc. The backing system is typically made of hard plastic, phenolic resin, or medium-hard rubber depending on the amount of flexibility desired.

Angle grinders may be used both for removing excess material from a piece or simply cutting into a piece. There are many different kinds of discs that are used for various materials and tasks, such as cut-off discs (diamond blade), abrasive grinding discs, grinding stones, sanding discs, wire brush wheels and polishing pads. The angle grinder has large bearings to counter side forces generated during cutting, unlike a power drill, where the force is axial.

Angle grinders are widely used in metalworking and construction, as well as in emergency rescues. They are commonly found in workshops, service garages and auto body repair shops.



Drilling Machine:

A **drill** is a tool fitted with a cutting tool attachment or driving tool attachment, usually a drill bit or driver bit, used for drilling holes in various materials or fastening various materials together with the use of fasteners. The attachment is gripped by a chuck at one end of the drill and rotated while pressed against the target material. The tip, and sometimes edges, of the cutting tool does the work of cutting into the target material. This may be slicing off thin shavings (twist drills or auger bits), grinding off small particles (oil drilling), crushing and removing pieces of the work piece, countersinking, counter boring, or other operations.

Drills are commonly used in woodworking, metalworking, construction and do-ityourself projects. Specially designed drills are also used in medicine, space missions and other applications. Drills are available with a wide variety of performance characteristics, such as power and capacity.



Jigsaw:

A **jigsaw** is a tool used for cutting arbitrary curves, such as stenciled designs or other custom shapes, into a piece of wood, metal, or other material. It can be used in a more artistic fashion than other saws, which typically cut in straight lines only. In this way, it is similar to the rasp and the chisel. Although a jigsaw can be used to cut arbitrary patterns, making a straight cut freehand is difficult even with a guide.

Traditional jigsaws are hand saws, consisting of a handle attached to a small, thin blade. The first jigsaw puzzles were made using this kind of unpowered saw. More modern jigsaws are power tools, made up of an electric motor and a reciprocating saw blade.

A jigsaw with a bevel function on the sole plate allows cutting angles of typically up to 45 degrees relative to the normal vertical stroke for cutting miter joints.



NAIL GUN:

A **nail gun**, **nailgun** or **nailer** is a type of tool used to drive nails into wood or some other kind of material. It is usually driven by electromagnetism, compressed air (pneumatic), highly flammable gases such as butane or propane, or, for powder-actuated tools, a small explosive charge. Nail guns have in many ways replaced hammers as tools of choice among builders.



IMPACT WRENCH:

An **impact wrench** (also known as an **impactor**, **air wrench**, **air gun**, **rattle gun**, **torque gun**, **windy gun**) is a socket wrench power tool designed to deliver high torque output with minimal exertion by the user, by storing energy in a rotating mass, then delivering it suddenly to the output shaft.

Compressed air is the most common power source, although electric or hydraulic power is also used, with cordless electric devices becoming increasingly popular in recent times.

Impact wrenches are widely used in many industries, such as automotive repair, heavy equipment maintenance, product assembly (often called "pulse tools" and designed for precise torque output), major construction projects, and any other instance where a high torque output is needed.



CUT OFF MACHINE:

An **abrasive saw**, also known as a **cut-off saw** or **metal chop saw**, is a power tool which is typically used to cut hard materials, such as metals. The cutting action is performed by an abrasive disc, similar to a thin grinding wheel. The saw generally has a built-in vise or other clamping arrangement, and has the cutting wheel and motor mounted on a pivoting arm attached to a fixed base plate.

They typically use composite friction disk blades to abrasively cut through the steel. The disks are consumable items as they wear throughout the cut. The abrasive disks for these saws are typically 14 in (360 mm) in diameter and $^{7}/_{64}$ in (2.8 mm) thick. Larger saws use 410 mm (16 in) diameter blades. Disks are available for steel and stainless steel.



Power Tool Safety Tips

1. Safety glasses: These prevent dust, debris, wood shavings, shards from fiberglass, etc from getting into the eyes. Safety glasses are one of the most basic pieces of safety equipment that must be used when working with power tools.

2. Protection for the ears: Power tools can generate a lot of noise, which may sound louder in the cloistered environment of a workshop; in order to minimize damage to the ears, it is advisable to wear earplugs.

3. Knowing the right tools for the job: It is important to know the right tools for the job in order to avoid injury to oneself and damage to the materials. To this end, it is advisable to thoroughly read the instruction manuals provided with the equipment and get familiar with the recommended safety precautions.

4. Correct method of using tools: Tools should not be carried by their cords; tools that are not in use should be disconnected; and while handling a tool connected to a power source, fingers should be kept away from the on/off switch.

5. The right clothes: Long hair should be tied and loose clothing should be avoided. Ideally, clothing that covers the entire body should be worn and heavy gloves should be used in order to avoid sharp implements and splinters from hurting the hands. Masks prevent inhalation of harmful minute particles of the material that is being worked upon. Steel-toed work boots and hard hats can also be worn.

6. Tool inspection: Power tools should not be employed in wet environments and should never be dipped in water; they should be checked periodically for exposed wiring, damaged plugs, and loose plug pins. Nicked cords can be taped but if a cut appears to be deep, a cord should be replaced. Tools that are damaged or those that sound and feel different when used should be checked and repaired.

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7. Cleanliness in the work area: This should be maintained because accumulated dust particles in the air can ignite with a spark. Of course, flammable liquids should be kept covered and away from the place where power tools are being used. An uncluttered work area also makes it easy to maneuver the power tool; often distractions caused by a tangled cord can result in an accident.

8. Care with particular tools: Miter saws and table saws should be used with a quick-release clamp and a wood push-through, respectively. Extra care should be taken while using nail guns and power belt sanders.

9. Keep tools in place: Power tools should be returned to their cabinets after use to prevent them from being used by an unauthorized and incapable person.

10. Lighting: It is important to use proper lighting while working with power tools, particularly when working in the basement and garage where lighting may not be satisfactory.

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Viva Voce questions

- 1. What is fitting?
- 2. What do you mean by bench work?
- 3. Name the important tools used in fitter shop?
- 4. Name some important fitting operations?
- 5. Differentiate between instruments and tools with examples?
- 6. What are the different types of vice?
- 7. What the different types of hammers?
- 8. Name different parts of ball peen hammer.
- 9. Name the different types of chisels?
- 10. Name the different types of marking tools and their purpose?
- 11. Name the different measuring instruments used in fitting?
- 12. What is sawing?
- 13. Classify the Hacksaw blade according to its pitch?
- 14. How Hack saw blades are specified?
- 15. What is chipping?
- 16. Which type of vice is used for chipping?
- 17. Distinguish between hot chisel and cold chisel?
- 18. What is filing?
- 19. How are files classified according to the coarseness and spacing between the rows of teeth?
- 20. Name the various types of files and corresponding uses?
- 21. What is straight filing?
- 22. What is cross filing?
- 23. What is tapping?
- 24. What is the difference between a divider and a caliper?
- 25. How are calipers classified?
- 26. What is the work-holding device in fitting?
- 27. Mention the tools are used in fitting?
- 28. What is the use of surface plate?
- 29. Which type of file is used for filing flat surfaces?
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- 30. Which type of tools is used for cutting external threads on bars or tubes?
- 31. Mention the types of fitting commonly used?
- 32. Name the principal parts of a micrometer?
- 33. What is the use of rule depth gauge?
- 34. What is the use of bevel protractor?
- 35. What is meant by drilling?
- 36. Name the material used in the manufacture of the surface plate?
- 37. What is use of surface plate?
- 38. What is angle plate?
- 39. What is the use of center punch?
- 40. What is welding?
- 41. How are welding process classified?
- 42. What is arc welding?
- 43. What is an electrode?
- 44. What is arc length?
- 45. What is plasma and fusion welding?
- 46. What are the defects in welding?
- 47. What are the functions of coated electrodes?
- 48. What are different types of electrodes?
- 49. What is flux-coated electrode?
- 50. What are the different types of welding joints?
- 51. How are welded joints tested?
- 52. What is the use of chipping hammer?
- 53. What is flux?
- 54. What are the compositions of electrode?
- 55. What is the temperature of arc welding?
- 56. What is the thickness of sheets used in sheet metal applications?
- 57. What is trammel point?
- 58. What do you mean by snip?
- 59. Name the some metals in sheet metal work?
- 60. What are different sheet metal operations?
- 61. Define development in sheet metal working.
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- 62. Explain various methods of Development.
- 63. Define Gauge.
- 64. What do mean by hems and seams?
- 65. What do you mean by stake?
- 66. Name the different types of stakes?
- 67. What do you mean by single and double cut of file?
- 68. What do you mean by ball peen hammer? What for it is used?
- 69. How do you specify (classify) the files?
- 70. Name commonly used for materials for preparing filling models.
- 71. What is the carbon percentage of mild steel?
- 72. Classify engineering materials.
- 73. Classify metals.
- 74. Classify plain carbon steels.
- 75. What percentage of carbon in mild steel?
- 76. What percentage of carbon in high carbon steel?
- 77. What are the advantages of AC welding?
- 78. What are the advantages of gas welding?
- 79. Define power tools.
- 80. What are the various powers tools? Explain.
- 81. What are the applications of power tools?
- 82. What are the precautions that have to be considered while using power tools?
- 83. What are the advantages of power tools?