LAB MANUAL

WORKSHOPPRACTICE III-IV

DEPARTMENT OF TECHNICAL EDUCATION
KERALA

GOVERNMENT POLYTECHNIC COLLEGE
PERUMBAVOOR
Koovappady P.O, Perumbavoor, Ernakulam – 683544

SEMESTER III-IV

REVISION 2015

DEPARMENT OF MECHANICAL ENGINEERING

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DEPARTMENT OF MECHANICALENGINEERING

Vision of the Institute

Excel as a centre of skill education moulding professionals who sincerely strive for the betterment of society.

Mission of the Institute

1. To impart state of the art knowledge and skill to the graduate and moulding them to be competent, committed and responsible for the wellbeing of society.
2. To apply technology in the traditional skills, thereby enhancing the living standard of the community.

DEPARTMENT OF MECHANICAL ENGINEERING

PROGRAMME EDUCATIONAL OBJECTIVES [PEOs]

PEO-1: To develop diploma holders with sound technical competency.

PEO-2: To impart quality consciousness, self-learning attitude along with safety and environmental awareness.

PEO-3: To foster a passion for mechanical engineering to pursue higher studies and lifelong learning in their professional careers.

PEO-4: To inculcate diploma holders with good management practices, interpersonal skill and entrepreneurial discipline with strong adherence to ethics and values.

PROGRAMME OUTCOMES [PO's]

1. **Basic knowledge:** An ability to apply knowledge of basic mathematics, science and engineering to solve the engineering problems.
2. **Discipline knowledge:** An ability to apply knowledge in mechanical engineering to solve core and/or applied engineering problems.
3. **Experiments and practice:** An ability to plan and perform experiments and practices and to use the results to solve engineering problems.
4. **Engineering Tools:** Apply appropriate technologies and tools with an understanding of the limitations.
5. **The engineer and society:** Demonstrate knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to engineering practice.
6. **Environment and sustainability:** Understand the impact of the engineering solutions in societal and environmental contexts, and demonstrate the knowledge and need for sustainable development.
7. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice**.**
8. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse/multidisciplinary teams.
9. **Communication:** An ability to communicate effectively.
10. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the context of technological changes.

SYLLABUS

COURSE TITLE	**:**	**WORKSHOP PRACTICE III**
COURSE CODE	**:**	**3027**
COURSE CATEGORY	**:**	**B**
PERIODS / WEEK	**:**	**6**
PERIODS/ SEMESTER	**:**	**90**
CREDIT	**:**	**3**

TIME SCHEDULE

MODULE	TOPICS	PERIOD
1	Machine Shop	**24**
2	Fitting.	**24**
3	Sheet Metal, Aluminum Fabrication	**22**
4	Welding	**20**
	Total	**90**

Course out comes:

STUDENT WILL BE ABLE TO**:**

Sl.No.	Sub	Students will be able to
1	1	Work on lathes.
	2	Work on shaper machine.
	3	Work on drilling machine
2	4	Understand the fitting practice and use of gauges.
	5	Work in sheet metal shop and aluminum fabrication.
	6	Work on welding machine.

Course Distribution

Module	Name of Module	Course outcome No.	Total periods per Semester		
			Instructional	Test	Total
1	Machine Shop	1 2 3	Theory practical: 21	3	24
2	Fitting.	4	Theory practical: 21	3	24
3	Sheet Metal, Aluminum Fabrication	5	Theory practical: 21	3	22
4	Welding	6	Theory practical: 21	3	20
		Total periods per semester			90

CONTENT DETAILS

MODULE I MACHINE SHOP

Understand the safety precautions

1.1.0 Lathe work

1.1.1 Familiarization with lathes- principal parts, work holding device, measuring instruments, accessories & attachments.

1.1.2 Plain turning to the given accuracy - Practice with Precision measuring devices – use of digital Vernier and Micrometer.

1.1.3 Taper turning.

1.1.4 Form turning (ball and curve).

1.1.5 Combination of above operations (taper, ball and curve).

1.2.0 Work on shaper

1.2.1 Familiarize with the parts, accessories and attachments.

1.2.2 Simple operations on Shaper (Planing).

1.2.3 Shaping of a rectangular block.

1.2.4 Shaping a 'V' in a rectangular block.

1.3.0 Work on drilling machine

1.3.1 Familiarization of drilling machine parts.

1.3.2 Marking and drilling holes

1.3.3 Boring and counter boring

1.3.4 Reaming

1.3.5 Combination works

MODULE II FITTING PRACTICE

2.1 Study of measuring gauges-dial gauges, feeler gauges, thread gauges

2.2 Working from a given blue print exercises involving marking, filing, drilling, reaming and tapping to an accuracy of 0.02mm (T- joint, V-joint, Single dove tail joint).

MODULE III SHEET METAL & ALUMINIUM FABRICATION

3.1 Understand safety precautions.

3.2 Familiarization of sheet metal tools – scribers, dividers, trammel points, set square, punches – prick punches, centre punches – hand Grover, rivet, chisels, hammers, riveting hammers, ball peen hammers – mallet, snips, shears, pliers, hand seamers (tongs) files and stakes. Measuring instruments in sheet metal - folding rule, common rule, steel circumference rule, vernier calipers, micrometer, combination set, Thickness gauges – Plate gauge.

MODULE IV WELDING

4.1 Safety precautions

4.2 Study of various tools and equipment's used in the welding shop for both arc welding and gas welding(review)

4.3.0 Practice work

4.3.1. D.C. arc welding (review of practice)

4.3.2. A.C. arc welding (review of practice)

4.3.3. Gas welding (review of practice)

4.3.4. Horizontal, flat, vertical and overhead welding

4.3.5. Edge preparation of welded joint such as V, double V.

4.3.6. Pipe welding – linear and round

4.3.7. Flame cutting

GENERAL INFORMATION:

*Class is divided into 2 batches (Batch I and Batch II). For Batch I – Machine Shop and Fitting shop and for Batch II- Sheet metal, Aluminum fabrication and welding. This syllabus should be continued for Semester IV also by interchanging the batch of students.

SEMESTER IV

SYLLABUS

COURSE TITLE : WORK SHOP PRACTICE – IV & MINI PROJECT

COURSE CODE : 4029

COURSE CATEGORY : A

PERIODS / WEEK : 6

PERIODS / SEMESTER : 90

CREDIT : 5

GENERAL INFORMATION:

- Same as for Semester-III
- Batches I and II are to be interchanged to compensate.
- Student should work 35 periods (5days) for completing mini project
- One of the exercise done in the workshop should be related to the industrial product.
- Fabrication of Nut & Bolt, Bucket, Office tray and maintenance of available machinery in the workshop/ lab will be treated as mini project
- Group work for students can be assigned to undertake repair and maintenance works
- At the end of the semester each student shall prepare a report on mini project for evaluation certified by the Head of department.

General safety

1. Always wear safety glasses or face shields designed for the type of the work
2. Wear safety shoes with thick soles.
3. Wear clothing suited for the job.
4. Don't wear rings, watches, bracelets or other jewellery that could get caught in moving machinery.
5. Don`t wear neck ties or loose turn clothing of any kind.
6. Wear shirts or uppers with sleeves cut off or rolled above the elbows.
7. Be sure you have sufficient light to see in work area.
8. Get first aid immediately for any injury.
9. Don't talk to others when they are operating a machine.
10. Keeping floor free from oil, grease or any other liquid.
11. Store materials in such a way that they cannot become tripping hazards.
12. Don't leave tools or work on the work table.
13. Keep tools always in Cupboards when not in use.
14. Place the scrap materials in the box provided.
15. Be sure that all machines have effective and properly working guards.
16. Don't operate any machine unless authorized to do so by the instructor.
17. Don't attempt to oil, clean, adjust or repair any machine while it is running.
18. Keep the floor clean of metal chips or curls and waste pieces, put them in boxes provided for such things.
19. Don`t operate machinery before getting instruction.
20. Ensure that all safety equipment remains accessible to the workshop personnel at all times.

MACHINE SHOP

MACHINE SHOP

SAFETY PRECAUTIONS

1) Be sure that all machines have effective and properly working guards that are always in place where machines are operating.
2) Do not attempt to oil, clean, adjust or repair any machine while it is running.
3) Do not operate any machine unless authorized.
4) Do not try to stop the machine with your hand or body while running.
5) Always check whether the work and cutting tools properly clamped on the machine before starting.
6) Keep the floor clean of metal chips or curls and waste pieces.
7) When working with another, only one should operate machine or switches.
8) Concentrate on the work, avoid unnecessary talks while operating machine.
9) Get first aid immediately for any injury.
10) Always wear safety shoes.
11) Wear clothing suited for the job, wear shoes with thick soles.
12) Do not wear rings, watches, bracelets or other jewellery that could get caught in moving machinery.
13) Do not wear neckties or loose turn clothing of any kind.
14) Wear shirts or uppers with sleeves cut off or rolled above the elbows.
15) Always remove gloves before turning on or operating a machine.
16) Keep the floor always clean.
17) Passage should be clear, at all time to avoid accident.
18) Do not leave tools or work on the table of a machine even if the machine in not turning. Tools or work may fall off and cause the fact of injury.
19) Switch off the machine immediately when supply fails.

MEASURING INSTRUMENTS

INTRODUCTION

Measuring instruments have an important role in a mechanical workshop. The quality of work is based on the accuracy and precision of the instruments used for inspection. Tools used to measure length, breadth, thickness, diameter, angle, surface finish, etc. of any work piece are known as measuring instruments. Generally, they are divided into two, they are

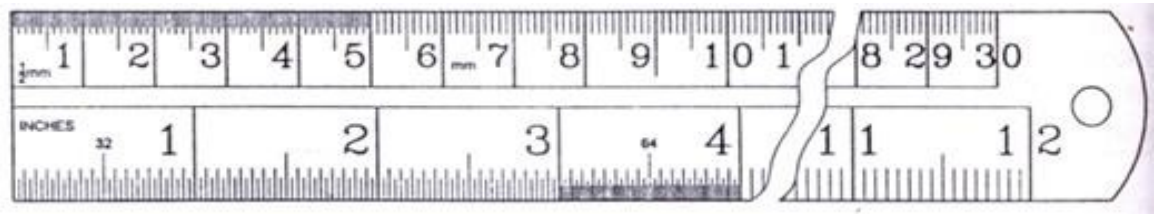
- Direct reading (eg: vernier caliper, steel rule, etc.),
- Indirect reading (eg: outside & inside calipers) and it is transferred to another instrument for reading

LINEAR MEASURING INSTRUMENTS

Linear measuring instruments are used to measure length, diameter, height and depth etc.

Steel rule

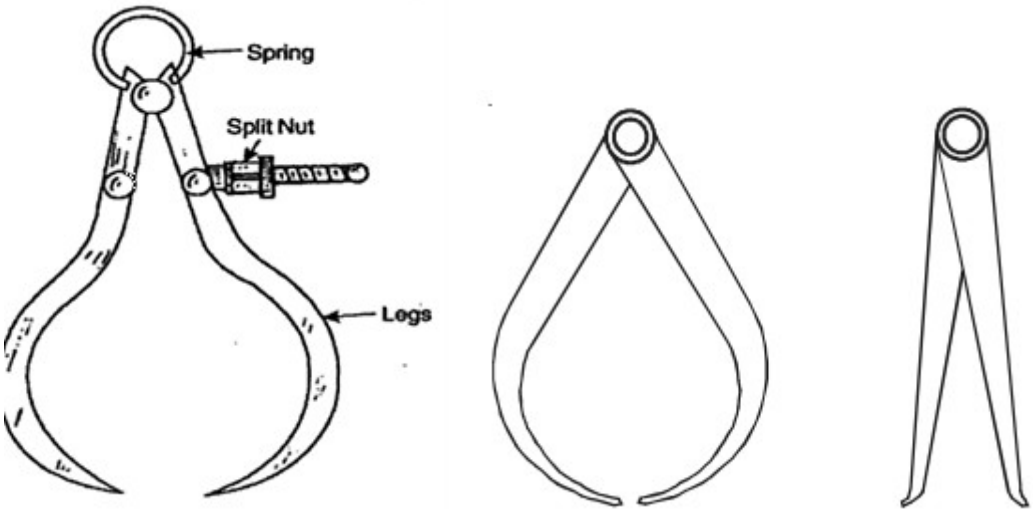
Steel rule is a direct reading and measuring instrument to read an accuracy of 0.5 mm. It is used for measuring distances between two points etc. These are available in different sizes such as in 15cm, 30cm, 60cm, 1m, 1.5m, 2m, 3m, 4m, 5m & 6m. They are made of high carbon steel, stainless steel and various alloy steels.



Calipers: It is an instrument used for measuring internal or external dimensions, consisting of two steel legs hinged together. They are:

Outside calipers: Outside calipers are used to measure diameter of shafts, length and thickness of objects.

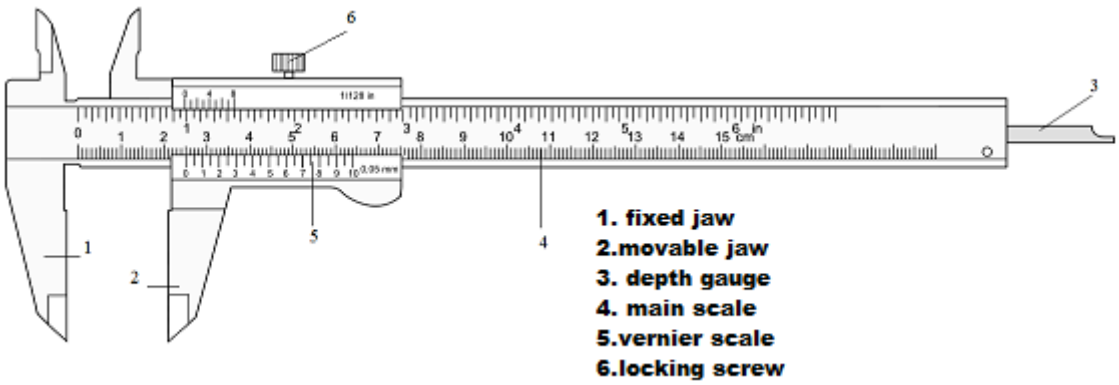
Inside calipers: Inside calipers are used to measure holes, width of slots of an object etc.



Jenny calipers: Jenny calipers have one straight pointed leg and the other leg turned inward. Jenny calipers are used (a) to mark and check centers of round objects. (b) to draw parallel lines with respect to a straight edge.

VERNIER CALIPER

The Vernier caliper is a precision instrument used for measuring internal and external distances between two points extremely accurately. It can also be used to measure depth. Accuracy of metric scale vernier caliper is 0.02mm. The main parts of a vernier caliper are: Outside jaws, Inside jaws, depth gauge, main scale, vernier scale



A Vernier Caliper has one main scale and a vernier scale. The vernier scale slide over the main scale. The accuracy of vernier caliper is the difference of one division of main scale and one division of vernier scale. A vernier caliper having main scale length of 49 mm is divided into 50divisions in Vernier scale.

One main scale division = 1 mm.

One vernier scale division = 49/50 mm. = 0.98

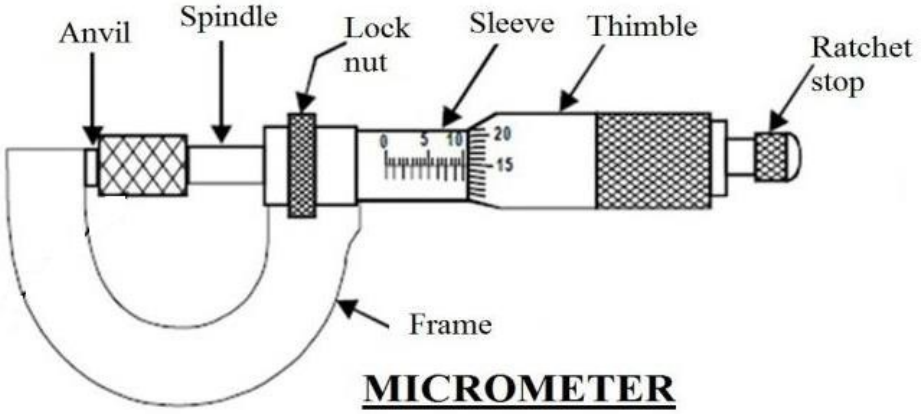
mm. Least count = 1- 0.98 mm = 0.02 mm.

To read the vernier caliper, two things are observed,

- The position of the vernier zero mark
- The vernier division, which coincides with a division of the main scale

MICROMETER

It is a precision measuring instrument used to read an accuracy of 0. 01m.m



MICROMETER

Micrometers are in three types

(a) Outside micrometer (b) Inside micrometer(c) Depth micrometer

Outside micrometer

It is used to measure external measurements with in an accuracy of 0.01 mm. The work is placed between anvil and spindle face. The working principle of micrometer is a nut and bolt. The spindles have a thread of 0.5 mm pitch

which is assembled with the thimble. One revolution of thimble makes movements of 0.5 mm of spindle. The thimble is divided into 50 equal divisions. One divisions of thimble 0.5/50 = 0.01 mm. This is the least count of micrometer.

The outside micrometers are available 0-25mm, 25-50 mm, 50-75mm, 75-100 mm etc. The main parts of a micrometer are: Frame, Anvil, Thimble, Locking screw, spindle, Ratchet stop, Main scale.

ANGULAR MEASURING INSTRUMENTS

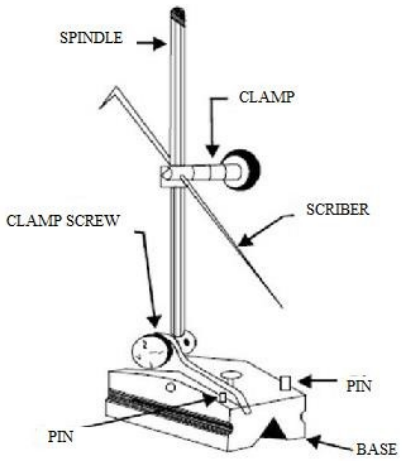
Try Square, Bevel square, Vernier bevel protractor (Universal Bevel Protractor), Spirit Level, Combination set etc.

SURFACE MEASURING INSTRUMENTS

It is used to measure or check surface. eg: dial test indicator, surface gauge.

Surface gauge:

The scribing block or surface gauge is an instrument used on a surface plate for scribing lines in a layout work. It can be usefully employed in setting up work or tools on the lathe.



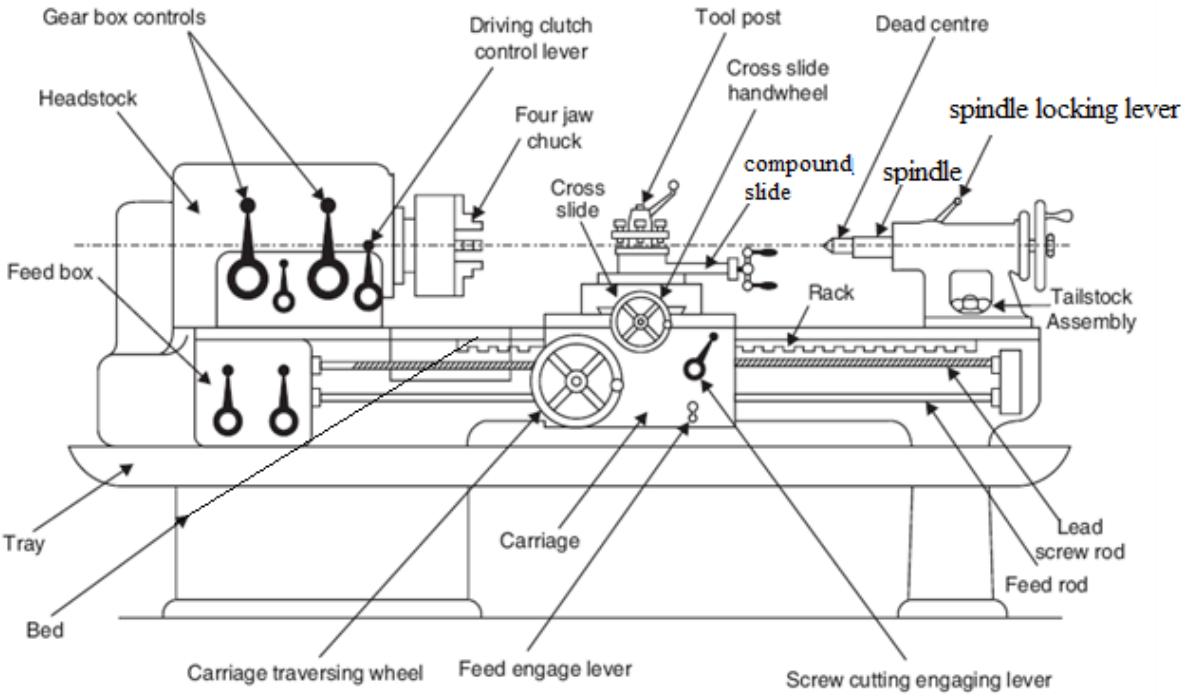
UNIVERSAL SURFACE GAUGE

LATHE

Introduction

Lathe is considered as one of the oldest machine tools and is widely used in industries. It is called as mother of machine tools. The first screw cutting lathe was developed by an Englishman named Henry Maudslay in the year 1797. Modern high speed, heavy duty lathes are developed based on this machine.

The process of machining a work piece to the required shape and size by moving the cutting tool either parallel or perpendicular to the axis of rotation of the work piece is known as turning. In this process, excess unwanted metal is removed.



Engine lathe

Types of lathe

Speed lathe: Spindle of a speed lathe operates at very high speeds. It consists of a headstock, a tailstock, a bed and a tool slide only. Parts like lead screw, feed rod and apron are not found in this type of lathe.

Engine lathe or centre lathe: Engine lathes are named so because the early lathes were driven by steam engines. As the turning operations are performed by holding the work piece between two centers, it is also known as centre lathe. It consists of parts like headstock, tailstock and carriage, leads crew and feed rod.

Bench lathe: Bench lathe is a small lathe generally mounted on a bench. It consists of all the parts of an engine lathe. It is used for small works like machining tiny and precise parts.

Tool room lathe: A tool room lathe has similar features of an engine lathe but is accurately built and has wide range of spindle speeds to perform precise operations and different feeds. It is costlier than a centre lathe. This is mainly used for precision works like manufacturing tools, dies, jigs, fixtures and gauges.

Semi-automatic lathe: Turret and Capstan lathes are known as semi-automatic lathes. These lathes are used for production work where large quantities of identical work pieces are manufactured. They are called semi-automatic lathes as some of the tasks are performed by the operators and the rest by the machines themselves.

Automatic lathe: Automatic lathes are operated with complete automatic control. They are high speed, mass production lathes. An operator can look after more than one automatic lathe at a time.

Special purpose lathe: Special purpose lathes are used for special purpose jobs, which cannot be accommodated and conveniently

machined on a standard lathe. Wheel lathe, 'T' lathe, duplicating lathe are some examples of special purpose lathe.

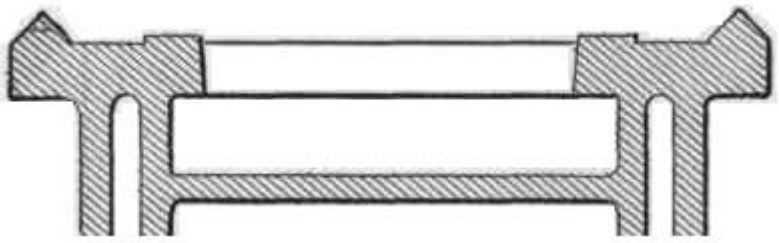
CNC Lathe: Computer Numerical Control (CNC) is one in which the functions and motions of a machine tool are controlled by means of a prepared program containing coded alphanumeric data. CNC can control the motions of the work piece or tool, the input parameters such as feed, depth of cut, speed, and the functions such as turning spindle on/off, turning coolant on, etc.

Main parts of a lathe

Every individual part performs an important task in a lathe. Some important parts of a lathe are listed below:

1. Bed
2. Headstock
3. Spindle
4. Tailstock
5. Carriage
6. Leadscrew
7. Feed rod

Bed: The bed is the foundation of the lathe. It is made of gray cast iron



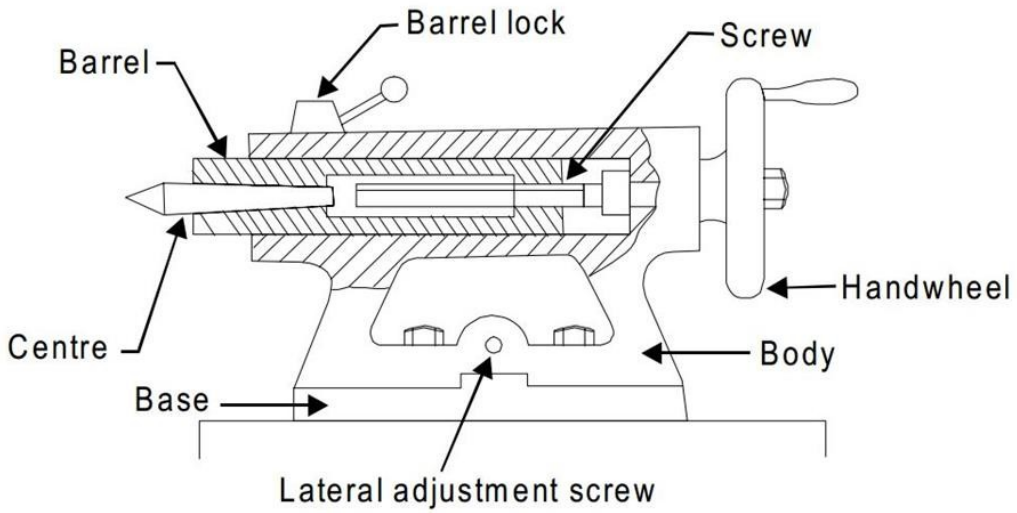
LATHE BED

Headstock

Headstock is mounted permanently at the left hand side of the bed. The headstock houses a hollow spindle and the mechanism for driving the spindle at multiple speeds. It contains cone pulleys, 'V' pulleys, or gears to provide the necessary range of spindle speeds.

Tailstock

Tailstock is located at the right side of the bed opposite to the headstock. It may be clamped in any position along the lathe bed. Tailstock spindle has a Morse taper to receive the dead centre or shanks of tools like drill or reamer.



The main uses of tailstock are:

1. It supports the other end of the long work piece when it is machined between centres.

2. It is useful in holding tools like drills, reamers and taps when performing drilling, reaming and tapping.

Carriage: Carriage is located between the headstock and tailstock on the lathe bed. It can be moved along the bed either towards or away from the headstock. It has several parts to support, move and control the cutting tool. The parts of the carriage are:

a) saddle b) apron c) cross-slide d) compound rest

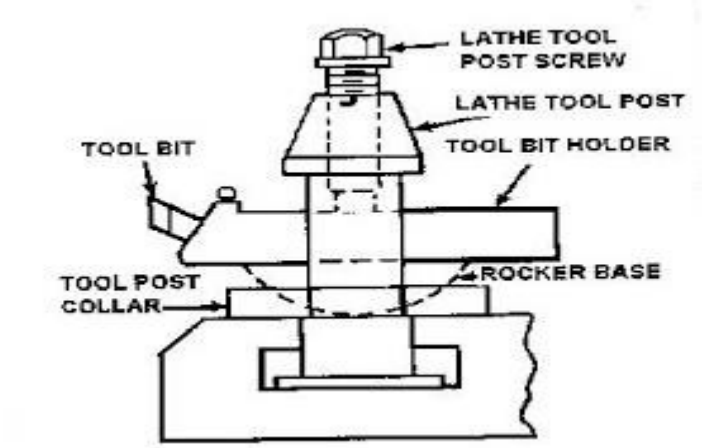
e) compound slide f) tool post

Cross slide: Cross slide moves perpendicular to the axis of the lathe. It carries compound rest, compound slide and tool post.

Compound rest: Compound rest supports the tool post. It has a circular base on which angular graduations are marked. The compound rest can be swivelled to the required angle while turning short tapers. The length of taper is limited to the travel of the compound slide

Tool post: This is located on top of the compound slide. It is used to hold the tools rigidly. Tools are selected according to the type of operation. There are different types of tool posts:

1. Single way tool post 2. Four-way tool post 3. Quick change tool post



Single Way Tool Post

Lead screw

It is made from good quality alloy steel and provided with acme thread for the easy engagement of half nut. It passes through the carriage and fitted in front of the bed by a bracket. It is used for thread cutting and in some machines, it is used for automatic feed also.

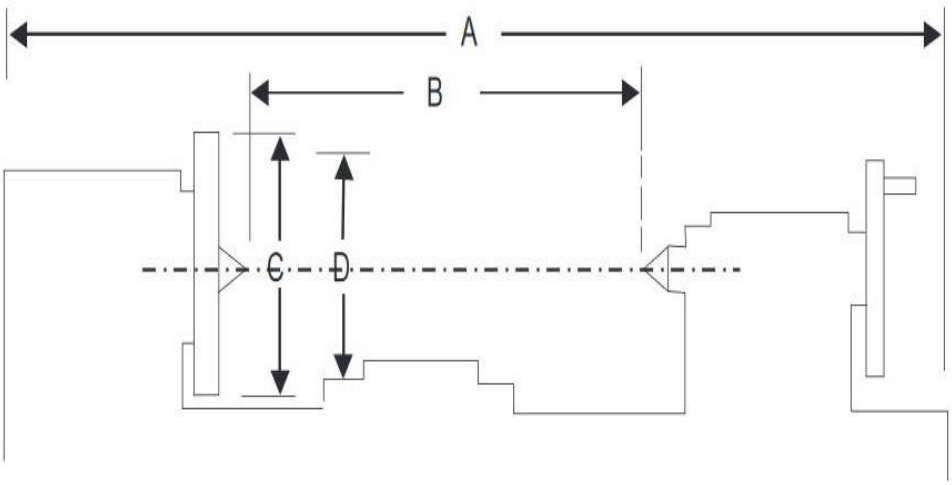
Feed rod

Feed rod is placed parallel to the leadscrew on the front side of the bed. It is a long shaft which has a keyway along its length. The power is transmitted from the spindle to the feed rod through tumbler gears and a gear train. It is useful in providing feed movement to the carriage.

SPECIFICATION OF A LATHE

The following points specify the size of a lathe

1. Length of bed
2. Maximum distance between (live and dead) centres.
3. Height of centre from the bed
4. Swing diameter over bed - It refers to the largest diameter of the work that will be rotated without touching over the bed.
5. Swing diameter over carriage - It is the largest diameter of the work that will revolve without touching over the saddle.
6. Bore diameter of the spindle.
7. Type of bed



A - Length of bed.
B - Distance between centres.
C - Diameter of the work that can be turned over the ways.
D - Diameter of the work that can be turned over the cross slide.

Work holding devices used in a lathe (accessories)

The work holding devices are used to hold and rotate the work pieces along with the spindle. Different work holding devices are used according to the shape, length, diameter of the work to be machined. They are:

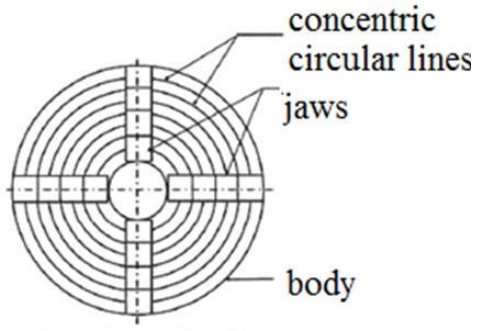
1. Chucks 2. Face plate 3. Driving plate 4. Catch plate

5. Carriers 6. Mandrels 7. Centres 8. Rests

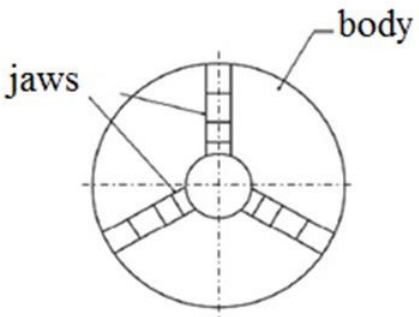
Chucks: They are used for holding work pieces, they are classified into,

1. Three Jaw Chuck (Self centering) –: The three-jaw chuck is a self-centering chuck. Self-centering means that all three jaws move in or out depending on the direction of rotation of the key. The 3jaw self-cantering chuck will automatically centre round and hexagonal job.

2. Four Jaw (Independent) Chuck: This chuck is used for holding work of irregular shape. It can also be used for holding squares or rounds. All jaws are controlled independently of each other. The jaws are reversible. This allows the holding of larger work.

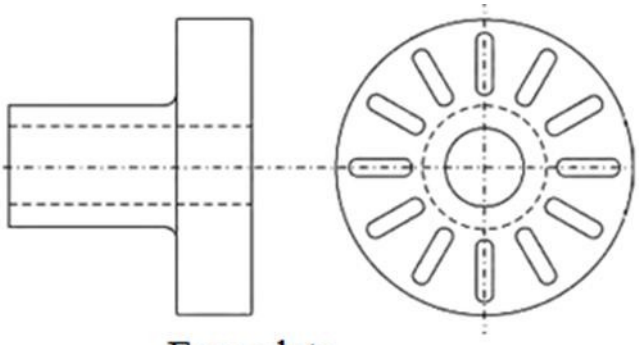


four jaw chuck



Three jaw chuck

Face Plate: Faceplate is used for mounting work of irregular shapes.

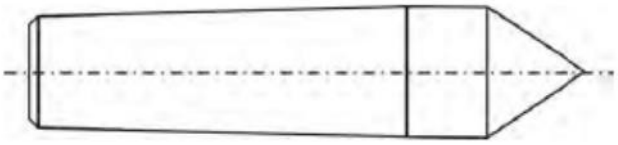


Face plate

Lathe Centers

Centres are useful in supporting the work in a lathe. The shank of a centre has Morse taper on it and the face is conical in shape. There are two types of centres, namely

1. Live centre
2. Dead centre



Centre

The live centre is fitted on the headstock spindle and rotates along with the work. The centre fitted on the tailstock spindle is called dead centre. Centres are made of high carbon steel and hardened and then tempered. Different types of centres are available according to the shape of the work and the operation to be performed

LATHE OPERATIONS

Various operations are performed in a lathe machine other than plain turning. These are:- Facing, Turning, Chamfering, Grooving, Forming, Knurling, Undercutting, Eccentric turning, Taper turning, Thread cutting, Drilling, Reaming and Boring.

Facing: Facing is the operation of machining the ends of a piece of work to produce flat surface square with the axis. The operation involves feeding the tool perpendicular to the axis of rotation of the work.

Turning: Turning in a lathe is to remove excess material from the work piece to produce a cylindrical surface of required shape and size.

Straight turning: The work is turned straight when it is made to rotate about the lathe axis and the tool is fed parallel to the lathe axis. The straight turning produces a cylindrical surface by removing excess metal from the work pieces.

Step turning: Step turning is the process of turning different surfaces having different diameters. The work is held between centres and the tool is moved parallel to the axis of the lathe. It is also called shoulder turning.

Boring: The process of removal of stock from a hole in the work piece is called boring. Holes are bored by single point cutting tools.

Drilling: This is the process of making holes in the work piece with the help of drills. The drill is held in the tailstock and the drilling operation is carried out by advancing the drill in the work piece by rotating the handle of the tail stock

Forming: Forming is a process of turning a convex, concave or any irregular shape. For turning a small length formed surface, a forming tool having cutting edges conforming to the shape required is fed straight into the work.

Knurling: Knurling is the process of embossing a diamond shaped pattern on the surface of the work piece. The knurling tool holder has one or two hardened steel rollers with edges of required pattern. The tool holder is pressed against the rotating work. The rollers emboss the required pattern.

Undercutting: It is a process of enlarging the diameter if done internally and reducing the diameter if done externally over a short length. It is useful mainly to make fits perfect. Boring tools and parting tools are used for this operation.

Taper turning

Taper: A taper may be defined as a uniform increase or decrease in diameter of a piece of work measured along its length.

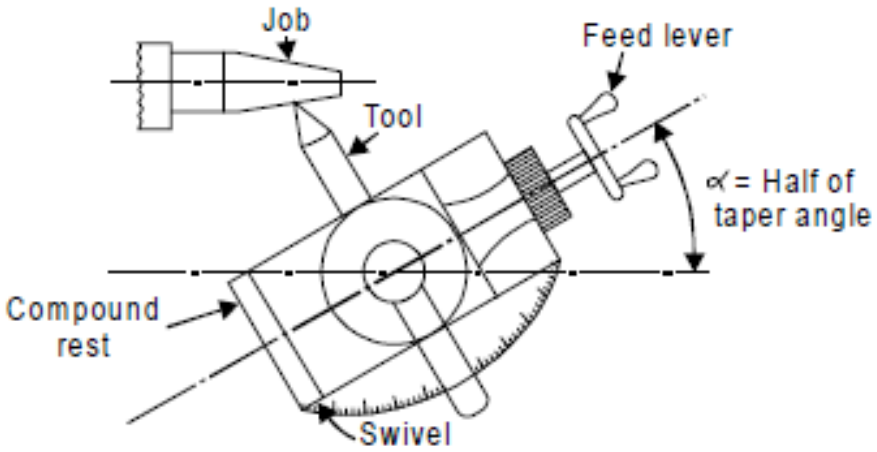
Taper turning methods

- Form tool method
- Compound rest method
- Tailstock set over method
- Taper turning attachment method

Compound rest method: Short tapers may be cut on the lathe by swiveling the compound rest to the required angle. The compound rest of the lathe is designed by a circular base graduated in degrees, which may be swivelled and clamped at any desired angle. The angle of taper is calculated using the formula:

$\tan\theta = \frac{D-d}{2l}$ where D = Larger diameter d = Smaller diameter l = Length of the taper ɵ = Half taper angle	Thumb rule D-d 2l

The compound rest is swivelled to the angle calculated as above and clamped. Feed is given to the compound slide to generate the required taper.



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

Thread cutting

Threads may be cut on the external or internal cylindrical surfaces. A specially shaped cutting tool known as thread cutting tool is used for this purpose. The job is revolved between centres or by a chuck. The longitudinal feed should be equal to the pitch of the thread to be cut per revolution of the work piece.

CUTTING TOOL MATERIAL

Cutting tools perform the function of cutting. The cutting tool materials must be stronger and harder than the material to be cut.

The following points are considered for selecting a tool material

- Material to be machined
- Condition of machine tool
- Total quantity of production
- The dimensional accuracy required
- Surface finish

The main cutting tool materials used for metal cutting purpose are:-

- Carbon steel
- High speed steel(HSS)
- Cemented carbide
- Ceramics
- Stellite

Types of cutting tools

Cutting tools are classified as

- Single point cutting tool
- Multipoint cutting tool
- Form tools

Single point cutting tool:- It has one cutting edge which performs the cutting action. Most of the lathe cutting tools are single point cutting tools.

Examples- Lathe tools, boring tools, planning tools,

Multipoint cutting tools:- They have more than one cutting edge. They remove metals from the work simultaneously by the action of all the cutting edges. It gives better surface finish.

Examples- Milling cutter, drills, reamers, grinding wheels etc.

Form tools:- These tools reproduce on the work the form and shape of the cutting edge to which they are ground.

Cutting tool nomenclature

Cutting tool nomenclature means systematic naming of the various parts and angles of a cutting tool. They are shank, face, flank, heel, nose, base, back rake, side rake, side clearance, end cutting edge, side cutting edge, and lip angle etc.

Shank: - it is the portion of the tool which is not ground to form cutting edges and is rectangular in cross section.

Face: -it is the surface against which the chip slides upwards.

Flank: - it is the surface which face the work piece.

Heel: -it is the lowest portion of the side cutting edges.

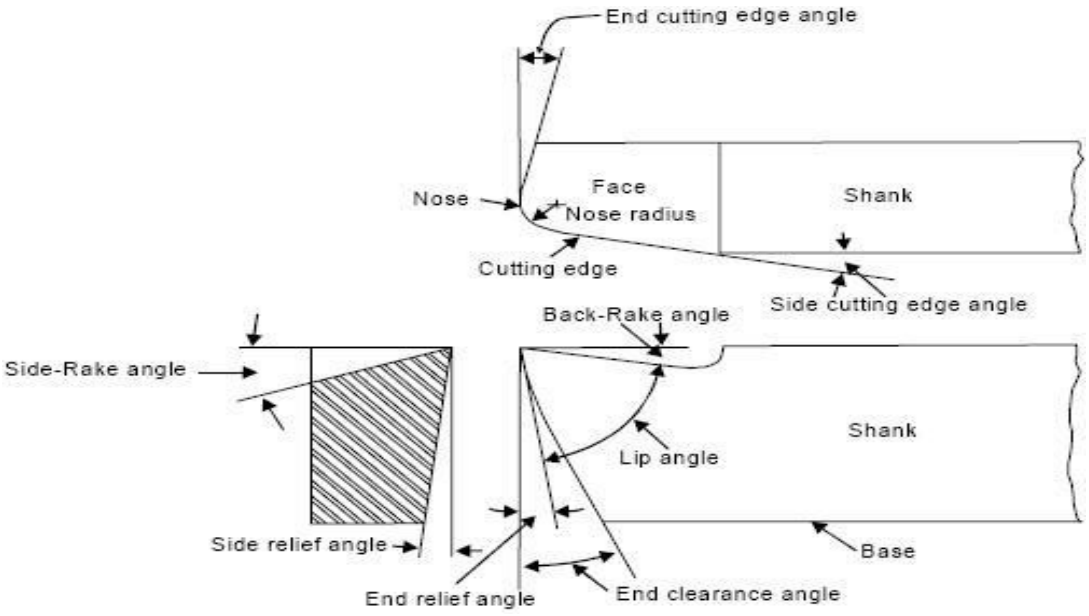
Nose: -it is the conjunction of the side and end cutting edges. A nose radius increases the tool life and improves the surface finish.

Base: -it is the underside of the shank.

Back Rake angle: - the top or back rake angle of the tool is ground on the top of the tool, and it is a slop formed between the front of the cutting edge and the top face.

Side rake angle: -it is the slop between the side of the cutting edge to the top face of the tool width wise. It varies from 0 to 20^0 according to the material to be machined. The top and side rake ground on a tool controls the chip flow.

End clearance angle (End relief angle): -it is the angle between the plane perpendicular to the base and end flank, immediately adjacent to the base.



Side clearance angle (Side relief angle): -it indicates that the nose or end of a tool has been ground back at an angle slopping down from the end cutting edge.

End cutting edge angle: -it is ground at 30^0 to a line perpendicular to the axis of the tool.

Side cutting edge angle: -this is ground on the side of the cutting tool. The angle ground may range from 25 to 40^0 (standard angle $30^0$is usually provided).

Lip angle: -it is the included angle when the tool has been ground wedge shaped.

Tool-life

Tool-life is the time elapsed between two successive grinding of a cutting tool. Tool-life depends on the following factors.

- Cutting speed
- Feed
- Depth of cut
- Cutting tool material
- Cutting fluid

SHAPER

INTRODUCTION

Shaping is a process of machining a flat surface which may be horizontal, vertical, inclined, concave or convex using a reciprocating single point tool. A shaping machine is a reciprocating type of machine tool.

Common types of shaper

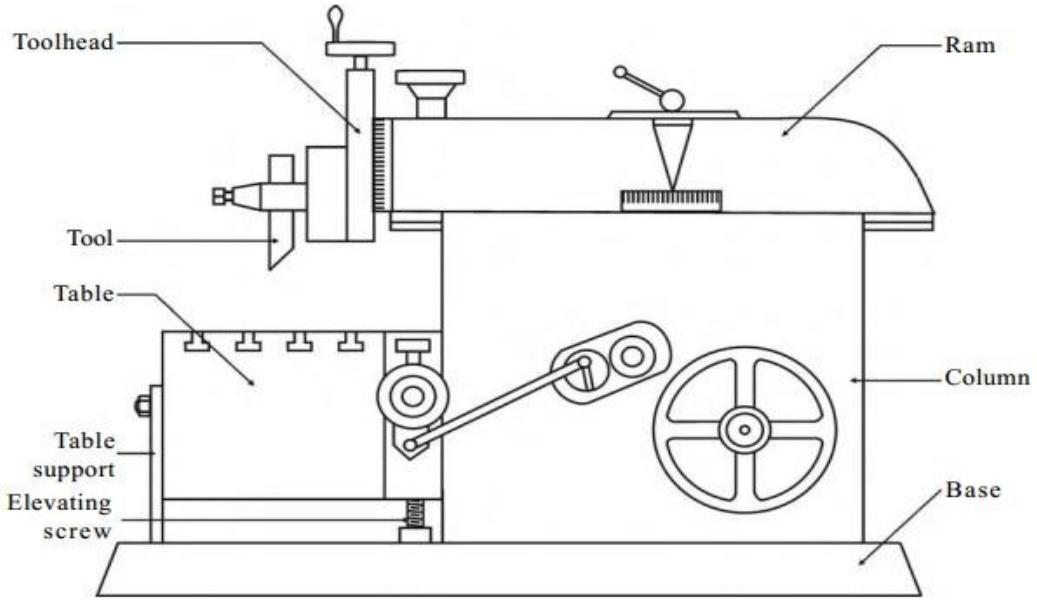
Shapers are classified in many ways, i.e. According to the length of the stroke, type of driving mechanism, direction of travel of the ram, the type of work they do, the types and design of table etc. The different types of shapers are,

1. Crank shaper
2. Hydraulic shaper
3. Universal shaper
4. Standard shaper
5. Draw-cut shaper
6. Horizontal shaper
7. Vertical shaper
8. Geared Shaper
9. Contour shaper
10. Travelling head shaper

Shaper operations

A shaper is a machine tool primarily designed to generate a flat surface by a single point cutting tool. Besides this, it may also be used to perform many other operations. The different operations, which a shaper can perform, are as follows:

1. Machining horizontal surface
2. Machining vertical surface
3. Machining inclined surface
4. Slot cutting
5. Key ways cutting
6. Machining irregular surface



Shaper specifications

The size of a shaper is determined by the maximum length of cut or stroke it can make. The complete specification of a typical shaper is given below.

1. Length of stroke
2. Maximum horizontal travel of table
3. Maximum vertical travel of table
4. Maximum distance from table to ram
5. Maximum vertical travel of tool slide
6. Length and width of tabletop
7. Length and depth of tableside

Work holding devices

Work pieces can be held and supported on the shaper table directly or by having some special devices. Depending on the size and shape of the work, it may be supported on the table by any one of the following methods.

1. Shaper vise
2. Clamps and stop Pins plate

3. T- bolts & step bolts
4. Angle plate
5. V block

Tools used in a shaping machine

The materials of the cutting tool used in a shaping machine are as follows:

1. High Carbon Steel
2. High Speed Steel
3. Carbide tipped tool
4. Stellite tool

Quick return mechanisms

The ram moves at a comparatively slower speed during the forward cutting stroke. During the return stroke, the mechanism is so designed to make the tool move at a faster rate to reduce the idle return time. This mechanism is known as quick return mechanism which reduces total machining time and the rate of production increases. The following mechanisms are used for quick return of the ram.

1. Crank and slotted link mechanism
2. Hydraulic mechanism
3. Whitworth mechanism

Stroke length calculation and adjustment

The length of the stroke is calculated to be nearly 30mm longer than the work. The position of stroke is so adjusted that the tool starts to move from a distance of 25mm before the beginning of the cut and continues to move 5mm after the end of the cut.

DRILLING MACHINE

INTRODUCTION

A power operated machine tool which holds the drill in its spindle rotating at high speeds and when actuated move linearly against the work piece produces a hole. Drilling is a metal cutting process carried out by a rotating cutting tool to make circular holes in solid materials. Tool which makes hole is called as drill bit or twist drill.

Types of drilling machine.

Portable drilling machine.

Bench drilling machine

Radial drilling machine

Pillar drilling machine

Parts

Vertical main column, Base, Moving drill head, Work table, Electric motor

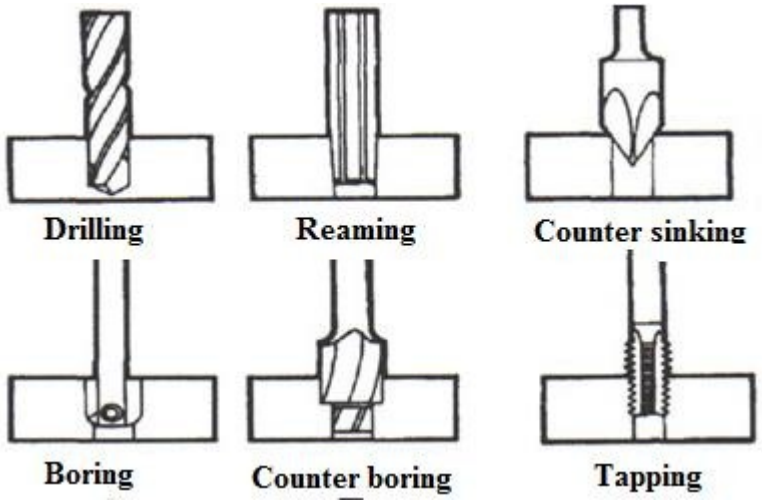
Variable speed gear box and spindle feed mechanism.

Working

- Work piece with the exact location marked on it with the centre punch is clamped rigidly on the work table.
- spindle axis and center punch indentation are in same line.
- Machine is started and drill bit is lowered by rotating feed handle.
- Drill bit touches the work and starts removing material

Drilling machine operation

Reaming, Boring, Counter boring, Counter sinking, Tapping.



Drilling machine operations

SPECIFICATIONS:

Power capacity. e.g.: 0.5 HP,

The range of speed. i.e. 50-2500 rpm

Length of arm on which drill head can traverse. e.g.: 600 mm,

Vertical movement of the arm e.g.: 500 mm.

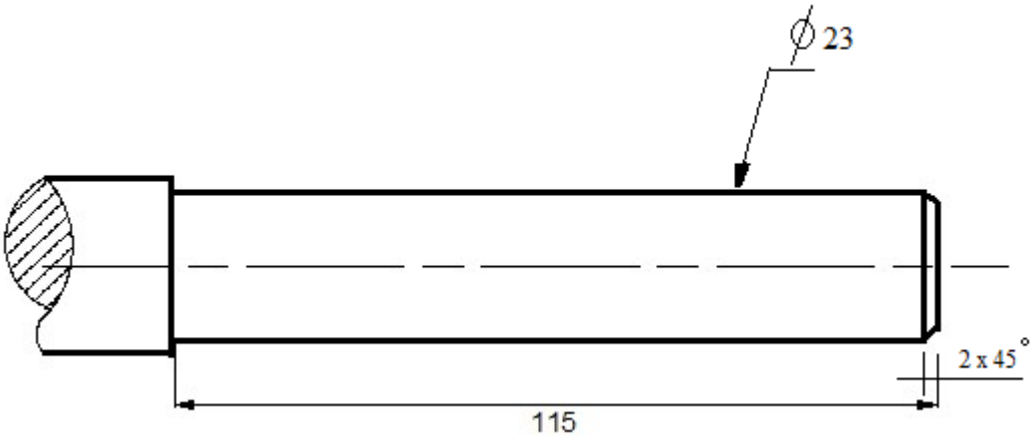
Angular swing of arm e.g.: 3600,

Range to which drill bit can reach e.g.: 350 mm to 900 mm.

The size of a drilling machine varies with the type of machine being considered.

Ex. No 1
Date:

PLAIN TURNING



All Dimensions are in mm

Ex. No 1
Date:

PLAIN TURNING

AIM:

Plain turning and chamfering operations of Mild Steel round rod.

MATERIAL REQUIRED:

M S round rod of Ø____mm x length_____mm.

TOOLS REQUIRED:

H.S.S. Single point cutting tool, chuck key, tool post key, vernier caliper, steel rule, jenny caliper,

OPERATIONS REQUIRED

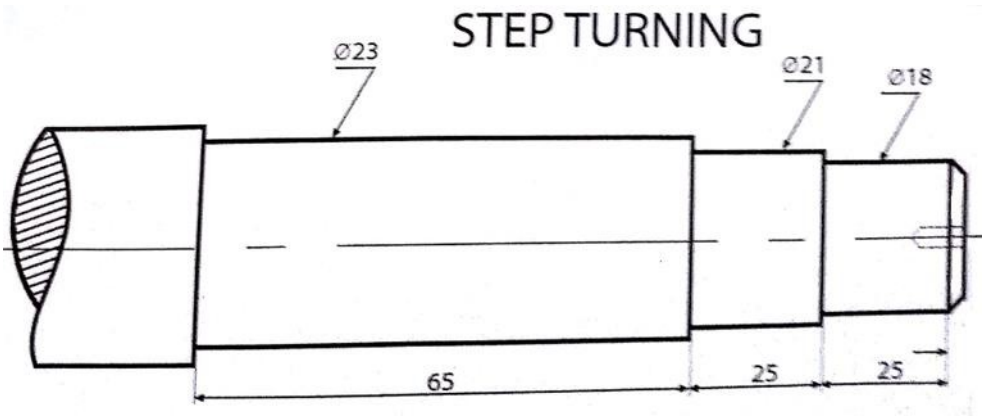
Work setting, Facing, Centering, Plain turning, Chamfering,

PROCEDURE

- The work piece is fixed in a 3-jaw chuck with sufficient overhang.
- Adjust the machine to run the job to a required cutting speed.
- Fix the cutting tool in the tool post
- Facing operation is performed outwards from the center of the job or from the circumference towards the center.
- Centering operation is performed so that the axis of the job coincides with the lathe axis.
- Re-fix the work with tail stock support.
- Give the feed and depth of cut to the cutting tool
- Plain turning operation is performed until the diameter of the work piece reduces to_____ mm and length_____mm.
- Check the dimensions by using vernier calipers.
- Finish the job as per correct dimensions
- Finally check the dimensions by using vernier calipers and submit for inspection

RESULT: Plain turning as per dimension.

Ex.No.2
Date:



All Dimensions are in mm

Ex.No.2
Date:

STEP TURNING

AIM:

Practice Step turning operations on Mild Steel round rod.

MATERIAL REQUIRED:

M S round rod of Ø_____mmx length_____mm.

TOOLS REQUIRED:

H.S.S. Single point cutting tool, chuck key, tool post key, vernier caliper, steel rule, jenny caliper,

OPERATIONS REQUIRED:

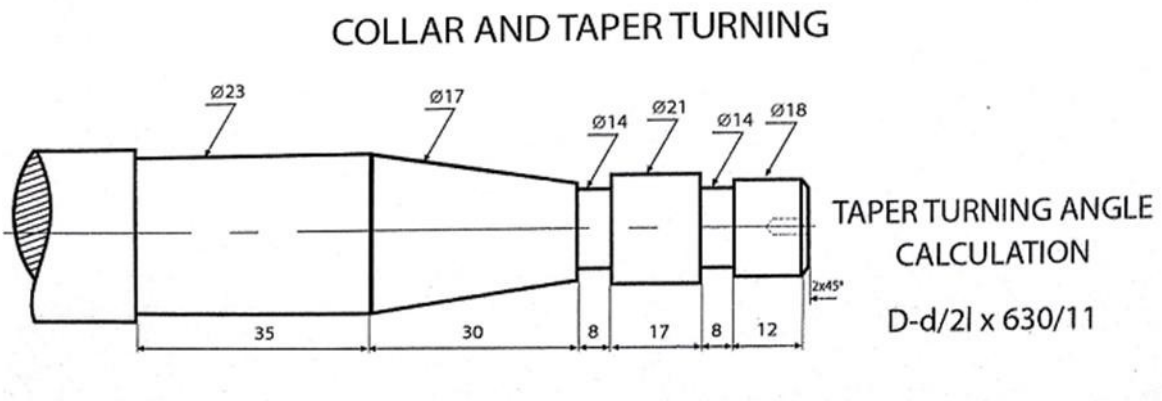
Work setting, Facing, Centering, Plain turning, step turning, chamfering

PROCEDURE

- The work piece is fixed in a 3-jaw chuck with sufficient overhang.
- Adjust the machine to run the job to a required cutting speed.
- Fix the cutting tool in the tool post.
- After facing and centering operation is performed re-fix the work with tail stock support.
- Give the feed and depth of cut to the cutting tool
- Plain turning operation is performed until the diameter of the work piece reduces to_____mm and length_____mm.
- Again step turning operation is performed until the diameter and length of work as per drawing.
- Then chamfering is done on the end of surface.
- Check the dimensions by using vernier calipers and submit for inspection.

RESULT: Complete the step turning job as per drawing

Ex. No. 3
Date:



All dimensions are in mm

Ex No:3
Date:

COLLAR AND TAPER TURNING

AIM:

Practice collar and taper turning (compound rest method).

MATERIAL REQUIRED:

M S round rod of Ø____mmx length_____mm.

TOOLS REQUIRED:

H.S.S. Single point cutting tool, parting tool, chuck key, tool post key, vernier caliper, steel rule, jenny caliper,

OPERATIONS REQUIRED

Work setting, Facing, Centering, Plain turning, step turning, grooving, taper turning, chamfering.

PROCEDURE

- The work piece is fixed in a 3-jaw chuck with sufficient overhang.
- Adjust the machine to run the job to a required cutting speed.
- Fix the cutting tool in the tool post.
- After facing and centering operation is performed, re-fix the work with tail stock support.
- Give the feed and depth of cut to the cutting tool
- Plain turning operation is performed until the diameter of the work piece reduces to____mm and length____mm.
- Again step turning operation is performed until the diameter and length of work reduce to_____mm,____mm and length_____mm.
- Using parting tool grooving operation is performed according to the Given dimensions and finish the two grooves of Ø ___ and length ____mm.
- Swivel the compound slide to the required angle and taper turning operation by rotating the compound slide wheel. The angle can be calculated by using the formula

$$\text{Tan}\alpha = \frac{D - d}{2L}$$

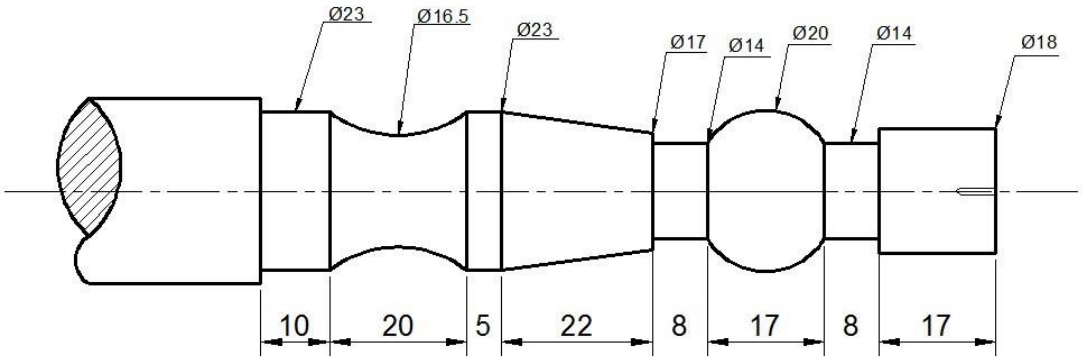
- Finish the job and check all dimensions by using vernier caliper.

RESULT: Completed the job as per drawing.

Ex.No.4

Date:

FORM TURNING (BALL AND CURVE)



All Dimension are in mm

Ex No:4
Date:

FORM TURNING (BALL AND CURVE)

AIM:

Practice form turning (Ball and curve).

MATERIAL REQUIRED:

M S round rod of Ø_____mmx length_____mm.

TOOLS REQUIRED:

H.S.S. Single point cutting tool, parting tool, chuck key, tool post key, vernier caliper, steel rule, jenny caliper,

OPERATIONS REQUIRED

Work setting, Facing, Centering, Plain turning, step turning, grooving, taper turning, chamfering.

PROCEDURE

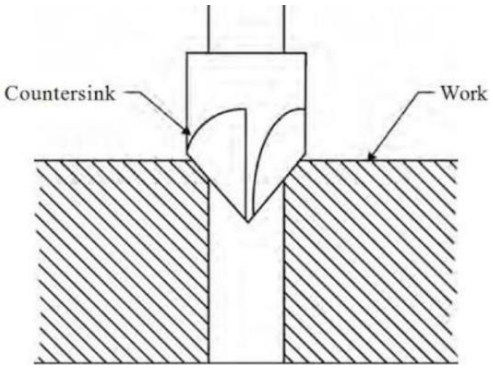
After third work fix the V tool on tool post and forming ball and curve by the movement of carriage and cross slide

RESULT:

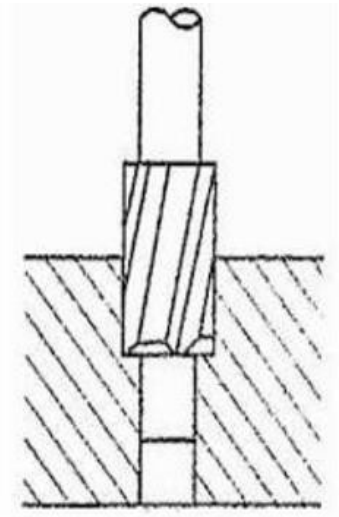
Completed the job as per drawing.

Ex. No 5
Date:

DRILLING OPERATIONS



COUNTER SINKING



counter boring

ExNo.5

Date

DRILLING OPERATIONS

AIM:

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

MATERIAL REQUIRED:

Cast Iron block

TOOLS REQUIRED:

Drilling machine, drill bit drill chuck, reamer etc.

OPERATIONS REQUIRED

Work setting, punching, drilling, boring, reaming

PROCEDURE

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

RESULT:

Performed various drilling machine operations.

FITTER


ADDENDUM
PITCH CIRCLE
VERTICAL SLIDE
THICKNESS OF TOOTH
TONGUE
SPINDLE
ANVIL
RATCHET STOP
THIMBLE
BARREL/SLEEVE
SPINDLE LOCK
FRAME

SAFETY PRECAUTIONS IN FITTING SHOP

1. Shop floor should be kept clean, free from debris, scrap, oil and grease.
2. Do not touch the chip as it comes out of the job.
3. When using grinding machine protect your eyes with goggles.
4. Always work under sufficient light.
5. Do not wear loose dress.
6. Never use hammers with loose heads.
7. Provide guards between opposite vices.
8. Files must have well fitted handles.
9. See that the job is properly fitted to the vice.
10. Do not blow filing when hacksawing.
11. Ease up the pressure when hack sawing is nearly through.

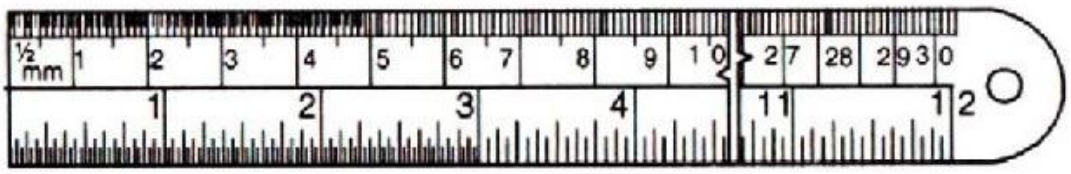
FITTING

INTRODUCTION

Fitting consists of a hard work involved in fitting together components usually performed at a bench equipped with a vice and hand tools. The mating components have a close relation with each other. We have to use hand tools, precision tools and perform various operations.

MEASURING AND MARKING INSTRUMENTS

1. Steel Rule: A steel rule is a direct reading measuring instrument used to read an accuracy of 0.5mm Available in various lengths, widths and thickness with several graduations. They are made from high carbon steel, spring steel, stainless steel and various alloy steel.



STEEL RULE

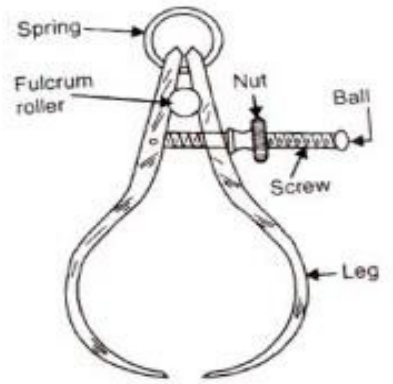
2. Caliper: It is a simple tool gauging legs. It is made of high carbon steel and the measuring points are hardened and tempered. Calipers are mainly classified into Spring type and firm joint caliper.

Types:

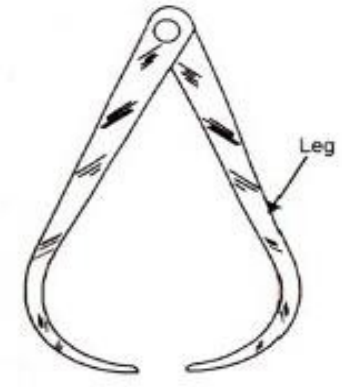
Outside Caliper- They are used to measure the outer dimensions of the shafts, pulleys and square bars etc.

Inside Caliper- They are used to measure the inner dimensions of holes, bores, slots etc.

Jenny Caliper- They are used in layout work for locating and testing centre on cylindrical and other sections laying of distance from an edge and to scribe parallel lines.



SPRING TYPE OUT SIDE CALIPER

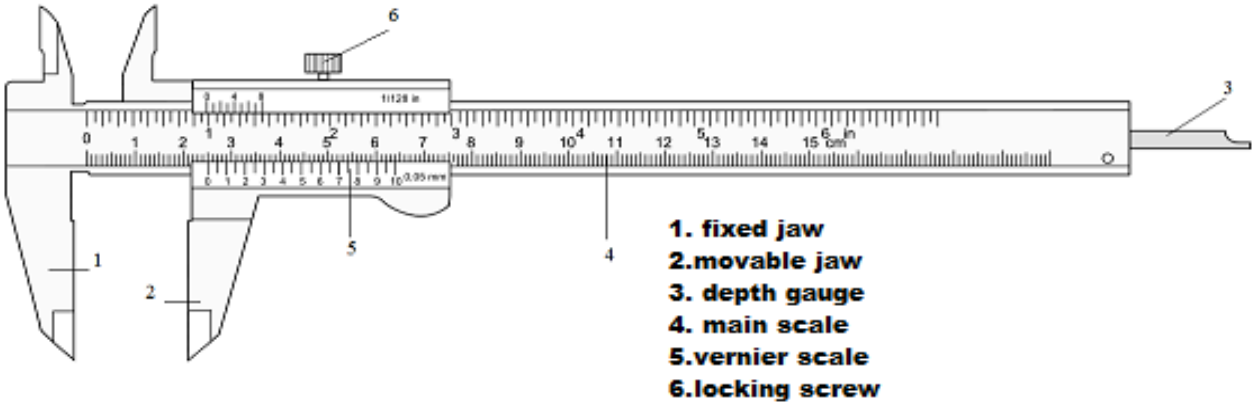


FIRM JOINT OUTSIDE CALIPER

Vernier caliper

The vernier Caliper is primarily intended for measuring both inside and outside diameters of shafts, thickness of parts etc, to an accuracy of 0.02mm by a vernier scale attachment to the caliper. To read the verniers first note the centimeter, millimeter and half millimeter that the zero of the vernier has moved from the zero of the main scale. Then count the number of division on the vernier scale from zero line to the line which consider with a line on the main scale

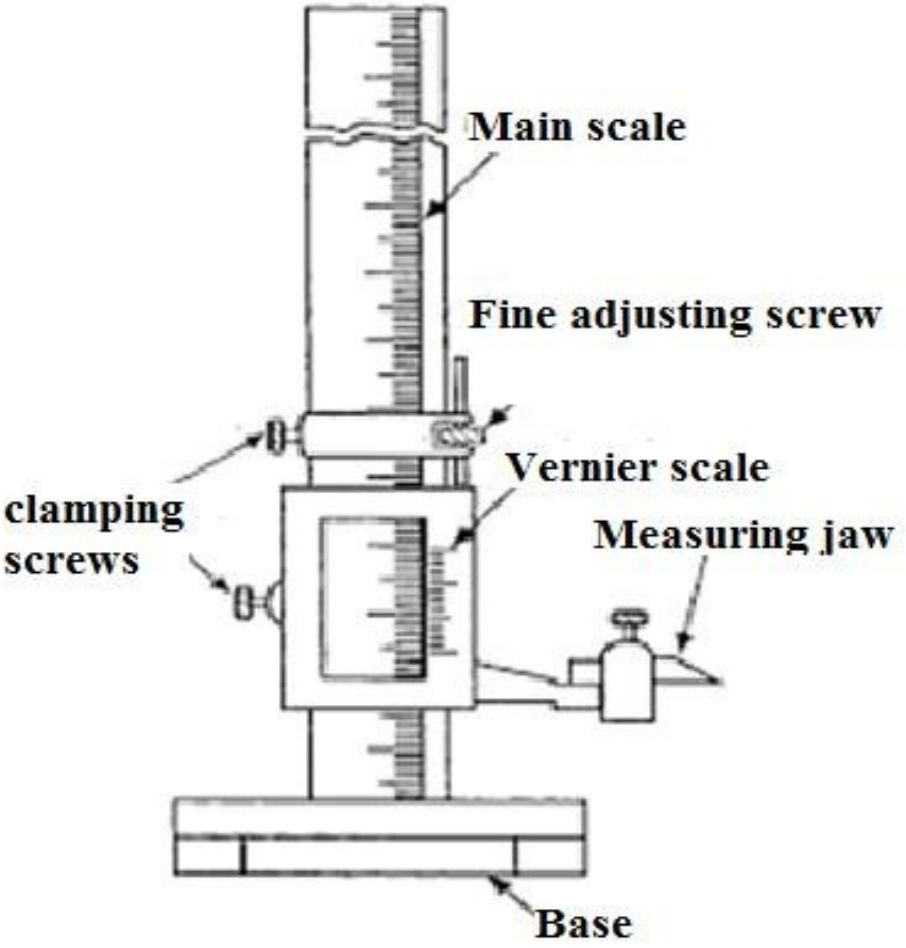
Dimension = main scale reading + Coinciding division x Least count.



Vernier height gauge

The Vernier Height gauge is used to measure the height of parts to an accuracy of 0.02mm (0.001 inches). The vernier Height gauges are available for

the following lower and upper limits of measurement 0-200, 20 to 250, 30 to 400, 40 to 500, 60 to 800 and 60to1000.

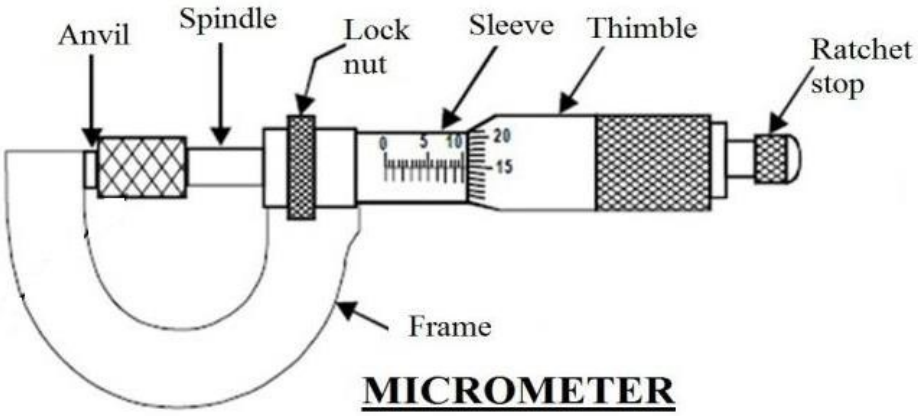


VERNIER HEIGHT GAUGE

For making out the scriber is set for the specified height and the lines are scribed by moving the scriber along the work piece.

EXTERNAL MICROMETER

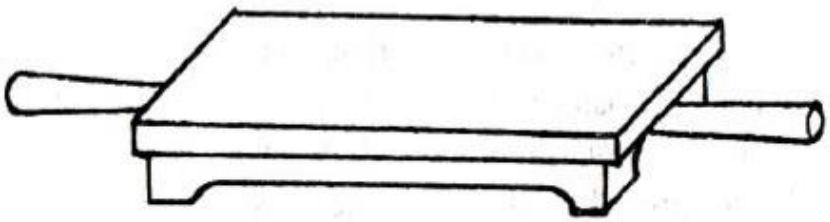
The external micrometer is primarily used to measure external dimension like diameter of shafts, thickness of parts etc., to an accuracy of 0.01mm. The essential parts of the instrument are frame, hardened anvil, screwed spindle, graduated sleeve, Thimble, ratchet stop and spindle clamp.



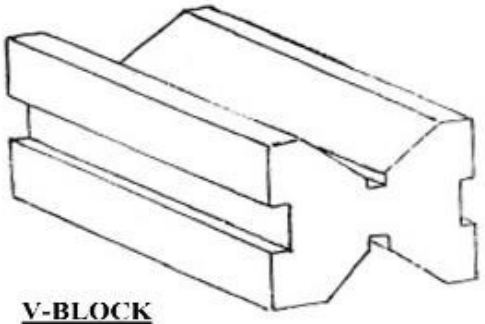
MICROMETER

SURFACE PLATE

Surface plate is the basic tools used for marking. It is a plane table of fine grained cast iron. Even though surface plates are made in different sizes and shapes, the most common shapes are rectangular and square. The surface plate is specified in it's sizes.



SURFACE PLATE



V-BLOCK

V-BLOCK

This is a block of steel or cast iron, which provide with V-shaped groove on its top or bottom or both surfaces. All its faces are truly machined. It is used

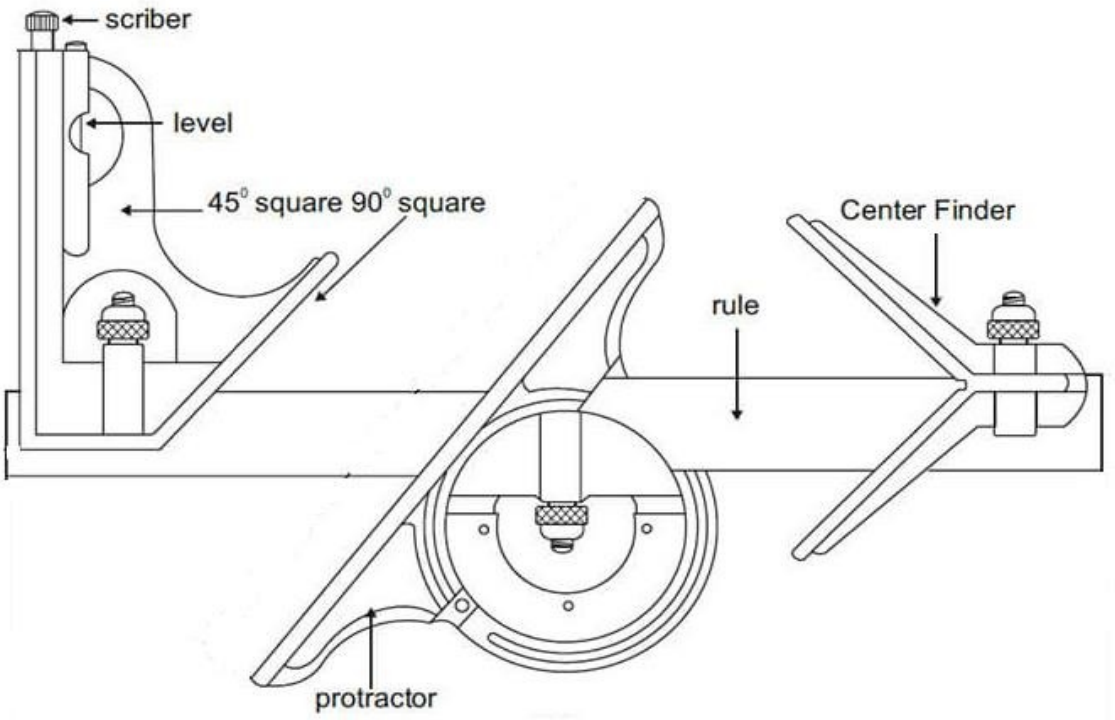
to hold round bars during marking and drilling. The round bars are clamped firmly on the V-block by a U -clamp using the slots cut at the 2 sides of the V-block.

COMBINATION SET

It is a precision checking instrument as well as a measuring instrument. It combines in one instrument a square head, a centre head and a Protractor head.

The three heads are used separately being held in at any desired position by nuts which engage in a slot machined on the whole length of the beam at its back.

The beam which acts as a rule is marked in inches and centimeters for measuring length or height as and when required.



Square Head: It has one edge square to the rule giving a right angle. It is also provided with a spirit level and both 90° and 45° can be tested by this head in conjunction with the rule.

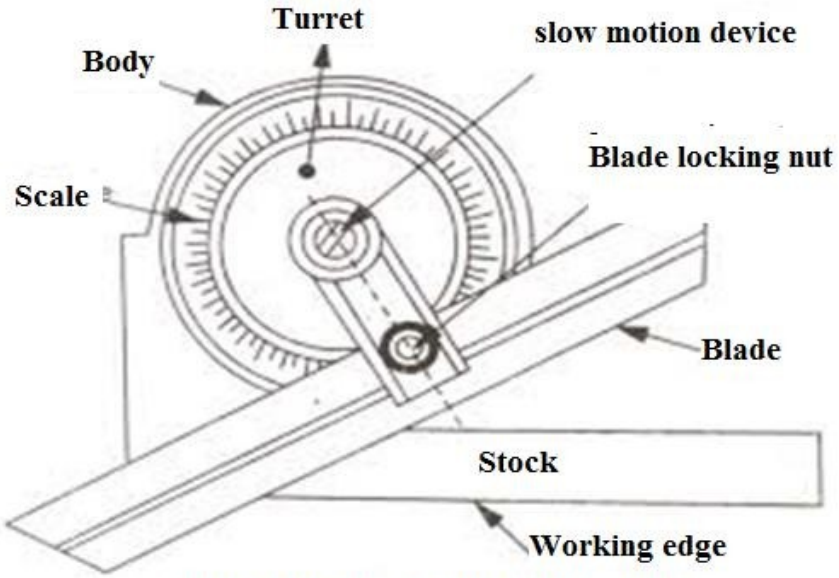
Centre Head: With the rule fastened to it is called a centre head. It has two arms at right angles to one another. This is placed usually at the end

opposite to the square head on the rule.

Protractor Head: It is fitted at the centre of the rule and is used to check, mark and measure angles from 0 to 180 degrees. It consists of a metal frame and graduated disc. The disc is graduated from 0 to 180 degrees in both directions. The adjustment is made by a screw; the head is provided with a spirit level to help in leveling the work or setting it at an angle.

Vernier bevel protractor

Vernier Bevel Protractor is a precision measuring instrument for masuring angles accurately. It consists of rotating disc containing main scale divisions, vernier scale, rule of 60° and 45° at both ends and clamping nut. It takes 0 to 180° at both ends. Its least count is 5 minute.



VERNIER BEVEL PROTRACTOR

STRIKING TOOLS

Hammers are used to strike a job or a tool. They are made of forged steel of various sizes and shapes to suit various purposes. A hammer consists of 4

parts namely, peen, head, eye and face. The eye is made oval or elliptical in shape and accommodates the handle.

Hammers are classified according to the shape and peen.

1. Ball peen hammer: This is the most common hammer. The peen has a shape of a ball which is hardened and polished; size varies from 0.11 to 0.91Kgs.

2. Cross peen hammer: This is similar to ball peen hammer in shape and size except the peen which is across the shaft or eye.

3. Straight peen hammer: This hammer has a peen straight with the shaft or parallel to the axis of the shaft.

4. Soft hammer: When it is necessary to strike metal with minimum damage to the surface a hammer called mallet is used. They are made of hard rubber, copper, brass or wood.

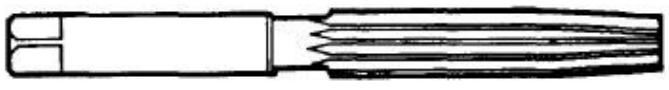
5. Double faced: Both faces are similar in shape and are striking faces. It is used for heavier work on flat surface in shops.

CUTTING TOOLS

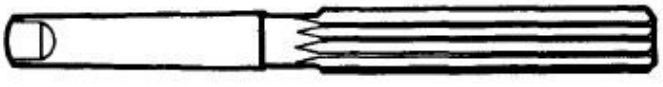
REAMER

Reamers are used for reaming an operation followed after drilling to get an accurate hole. There are two kinds of reamer, hand reamer and machine reamer.

Those which are turned by hand is hand reamer and those which are turned using a machine are called machine reamer. Reamers are made of cast steel or high speed steel with parallel or tapered cutter with straight or spiral



HAND REAMER



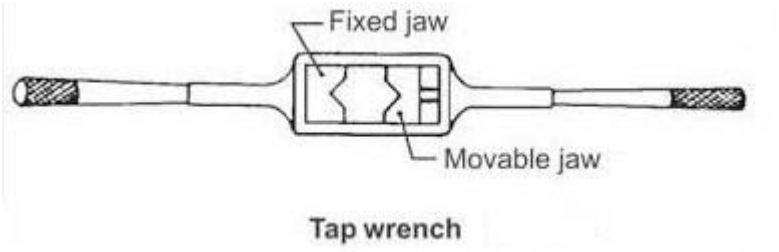
MACHINE REAMER

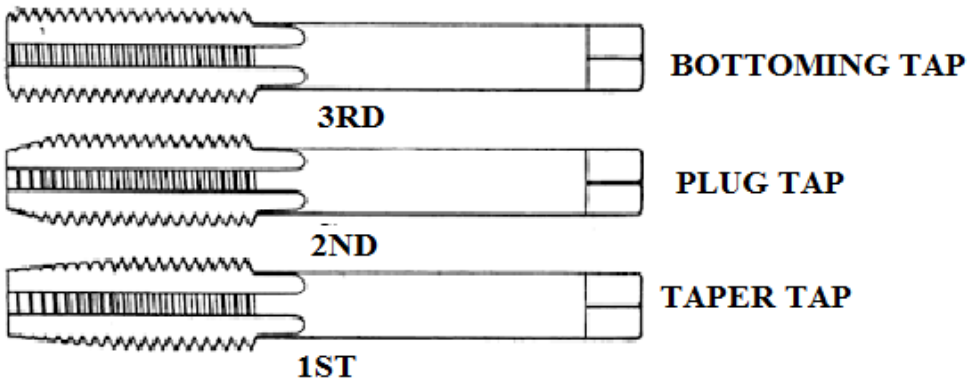
flutes.

TAP and DIE

A tap is a screw like tool, which has threads like a bolt, and three or four flutes cut across the threads. It is used to cut threads on the inside of a hole, as in a nut. The edges of the thread formed by the fluted are the cutting edges. The lower part of the tap is tapered. The upper part of the tap has a shank ending in a square, for holding the tap wrench. This is a two handled wrench and it may be either fixed or adjustable. Taps are made from carbon steel or high speed steel and are hardened and tempered. Hand taps are made in sets of three.

(a) taper tap, (b) second tap and (3) third tap or bottoming tap





Dies are used to cut threads on cylindrical work such as the threads on a bolt. It is a round or square block of hardened steel, with a hole containing threads and flutes, which form the cutting edges. There are two types of dies: (a) Solid die, and (b) Adjustable die.

Solid die has fixed dimensions while an adjustable die can be set to cut larger or smaller diameter by means of the set screw. The two-piece rectangular die fitted into a special stock can be closed using the adjusting screw.

The size of a die is specified by the outside diameter of the thread to be cut and pitch of the thread.

FITTING OPERATIONS

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

2. FILING: Filing is the most important operation in fitting. It is usually an after treatment of chipping. In serves to remove the burrs from cuts, clean the face of cuts and to finish the final shape of a work piece. Filing is done by use of tools known as files.

3.GRINDING: Grinding is the process of removing metal usually 0.25 to 0.5mm in most operation by use of grinding wheel. It is a finishing operation.

4. POLISHING: Polishing is the process of making a flat, scratch free, mirror like finish. Polishing procedure consists of rough grinding, intermediate grinding, rough polishing and fine polishing. It is done by emery cloth, rotating disc etc.

5. SAWING: Sawing is the quickest method of shaping and slotting in cold metals. Sawing is done by means of the tool called hacksaw. Power hacksaw are also available.

6. MARKING: Marking is the process of transferring of dimensions on a work piece.

7. REAMING: When an accurate hole with a smoother finish is required reaming is done after drilling. The tools used for reaming is known as reamers.

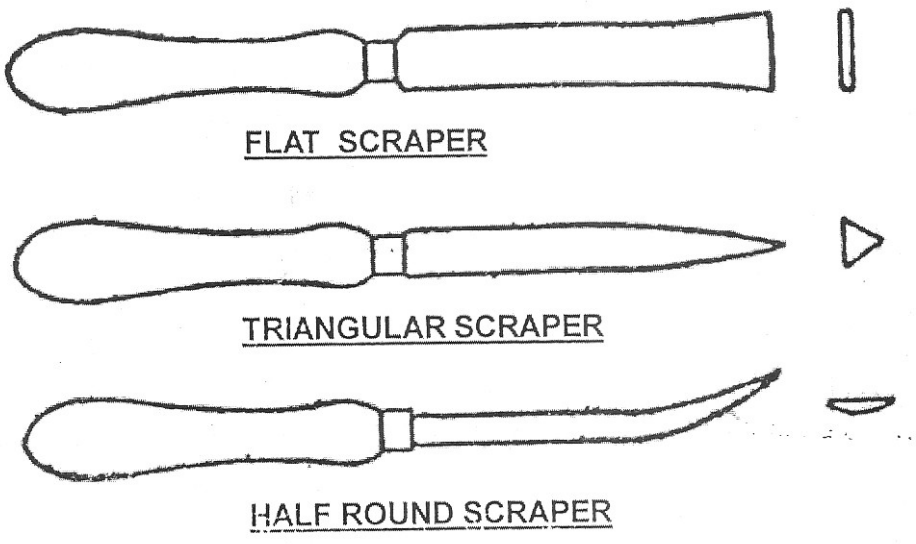
8. TAPPING: Taping is an operation of making internal threads in the work piece using the tool known as tapping

9. DIEING: Dieing is the process of making external threads on work piece.

10.SCRAPING: Scraping means shaving or paring of thin slices of metal to make a fine, smooth surface. This is done with tools called scrapers which have very hard cutting edges. Scraping is used for obtaining a truer surface than can be produced by machining of filing. So scraping often follows filing. Having got the surface of the block reasonably flat with the file, the block should first be tested on the surface plate, which is of cast iron and has a perfectly flat surface.

Triangular Scraper: The triangular scraper has three cutting edges and is made from a triangular file. It is used to scrape round or curved surfaces and to remove sharp corners and burrs.

Flat Scraper: The flat scraper is the most common and also the most easily made. The cutting edge is at the end. It should be curved a little looking at the broad side. This is done to keep from taking too broad a cut and to prevent the corners of the scraper from coming in contact with the surface being scraped and making deep scratches. A flat scraper is used for producing perfectly flat surface.



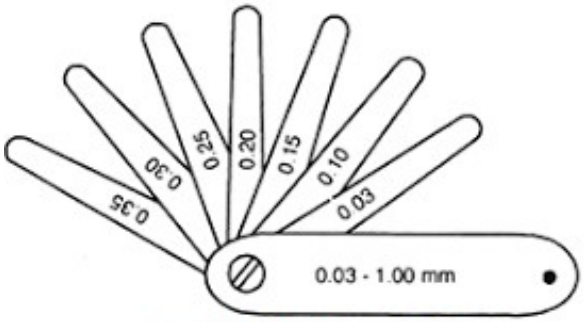
Half round Scraper: A half-round scraper is, in shape, like a half round

file. In fact, they are often made from old half-round file. They are used to scrape round or curved surfaces.

CHECKING INSTRUMENTS

Feeler gauge

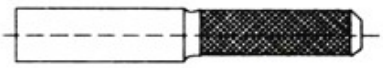
Feeler gauges are used for checking clearances between mating surfaces. It is made in the forms of a set of precision steel, machined blades 0.03to 1.0 mm thick and 100 mm long. The blades are pivoted in a holder. Each blade has an indication of its thickness.



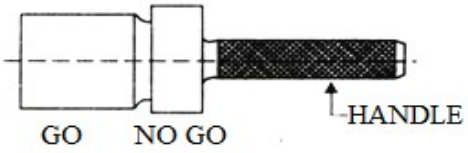
FEELER GAUGES

Plug Gauge `

Plug gauges are used for checking holes of different shapes and sizes. There are plug gauges for straight cylindrical holes, threaded, square and splined holes.



STANDARD PLUG GAUGE

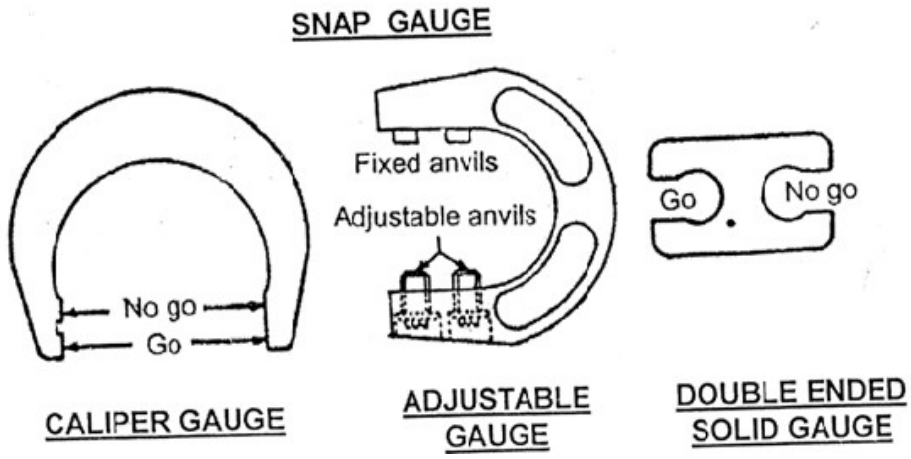


DOUBLE ENDED LIMIT PLUG GAUGE

PROGRESSIVE LIMIT PLUG GAUGE

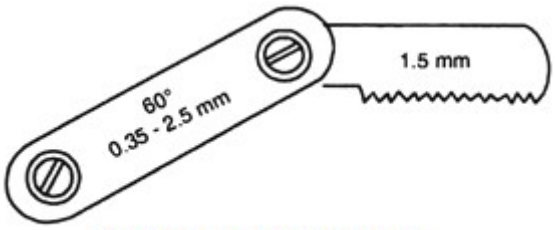
Ring Gauge: Ring gauges are used to test the external diameters. They allow shafts to be checked more accurately since they embrace the whole of their surface. In suiting a ring gauge, it should fit over the part being checked, without the use of force and without any side movement. `

Snap Gauge: Snap gauges are used for checking external dimensions, Shafts are mainly checked by snap gauges, they may be solid and progressive or adjustable or double ended. Solid or non-adjustable gauge with 'go' and 'no go' ends is used for large size. Adjustable snap gauge is used for larger sizes. This is made with two fixed anvils and two adjustable anvils. One for the 'GO and the other for the 'NO GO'. Double ended solid snap gauge with 'go and 'no go' ends are used for smaller sizes.



Thread gauge: Pitch diameters of threads are checked with thread gauges. For checking internal threads (nuts, bushes etc.) plug thread gauges are used while for checking external threads (screws, bolts etc.) ring thread gauges or snap gauges are used.

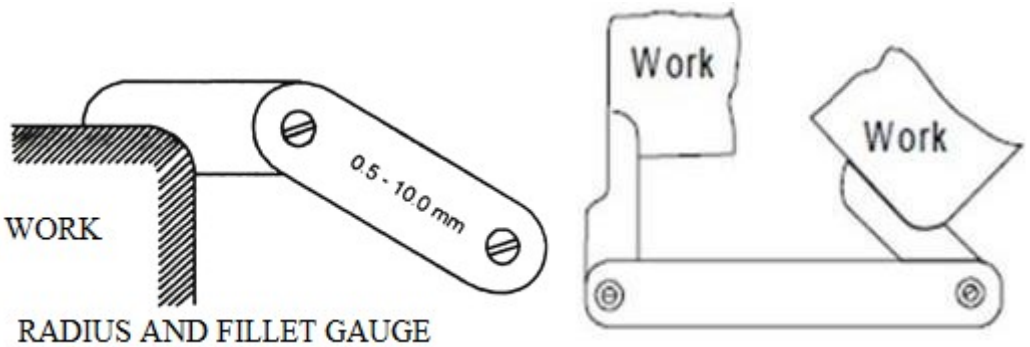
Screw Pitch gauge: This tool is used in picking out a required screw and for checking the pitch of screw threads. It consists of a number of flat blades which are cut out to given pitch and provided in a holder. Each blade is stamped with the pitch or number of threads per mm and the holes bears a number designating the thread it is intended for.



SCREW PITCH GAUGE

Radius and Fillet gauge.

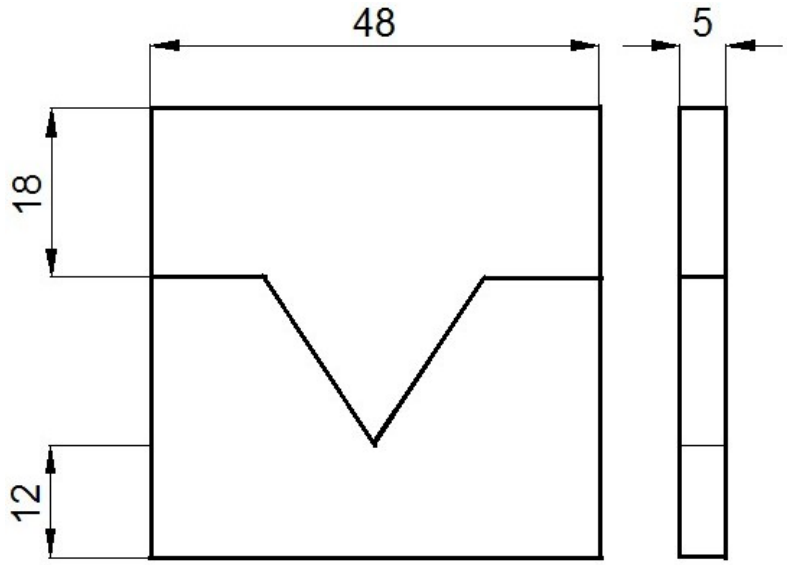
The function of these gauges are to check the radius of curvature of convex and concave surfaces, over a range from 1 to 25mm



RADIUS AND FILLET GAUGE

ExNo:1
Date

V JOINT



All dimension are in mm

Ex No:1

Date :

V JOINT

AIM: To make a V-joint with required dimensions.

MATERIAL REQUIRED: Mild steel flat piece of 50 x 65 x 6mm

TOOLS REQUIRED: flat file (bastard), triangular file, smooth file, straight edge, steel rule, Surface plate, V-block, Vernier height gauge, punch, ball peen hammer, try square.

OPERATIONS TO BE CARRIED OUT: filing, checking, marking, punching, cutting and finishing

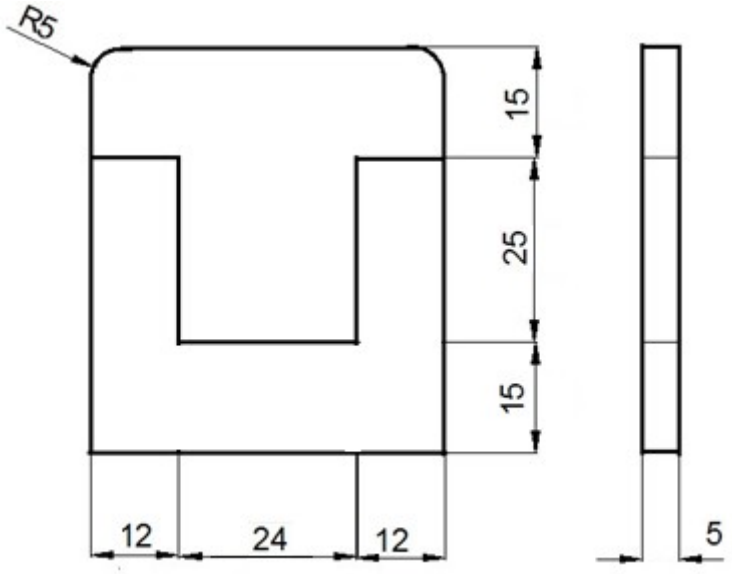
PROCEDURE

1. Hold the mild steel flat piece of 50 x 60 x 6 mm between the jaws of the bench vice
2. Remove the rust with the tip or edge of the flat file bar
3. Prepared the first flat surface and four side with the flat file bastard, try square straight edge and steel rule.
4. Apply chalk paste and mark the dimensions on the M.S flat piece with the help of V block, surface plate and Vernier height gauge.
5. Punch the required dimensions on the given M.S flat piece with help of dot punch and ball peen hammer
6. Start the work of V-cutting on the male and female piece
7. Fit the male and female parts of work piece and check the correctness of fitting, and finish the work

RESULT: The required V- joint is obtained.

Ex. No. 2
Date:

T- JOINT PRACTICE



All dimensions are in mm

Ex. No. 2

Date **T - JOINT PRACTICE**

AIM: T joint practice

MATERIAL REQUIRED: Mild steel flat piece of 50 x 85 x 6mm

TOOLS REQUIRED: Flat file bastard, flat file smooth, square file, safe edge file second cut, steel rule, straight edge, try square, surface plate, 'V' block, Vernier height gauge, dot punch, ball peen hammer, hacksaw, and outside caliper,

OPERATIONS TO BE CARRIED OUT: Filing, checking, marking, punching, cutting and finishing

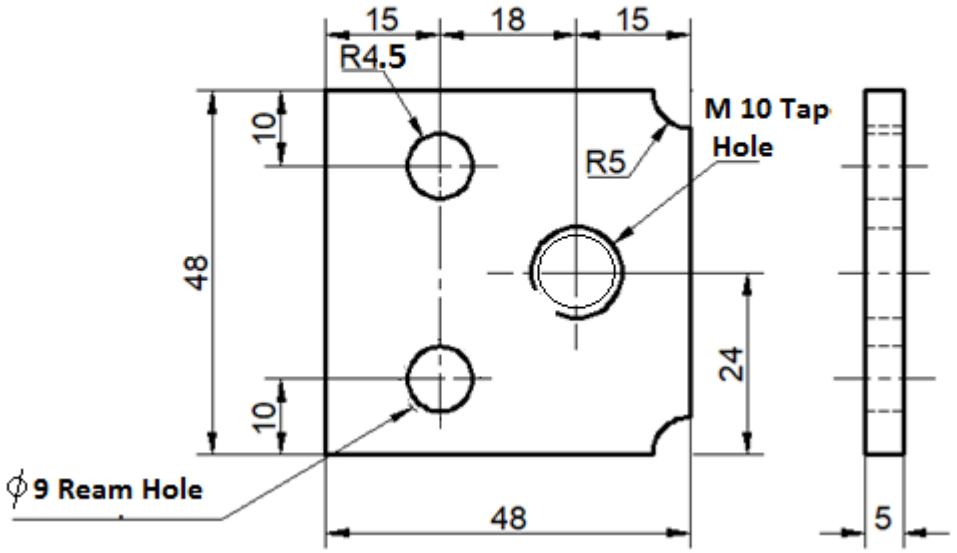
PROCEDURE

1. Hold the mild steel flat piece of 50 x 85 x 6 mm between the jaws of the bench vice
2. Remove the rust with the tip or edge of the flat file bar
3. Prepare the first flat surface and four side with the flat file bastard, try square straight edge and steel rule.
4. Apply chalk paste and mark the dimensions on the M S flat piece with the help of V-block, surface plate, Vernier height gauge.
5. Punch the required dimensions on the given M S flat piece with help of dot punch and ball peen hammer
6. Start the work of T-cutting on the male piece
7. Remove the unwanted material of T portion in the male and female part of the work piece,
8. Fit the male and female part work piece and check the correctness of the fitting, then finish the work.

RESULT: The required T-joint is obtained.

Ex.no. 3
Date:

DRILLING, TAPPING AND REAMING



All dimensions are in mm.

Ex.no. 3
Date

DRILLING, TAPPING AND REAMING PRACTICE

Aim: To practice drilling, tapping and reaming

Material required: Mild Steel flat piece of 50 x 50 x 6mm `

Tools required: scriber, steel rule, hacksaw, flat file, round file, try square, surface plate, v- block, vernier height gauge, vernier caliper, punch, ball peen hammer, tap set, reamer, drill bit, drilling machine, tap wrench

Operations to be carried out: filing, checking, marking, punching, cutting, drilling, tapping, reaming, and finishing

Procedure:

1. Hold the mild steel flat piece of 50 x 50 x 6mm between the jaws of the bench vice.
2. Start filing on first flat surface after removing the rust with the tip of flat file.
3. Straight filing is continued till the surface is formed perfectly flat.
4. Check the straightness by using straight edge.
5. Turn to the adjacent side which is narrow and make it straight, flat and 90° with flat surface prepared.
6. File the next adjacent side and make it flat and perpendicular to both flat surface and first narrow side which is already prepared.
7. Apply chalk on the finished flat surface and mark dimensions
8. Use surface plate V-block and vernier height gauge for marking.
9. Marked lines are punched by using dot punch and ball peen hammer.
10. File to correct dimensions in length and width and check the dimensions using an outside caliper and steel rule.
11. Mark two curve on the edge of M.S flat using divider.
12. Make curve using round file.

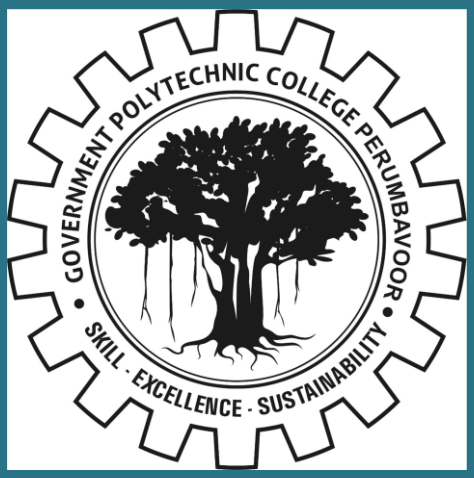
1. Punch the portion to be drilled on the M.S flat piece using dot punch and ball peen hammer
2. Fix the M.S flat piece on the bench vise of drilling machine.
3. Fit the 8.5mm drill bit on the chuck of the drill machine and check whether edge meets the correct positions.
4. Drill two holes on the work piece

TAPPING

1. Place the M.S flat piece on the bench vise
2. Fit the 1^{st}, 2^{nd} and 3^{rd} tap on the tap wrench respectively and apply oil on the top and perform tapping

REAMING

1. For reaming, drill a hole in M.S flat using 8.9 mm drill bit
2. Then place the M.S flat piece on bench vice and fix reamer on tap wrench and perform reaming


GOVERNMENT POLYTECHNIC COLLEGE PERUMBAVOOR
SKILL · EXCELLENCE · SUSTAINABILITY

SHEET METAL

SYLLABUS

COURSE TITLE	**:**	**WORKSHOP PRACTICE III**
COURSE CODE	**:**	**3027**
COURSE CATEGORY	**:**	**B**
PERIODS/ WEEK	**:**	**6**
PERIODS/ SEMESTER III	**:**	**90**
CREDIT	**:**	**3**

TIME SCHEDULE

MODULE	TOPICS	PERIOD
1	Machine Shop	**24**
2	Fitting.	**24**
3	Sheet Metal, Aluminum Fabrication	**22**
4	Welding	**20**
	Total	**90**

Course outcomes:

STUDENT WILL BE ABLE TO**:**

Sl.No.	Sub	Students will be able to
1	1	work on lathes.
	2	work on shaper machine.
	3	work on drilling machine
2	4	Understand the fitting practice and use of gauges.
	5	Work in sheet metal shop and aluminum fabrication.
	6	Work on welding machine.

Course Distribution

Module	Name of Module	Course outcome No.	Total periods per Semester		
			Instructional	Test	Total
1	Machine Shop	1 2 3	Theory practical: 21	3	24
2	Fitting.	4	Theory practical: 21	3	24
3	Sheet Metal, Aluminum Fabrication	5	Theory practical: 21	3	22
4	Welding	6	Theory practical: 21	3	20
		Total periods per semester			90

CONTENT DETAILS

MODULE IMACHINE SHOP

Understand the safety precautions

1.1.0 Lathe work

1.1.1 Familiarization with lathes- principal parts, work holding device, measuring instruments, accessories & attachments

1.1.2 Plain turning to the given accuracy - Practice with Precision measuring devices - use of digital vernier and Micrometer

1.1.3 Taper turning

1.1.4 Form turning (ball and curve)

1.1.5 Combination of above operations (taper, ball and curve)

1.2.0 Work on shaper

1.2.1 Familiarize with the parts, accessories and attachments.

1.2.2 Simple operations on Shaper (Planning)

1.2.3 Shaping of a rectangular block

1.2.4 Shaping a 'V' in a rectangular block

1.3.0 Work on drilling machine

1.3.1 Familiarization of drilling machine parts

1.3.2 Marking and drilling holes

1.3.3 Boring and counter boring

1.3.4 Reaming

1.3.5 Combination works

MODULE II FITTINGPRACTICE

2.1 Study of measuring gauges-dial gauges, feeler gauges, thread gauges

2.2 Working from a given blue print exercises involving marking filing, drilling, reaming and tapping to an accuracy of 0.02mm (T- joint, V-joint, Single dovetail joint)

MODULE III SHEET METAL &ALUMINIUM FABRICATION

3.1 Understand safety precautions.

3.2 Familiarization of sheet metal tools – scribers, dividers, trammel points, set square, punches –prick punches, centre punches – hand Grover, rivet, chisels, hammers, riveting hammers, ball peen hammers – mallet, snip shears, pliers, hand seamers (tongs) files, stakes. Measuring instruments in sheet metal - folding rule, common rule, steel circumference rule, vernier calipers, micrometer, combination set, Thickness gauges, Plate gauge.

MODULE IV WELDING

4.1 Safety precautions

4.2 Study of various tools and equipments used in the welding shop for both arc welding and gas welding (review)

4.3.0 Practice work

4.3.1. D.C. arc welding (review of practice)

4.3.2. A.C. arc welding (review of practice)

4.3.3. Gas welding (review of practice)

4.3.4. Horizontal, flat, vertical and over head welding

4.3.5. Edge preparation of welded joint such as V, double V.

4.3.6. Pipe welding – linear and round

4.3.7. Flame cutting

GENERAL INFORMATION:

*Class is divided into 2 batches (Batch I and Batch II). For Batch I – It is M/c. Shop and Fitting shop and for Batch II- It is Sheet metal, Aluminum fabrication and welding. This syllabus should be continued for Semester IV also by interchanging the batch of students.

SEMESTER IV

SYLLABUS

COURSE TITLE : WORK SHOP PRACTICE – IV & MINI PROJECT

COURSE CODE : 4029

COURSE CATEGORY : A

PERIODS/ WEEK : 6

PERIODS/ SEMESTER : 90

CREDIT : 5

GENERAL INFORMATION:

- Same as for Semester-III
- Batches I and II are to be interchanged to compensate.
- Student should work 35 periods (5days) for completing mini project
- One of the exercises done in the workshop should be related to the industrial product.
- Fabrication of Nut & Bolt, Bucket, Office tray, etc and maintenance of available machinery in the workshop/ lab will be treated as mini project
- Group work for students can be assigned to undertake repair and maintenance works
- At the end of the semester each student shall prepare a report on mini project for evaluation certified by the Head of department.

GENERAL SAFETY

- Wear safety glasses or face shields designed for the type of the work
- Wear safety shoes with thick soles.
- Wear clothing suited for the job.
- Don'twear rings, Watches, bracelets or other jeweler that could get caught in moving machinery.
- Don'twear neck ties or loose turn clothing ofany kind.
- Wear shirts or uppers with sleeves cut off or rolled above the elbows.
- Be sure you have sufficient light to see in Work area.
- Get first aid immediately for any injury.
- Don't talk to others when they are operating a machine.
- Keeping floor free from oil, grease or any other liquid.
- Store materials in such a Way that they cannot become tripping hazards.
- Don't leave tools or work on the Work table.
- Keep tools always in Cupboards when not in use.
- Place the scrap materials in the box provided.
- Be sure that all machines have effective and properly working guards.
- Don't operate any machine unless authorized, to do so by the instructor.
- Don't attempt to oil, clean, adjust or repair any machine while it is running,
- Keep the floor clean of metal chips or curls and waste pieces; put them in boxes provided for such things.
- Don't operate machinery before getting instruction.

SHEETMETAL

INTRODUCTION

Sheet metal work has its own significance in the engineering work. Many products, which fulfill the household needs, decoration work and various engineering articles, are produced from sheet metals. Common examples of sheet metal work are Hooper's, canisters, guards, covers, pipes, hoods, funnels, bends, boxes etc. Such articles are found less expensive, lighter in weight and in some cases sheet metal products replace the use of castings or forgings.

METALS USED IN SHEET METAL WORK:

A metal plate of thickness less than 4 mm is considered as sheet. The size of the sheet is specified by its length, width and thickness in mm. In British system, the thickness of sheet is specified by a number called Standard Wire Gauge (SWG). The commonly used gauge numbers and the equivalent thickness in mm

SWG (No.)	16	17	18	19	20	22	24	27	30
Thickness (mm)	1.62	1.42	1.22	1.02	0.91	0.71	0.56	0.42	0.37

The following metals are generally used in sheet metal work:

Black Iron Sheet

It is the cheapest among all. It has a bluish-black appearance and is uncoated sheet. Being uncoated, it corrodes rapidly. It is prepared by rolling to the desired thickness, then annealed by placing in a furnace and then set aside to cool gradually. The use of this metal is limited to articles that are to be painted or enameled such as stovepipes, tanks, pans etc.

Galvanized Iron

It is soft steel coated with molten zinc. This coating resist rust, improves appearances, improves solidaribility, and improves water resistance. It is

popularly known as G.I. sheets. Articles such as pans, buckets, furnaces, cabinet etc, are made from GI sheets.

Stainless Steel

It is an alloy of steel with nickel, chromium and traces of other metals. It has good corrosive resistance. The cost of stainless steel is very high but tougher than GI sheets. It is used in kitchenware, food handling equipment, chemical plants etc.

Copper

It is a reddish colored metal and is extremely malleable and ductile. Copper sheets have good corrosion resistance as well as good appearances but costs are high as compared to GI and stainless steel. Because of high thermal conductivity, it is used for the radiator of automobiles, domestic heating appliances etc.

Aluminium

Aluminium cannot be used in its pure form, but is used in alloy form. Common additions are copper, silicon, manganese and iron. It has many qualities like high ratio of strength to weight, corrosion resistant qualities, and ease in fabrication and whitish in color. It is used in manufacturing of a number of products such as refrigerator trays, household appliances, lighting fixtures, window work, construction of airplanes and in many electrical and transportation industries.

Tin Plates

It is an iron sheet coated with tin to protect it against rust. This metal has a very bright silvery appearance and is used principally in making food containers, cans and pans.

HAND TOOLS:

For measuring, marking cutting and forming, various types of hand tools are used in sheet metal work. A list of them is given below:

I. Measuring tools

II. Marking tools

III. Cutting tools

IV. Forming tools

V. Joining tools

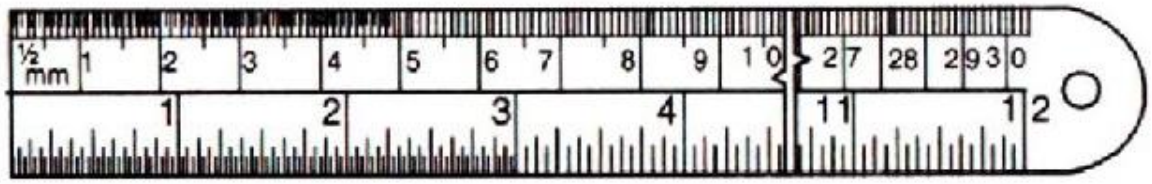
MEASURING TOOLS

The following types of tools are commonly used in sheet metal shops to measure the dimensions of work pieces:

1. Steel rule
2. Sheet Metal gauge
3. Try Square

Steel rule/ Brass rule

The steel rule consists of a hardened steel strip having line graduations etched or engraved in it. They are usually 150mm or 300mm long and are used to take linear measurements to an accuracy of 1mm or 0.5mm. The brass rule is similar to steel rule, but it is made of brass. Since the brass possess low coefficient of linear expansion, its dimensional accuracy will be more reliable in heated regions.

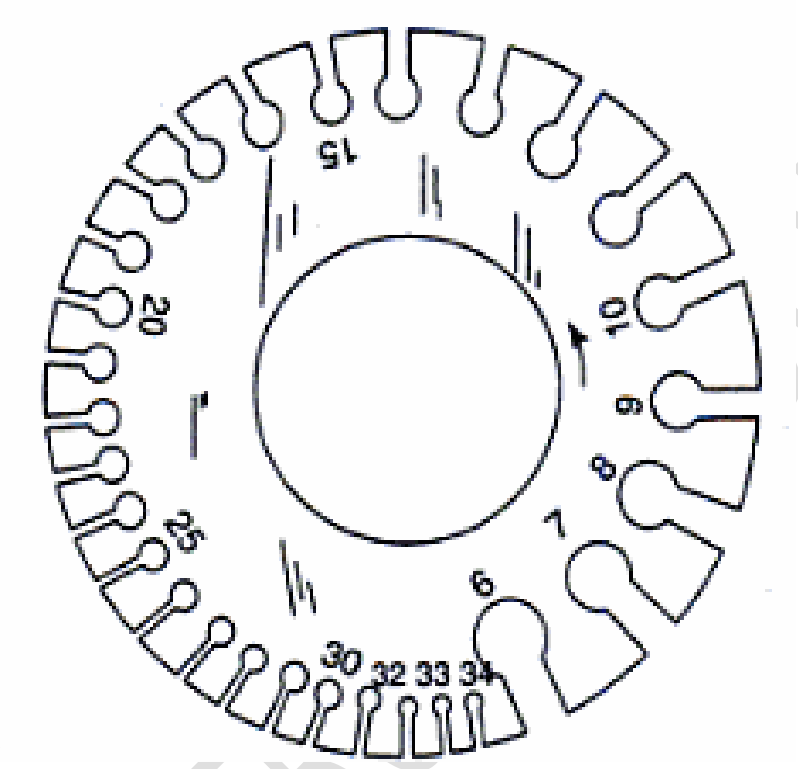


STEEL RULE

Sheet Metal Gauge

It is a disc shaped piece of metal, having a number of slots on the outside edge as shown in figure. The slots are of various widths and each corresponds to a certain standard wire gauge (SWG) number. The gauge is

placed over the edge of the sheet to be measured to find a slot that will slip over the sheet. Standard tables are referred to for conversion of SWG numbers to mm sizes.

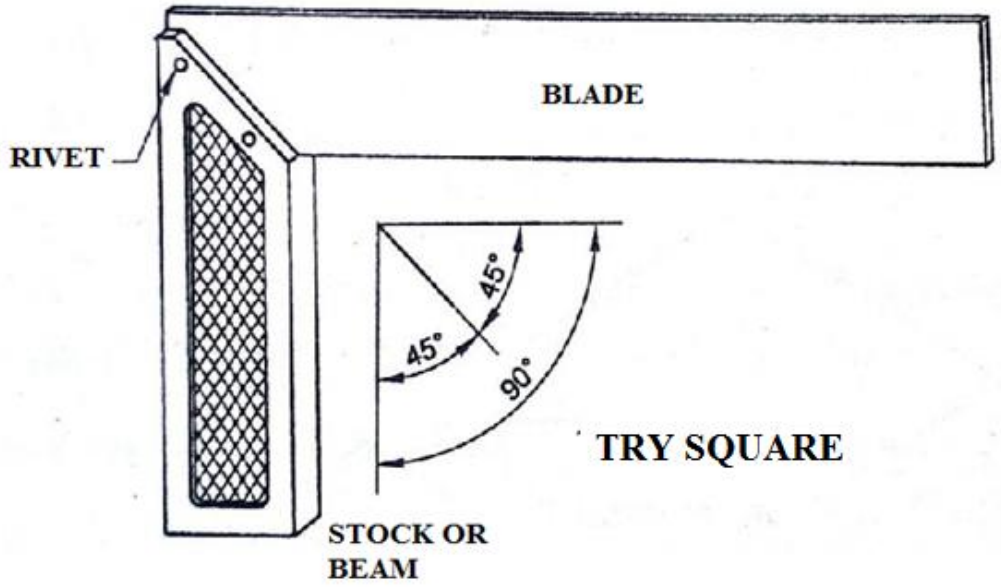


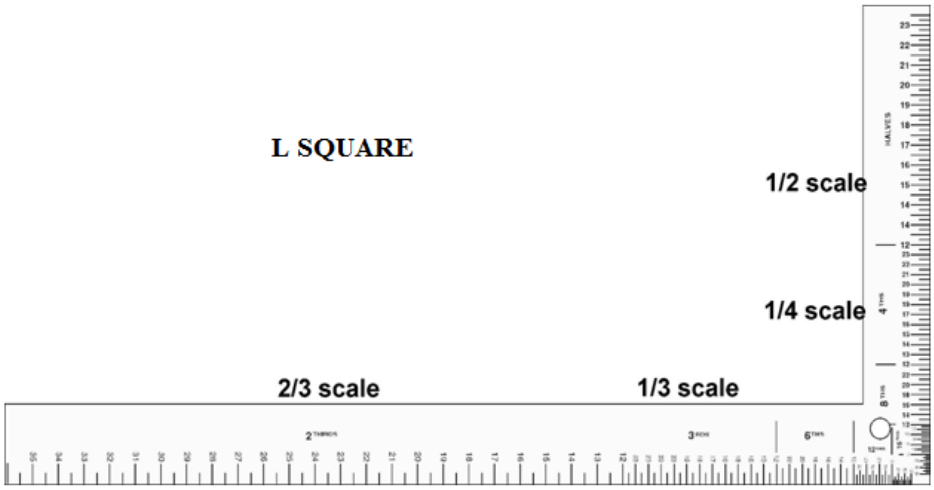
W

STANDARD WIRE GAUGE (SWG)

Try Square

It is used for checking squareness of two surfaces. It consists of a blade made up of nickel steel, which is attached to a base at 90 degrees. The base is made up of cast iron or steel. It is also used to mark the right angles and measuring straightness of surfaces. Never use try square as a hammer.





MARKING TOOLS

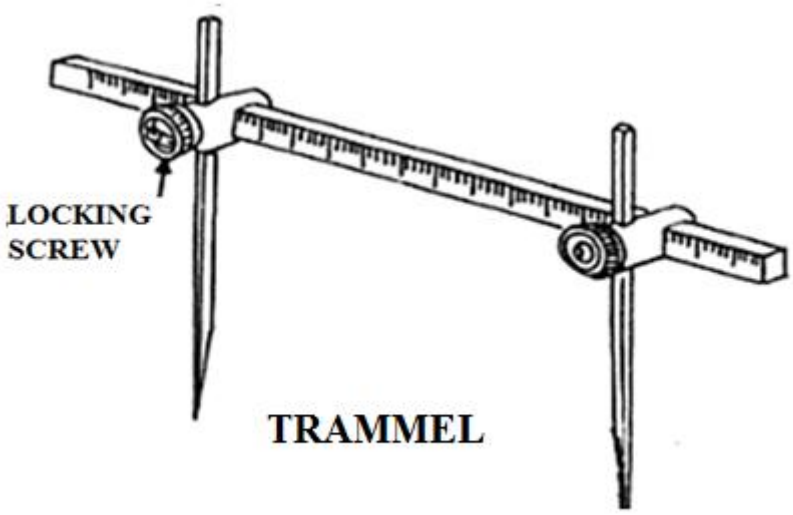
Scriber

It is used to scribe or mark line on a metal surface for a variety of purposes. It is a metalworker's pencil. It is used to scribe or mark line on a metal surface for a variety of purposes. It is a metalworker's pencil.

SCRIBER

Trammel:

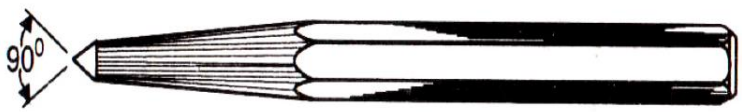
These are used for drawing large circles and arcs that are beyond the limit of dividers. It has two straight, removable legs tapered to a needle point mounted on separate holders which slide on steel (or wooden) bar and held in position by thumb screws.



TRAMMEL

Punches:

It is used in sheet metal work for marking on sheet, locating centers.Punches are percussion tools and are manufactured from tool steel. They are used on any scribed lines by indentations. Tips are tapered, hardened and tempered. The shanks are knurled for easier handling and gripping. The punch whose tip is tapered at an angle of 90º is known as centre punch used to mark centres to be drilled or to mark centre of an edge. A dot punch with tip tapered at 60º is used to punch a chain of dots on a scribed line.

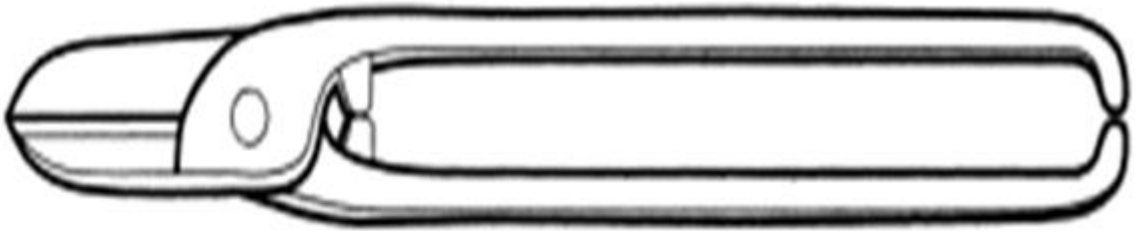


CENTRE PUNCH

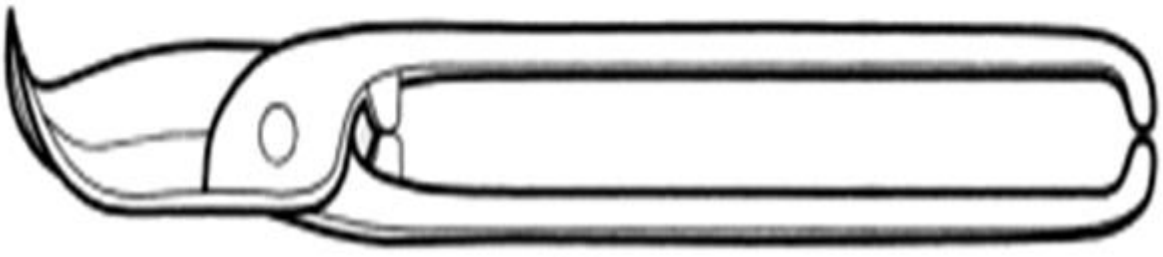
DOT PUNCH

CUTTING TOOLS:

To cut the sheet metal as per the pattern drawn and to make holes for rivets etc., the following types of tools are used. A snip is a hand shear used to cut thin sheets of gauge size number 20 or above. It works like ordinary scissors. There are several types and sizes of snips available to cut along straight lines or curved lines. A straight snip having straight blades to cut along straight lines, snips having curved blades to cut along curved lines. These snips are used for cutting thin sheets. The heavier types are known as bench shear and block shear.



STRAIGHT SNIPS



BENT SNIPS

FORMING TOOLS:

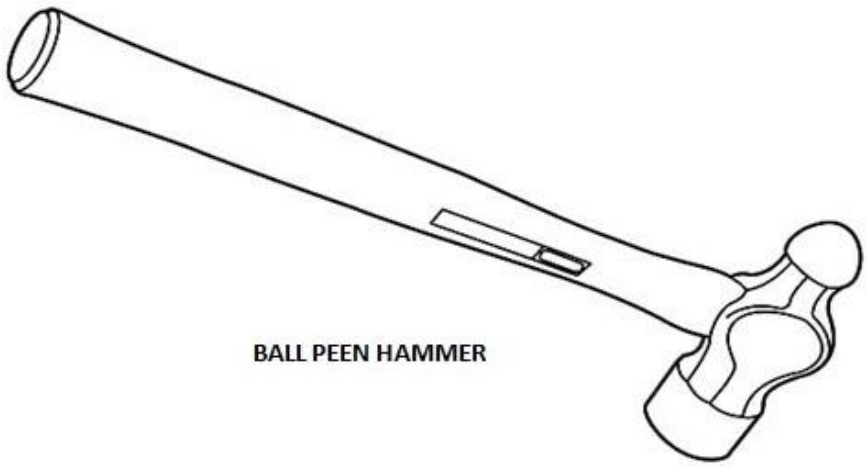
Shaping of the sheet metal such as folding, bending, curling, etc., is done by using the following types of forming tools.

HAMMERS:

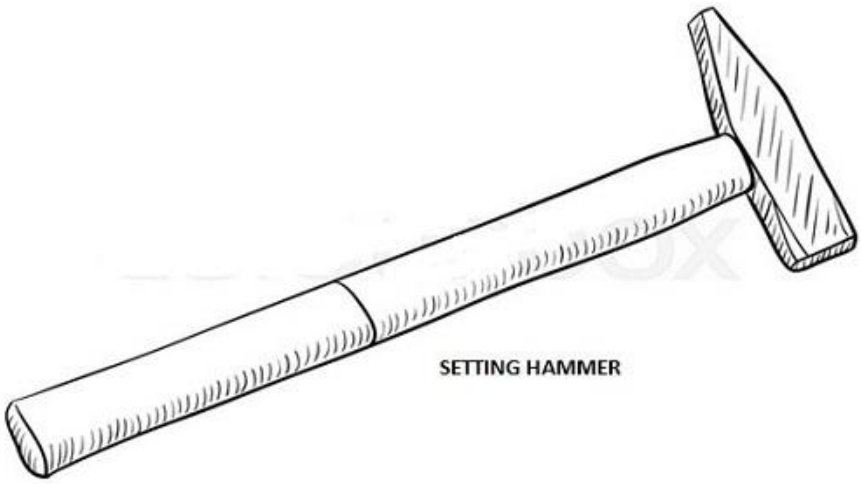
The sheet metal is shaped by hammering or striking with mallet, after keeping the work on suitable form of stake. The hammers used for sheet metal work are (a) Setting hammer, for setting down the edge while making double seam, (b) Raising hammer for forming curved or hollow shape from flat piece, and (c) Riveting hammer for riveting purpose. Mallets are soft hammers used to give soft blows which will not damage the sheet at the same time will shape them.

Ball peen hammer

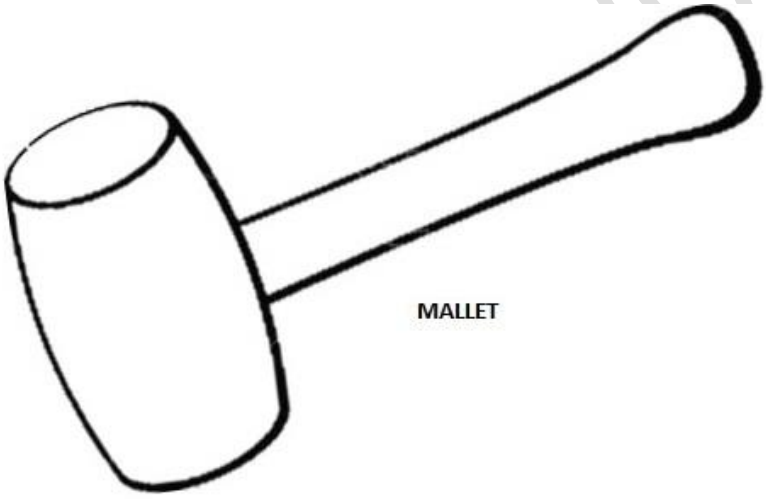
Hammer is a hand tool made of heat treated forged high-carbon steel or alloy steel, largely used for striking on the metals. A hammer is named by its peen. The ball shaped peen hammer is known as ball peen hammer. The peen and face are hardened.



BALL PEEN HAMMER



SETTING HAMMER



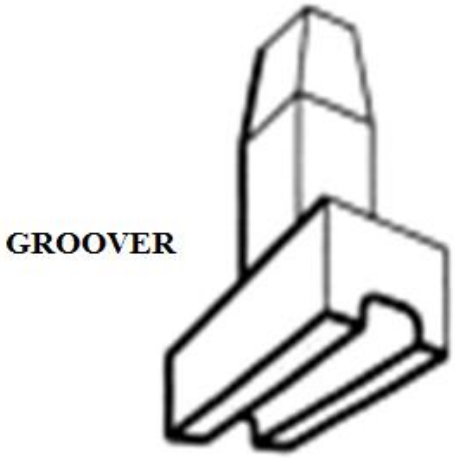
MALLET

JOINING TOOLS:

The tools exclusively used for making and finishing joints are:

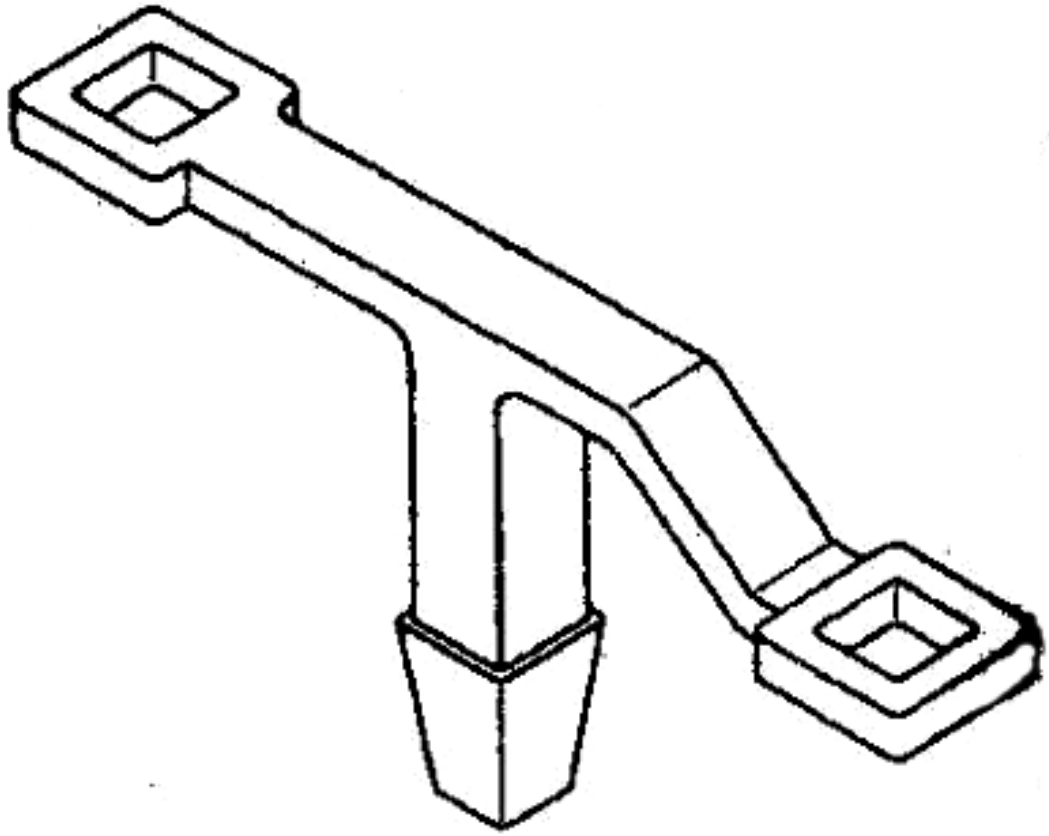
Hand Groover:

Hand groovers are used to flatten and shape joints made in sheet metal. The tool has a groove of required width and depth like a die. This groover is placed over the joint(double hem or lock seam) and hammered from the top of it, to shape the joint that of the groove.



Stakes

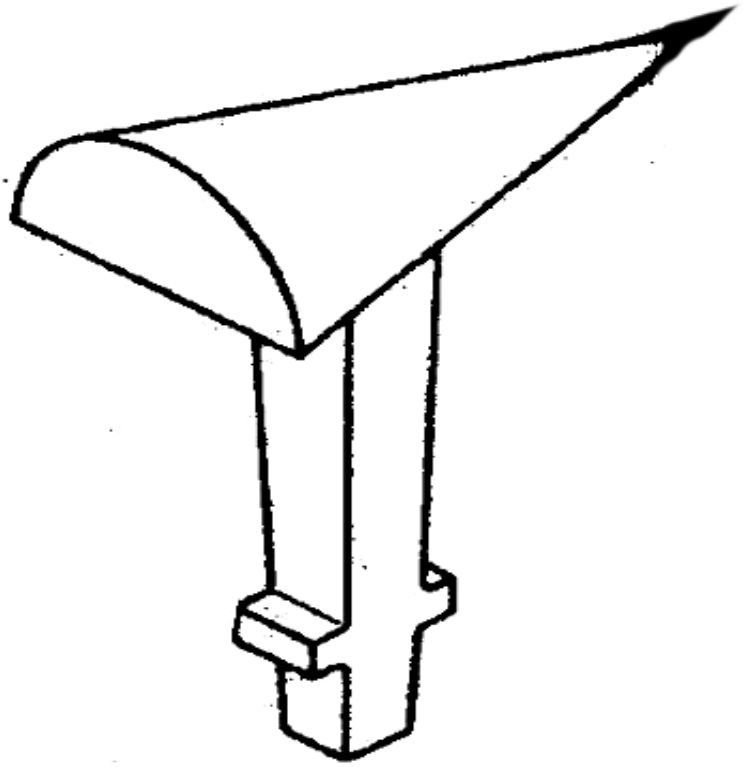
Various types of stakes are used to form the metal sheets into different types of shapes. The stake is a sort of anvil, which supports the sheet for sheet metal work. Stakes consist of a shank and a head or horn. The shank of the stake is designed to fit into a tapered bench socket. The head or horn of stake is available in a number of varieties of sizes and shapes. Working faces of stakes are machined to required shape. With the use of tools like hammer, operations such as bending, seaming or forming can be performed easily with stakes. Few stakes are made of forged mild steel faced with cast steel material. Whereas the better class stakes are made either of cast iron or cast steel material.



HORSE HEAD STAKE

Horse Head Stake :

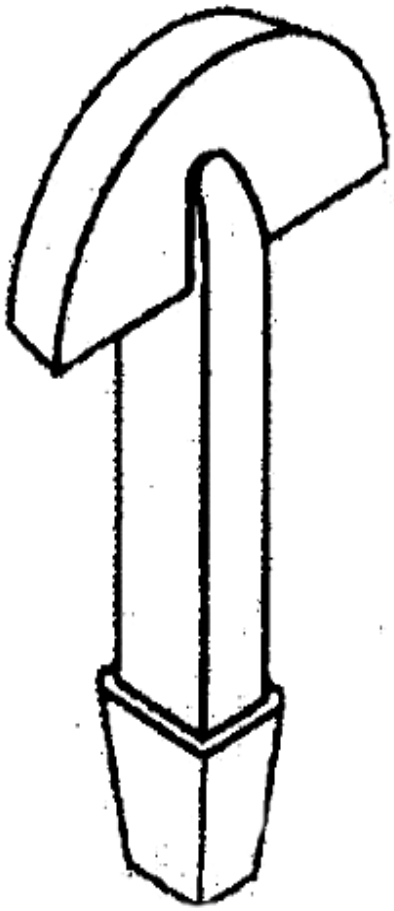
It is double ended holder for small stakes - one of which is cranked downwards for clearance purpose and has square holes at both ends. It is used for working beads, flats etc. on cylindrical work.



FUNNEL STAKE

Funnel Stake

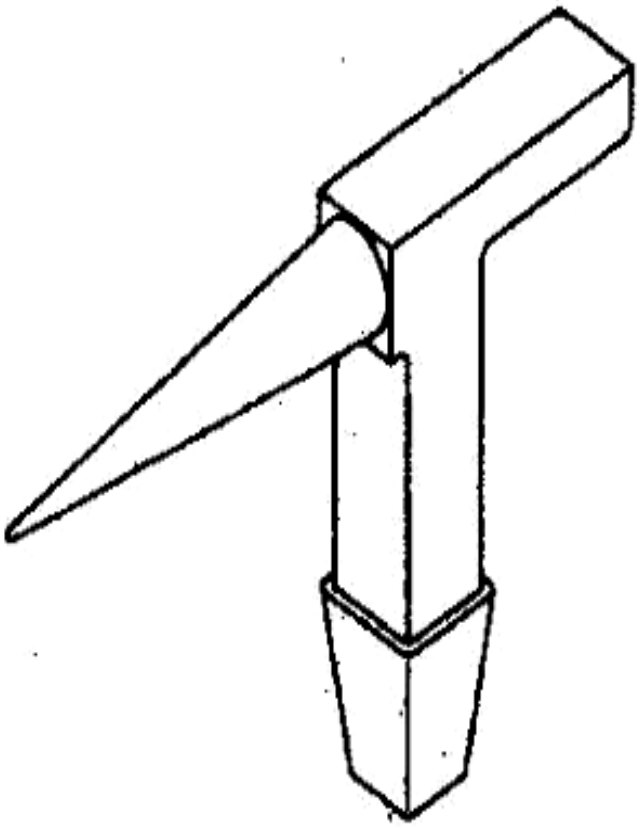
It is used for shaping and grooving conical articles, such as shaping of body of a funnel and forming a grooved seam along with such articles. This is also used for removing dents of conical articles.



HALF MOON STAKE

Half Moon Stake

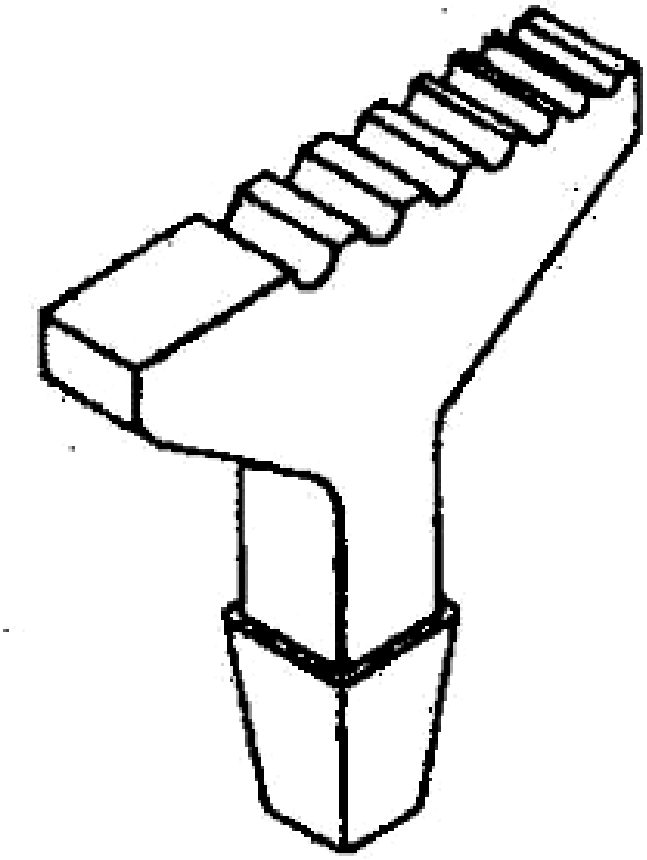
This stake has a sharp edge in the form of an arc of a circle, slanted along one side. It is used for turning over the edges of cylindrical & conical articles and for wiring edge of curved work.



BEAK HORN STAKE

Beak Stake or Beak Iron –

It has two horns, one of which is tapered, the other a rectangular shaped anvil. The thick taper or "beak" is used when working on conical, cylindrical and sharp tapering articles. Rectangular shaped anvil may be used for squaring corners, sealing and light riveting.



GROOVING STAKE

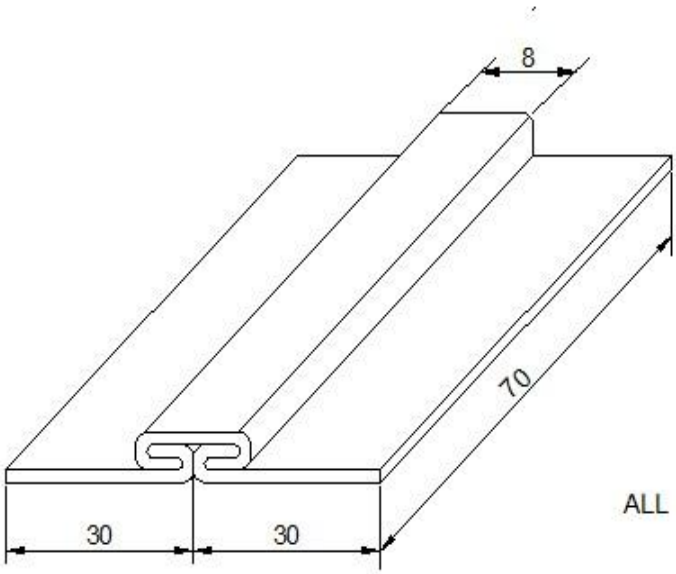
Grooving Stake / Creasing Iron

It has two rectangular shaped horns, one of which is plane. The other horn contains a series of grooving slots of various sizes. It is used to reduce the diameter of small tubes, produce a groove or a crease in sheet metal and also in the process of wiring (setting and stretching of wired edge).

EX.NO:1

DATE:

DOUBLE GROOVED JOINT



ALL DIMENSIONS ARE IN MM

EX.NO: 1

DATE:

DOUBLE GROOVED JOINT

AIM:

To make a Double grooved joint with a given piece of sheet.

TOOLS REQUIRED:

Bench Vice, Mallet, Steel Rule, Scriber, Try Square, Snips, file

MATERIALS REQUIRED:

A piece of ……. SWG GI sheet dimensions…….

OPERATIONS TO BE CARRIED OUT:

Marking, Cutting, Filing, Leveling, Bending, Finishing.

PROCEDURE:

Prepare a GI piece of dimension……. by filing and leveling the given pieces. 4mm is marked from edges of both sheets and bend through that marking pieces hooked and joined with the help of mallet, bend the allowance of the third piece in the shape of a cap. Connect with the third as in the figure, thus complete the work of Double Grooved Joint.

PRECAUTIONS:

1. Care should be taken while cutting with snip.
2. Care should be taken while bending and jumping

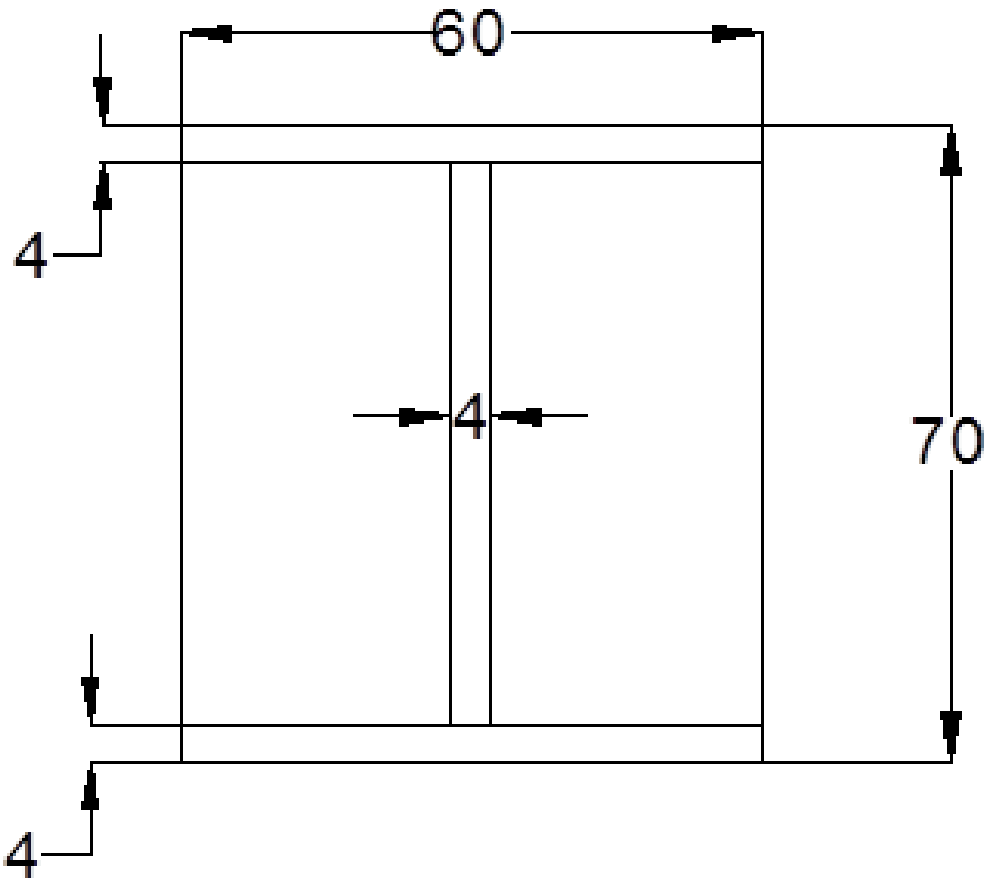
RESULT:

Double Grooved Joint is formed.

EX.NO: 2

DATE:

CUP MODEL



All Dimensions are in mm

EX.NO: 2

DATE:

CUP MODEL

AIM:

To make a Cup Model as per required dimensions.

MATERIALS REQUIRED:

A piece of ……. SWG GI sheet dimensions…….

TOOLS AND EQUIPMENT REQUIRED:

Steel rule, Bench Vice, Flat file, Scriber,Mallet, Try square, Snips, Dot punch, Stakes.

OPERATIONS TO BE CARRIED OUT:

Planning, Marking, Cutting, Bending, Filing, Leveling, Bending, Finishing

PROCEDURE:

The development of the cylinder is drawn with a diameter of…… Then sketch the development on the sheet. Cut out the sketch. Then 4mm is marked length wise and folded sheets and locked two ends us groover. Lastly make panned down joint, next bottom side make knocked up joint and finished the cup model.

PRECAUTIONS:

Care should be taken while cutting with snip.

Care should be taken while bending and jumping.

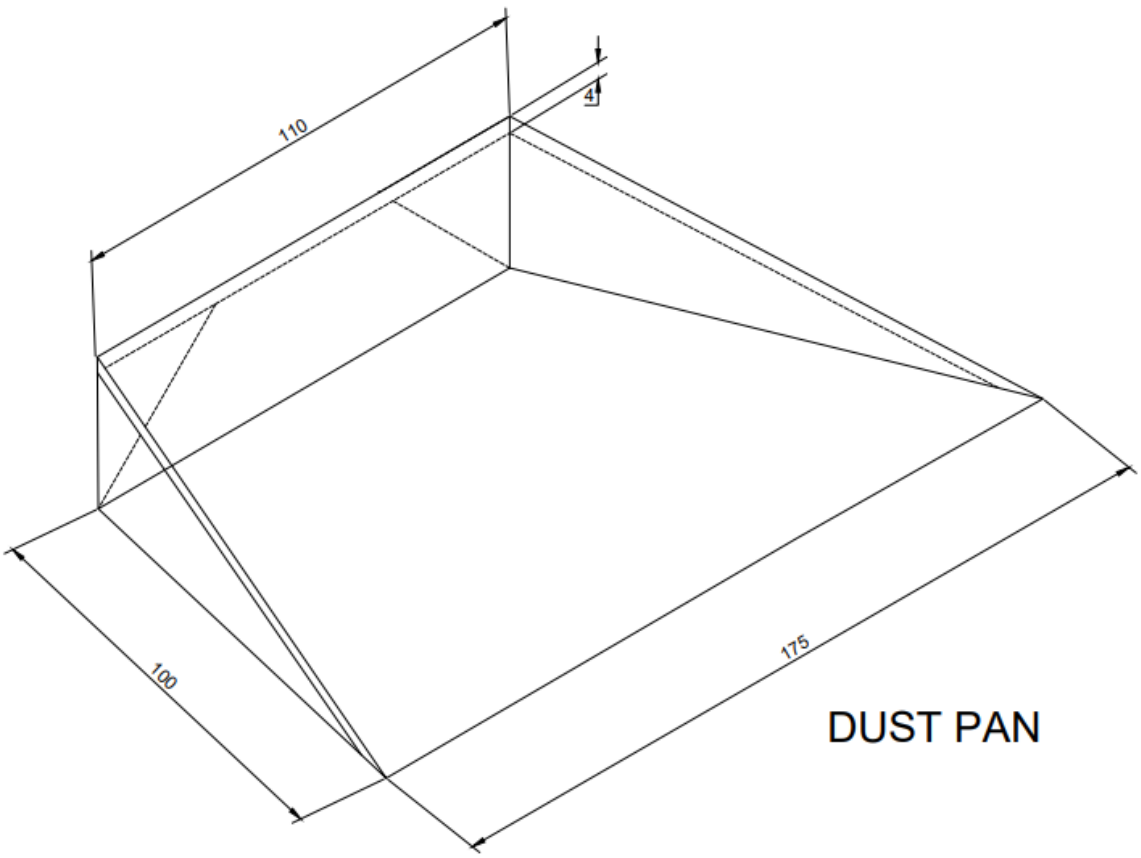
RESULTS

Cup Model is formed.

EX.NO: 3

DATE:

DUST PAN MAKING



All dimensions are in mm

EX.NO: 3

DATE:

DUST PAN MAKING

AIM:

To make Dust pan as per the given sketch

MATERIALS REQUIRED:

A piece of ……. SWG GI sheet dimensions…….

TOOLS AND EQUIPMENT REQUIRED:

Steel rule, Bench Vice, Flat file, Scriber, Mallet, Try square, Snips, Dot punch, Stakes.

OPERATIONS TO BE CARRIED OUT:

Planning, marking, developing, cutting, bending, filing, leveling, notching, Setting and Finishing

PROCEDURE:

Level the sheet and Develop the Pattern by adding allowances. Cut the sheet, cut the notches. Remove burrs and complete the single hemming. Bend the sides and bend the allowances of lap joint and thus complete the work of dust pan.

PRECAUTIONS:

Care should be taken while cutting with snip.

Care should be taken while bending and jumping

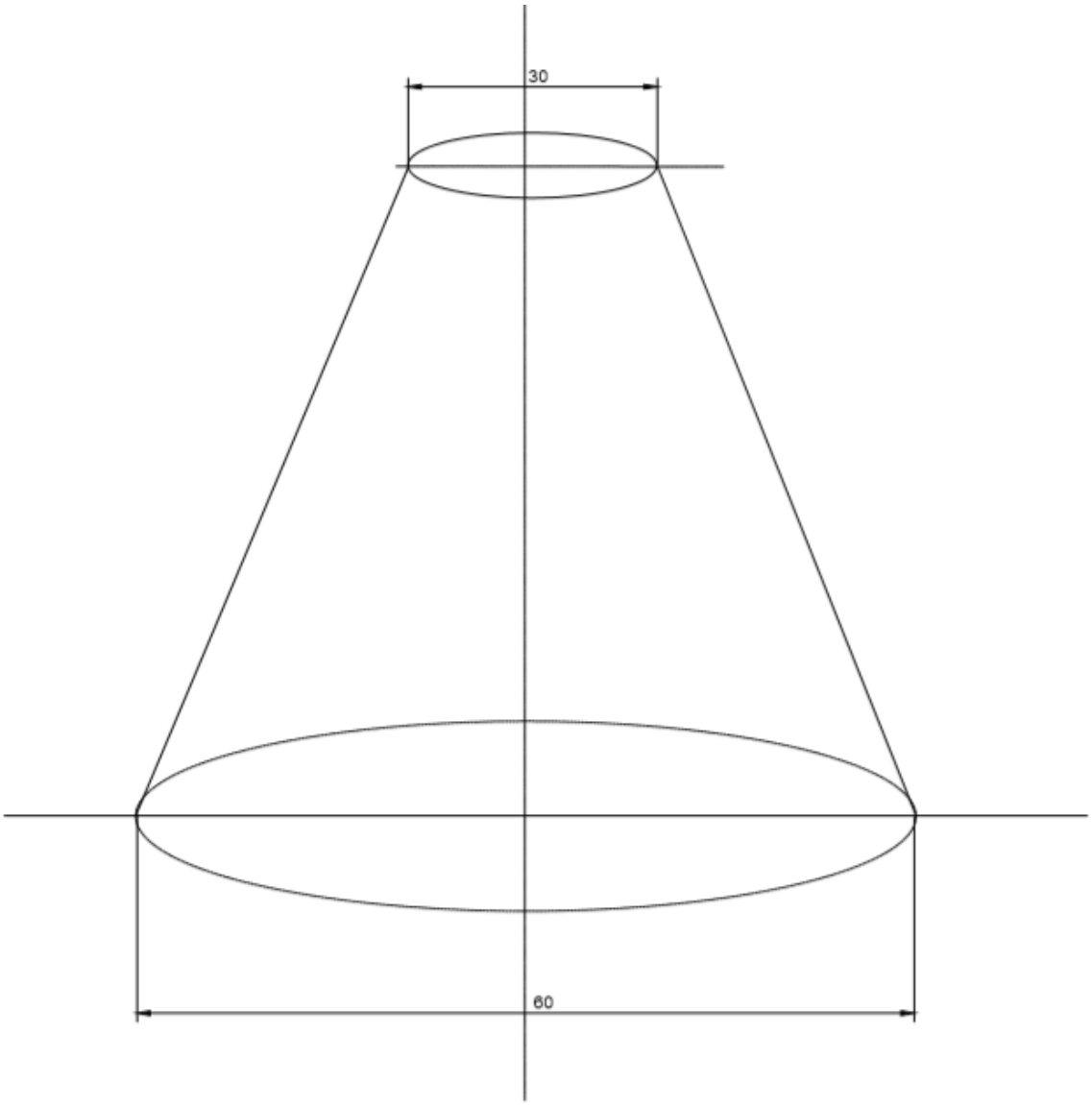
RESULTS

Dust pan is formed

EX.NO: 3

DATE

FRUSTUM OF CONE



All dimensions are in mm

EX.NO: 3

DATE:

FRUSTUM OF CONE

AIM:

To make Frustum of Cone as per the given sketch.

MATERIALS REQUIRED:

A piece of ……. SWG GI sheet dimensions…….

TOOLS AND EQUIPMENT REQUIRED:

Steel rule, Bench Vice, Flat file, Scriber, Mallet, Try square, Snips, Dot punch, Stakes.

OPERATIONS TO BE CARRIED OUT:

Planning, marking, developing, cutting, bending, filing, leveling, notching, Setting and Finishing

PROCEDURE:

Procedure: Develop the pattern of Frustum of cone after preparing the sheet for the job, by adding the allowances, cut the sheet, bend the allowances and bend the sheet in required shape. Complete the Locked Grooved Joint and finish the work.

PRECAUTIONS:

Care should be taken while cutting with snip.

Care should be taken while bending and jumping

RESULTS

Frustum of cone is formed

****


GOVERNMENT POLYTECHNIC COLLEGE PERUMBAVOOR
SKILL · EXCELLENCE · SUSTAINABILITY

WELDING

SYLLABUS

COURSE TITLE	**:**	**WORKSHOP PRACTICE III**
COURSE CODE	**:**	**3027**
COURSE CATEGORY	**:**	**B**
PERIODS/ WEEK	**:**	**6**
PERIODS/ SEMESTER (I & II)	**:**	**90**
CREDIT	**:**	**3**

TIME SCHEDULE

MODULE	TOPICS	PERIOD
1	Machine Shop	24
2	Fitting.	24
3	Sheet Metal, Aluminum Fabrication	22
4	Welding	20
	Total	90

Course outcomes:

STUDENT WILL BE ABLE TO:

Sl.No.	Sub	Students will be able to
1	1	work on lathes.
	2	work on shaper machine.
	3	work on drilling machine
2	4	Understand the fitting practice and use of gauges.
	5	Work in sheet metal shop and aluminum fabrication.
	6	Work on welding machine.

Course Distribution

Module	Name of Module	Course outcome No.	Total periods per Semester		
			Instructional	Test	Total
1	Machine Shop	1 2 3	Theory practical: 21	3	24
2	Fitting.	4	Theory practical: 21	3	24
3	Sheet Metal, Aluminum Fabrication	5	Theory practical: 21	3	22
4	Welding	6	Theory practical: 21	3	20
		Total periods per semester			**90**

CONTENT DETAILS

MODULE IMACHINE SHOP

Understand the safety precautions

1.1.0 Lathe work

1.1.1 Familiarization with lathes- principal parts, work holding device, measuring instruments, accessories & attachments

1.1.2 Plain turning to the given accuracy - Practice with Precision measuring devices - use of digital vernier and Micrometer

1.1.3 Taper turning

1.1.4 Form turning (ball and curve)

1.1.5 Combination of above operations (taper, ball and curve)

1.2.0 Work on shaper

1.2.1 Familiarize with the parts, accessories and attachments.

1.2.2 Simple operations on Shaper (Planning)

1.2.3 Shaping of a rectangular block

1.2.4 Shaping a 'V' in a rectangular block

1.3.0 Work on drilling machine

1.3.1 Familiarization of drilling machine parts

1.3.2 Marking and drilling holes

1.3.3 Boring and counter boring

1.3.4 Reaming

1.3.5 Combination works

MODULE II FITTINGPRACTICE

2.1 Study of measuring gauges-dial gauges, feeler gauges, thread gauges

2.2 Working from a given blue print exercises involving marking filing, drilling, reaming and tapping to an accuracy of 0.02mm (T- joint, V-joint, Single dovetail joint)

MODULE III SHEET METAL &ALUMINIUM FABRICATION

3.1 Understand safety precautions.

3.2 Familiarization of sheet metal tools – scribers, dividers, trammel points, set square, punches –prick punches, centre punches – hand Grover, rivet, chisels, hammers, riveting hammers, ballpeen hammers – mallet, snip shears, pliers, hand seamers (tongs) files, stakes. Measuring instruments in sheet metal - folding rule, common rule, steel circumference rule, vernier calipers, micrometer, combination set, Thickness gauges – Plate gauge.

MODULE IV WELDING

4.1 Safety precautions

4.2 Study of various tools and equipment's used in the welding shop for both arc welding and gas welding (review)

4.3.0 Practice work

4.3.1. D.C. arc welding (review of practice)

4.3.2. A.C. arc welding (review of practice)

4.3.3. Gas welding (review of practice)

4.3.4. Horizontal, flat, vertical and overhead welding

4.3.5. Edge preparation of welded joint such as V, double V.

4.3.6. Pipe welding – linear and round

4.3.7. Flame cutting

GENERAL INFORMATION:

*Class is divided into 2 batches (Batch I and Batch II). For Batch I –it is M/c. Shop and Fitting shop and for Batch II- it is Sheet metal, Aluminum fabrication and welding. This syllabus should be continued for Semester IV also by interchanging the batch of students.

This syllabus should be continued for Semester IV also by interchanging the batch of students.

SEMESTER IV

SYLLABUS

COURSE TITLE : WORK SHOP PRACTICE – IV & MINI PROJECT
COURSE CODE : 4029
COURSE CATEGORY : A
PERIODS/ WEEK : 6
PERIODS/ SEMESTER : 90
CREDIT : 5
GENERAL INFORMATION:

- Same as for Semester-III
- Batches I and II are to be interchanged to compensate.
- Student should work 35 periods (5days) for completing mini project
- One of the exercise done in the workshop should be related to the industrial product.
- Fabrication of Nut & Bolt, Bucket, Office tray, etc., and maintenance of available machinery in the
- workshop/ lab will be treated as mini project
- Group work for students can be assigned to undertake repair and maintenance works
- At the end of the semester each student shall prepare a report on mini project for evaluation certified by the Head of department.

GENERAL SAFETY

- Wear safety glasses or face shields designed for the type of the work
- Wear safety shoes with thick soles.
- Wear clothing suited for the job.
- Don't wear rings, Watches, bracelets or other jewellery that could get caught in moving machinery.
- Don't wear neck ties or loose turn clothing of any kind.
- Wear shirts or uppers with sleeves cut off or rolled above the elbows.
- Be sure you have sufficient light to see in Work area.
- Get first aid immediately for any injury.
- Don't talk to others when they are operating a machine.
- Keeping floor free from oil, grease or any other liquid.
- Store materials in such a Way that they cannot become tripping hazards.
- Don't leave tools or work on the Work table.
- Keep tools always in Cupboards when not in use.
- Place the scrap materials in the box provided.
- Be sure that all machines have effective and properly working guards.
- Don't operate any machine unless authorized, to do so by the instructor.
- Don't attempt to oil, clean, adjust or repair any machine while it is running,
- Keep the floor clean of metal chips or curls and waste pieces; put them in boxes provided for such things.
- Don't operate machinery before getting instruction.

WELDING

SAFETY PRECAUTIONS

1. Always weld in a dry & properly ventilated area.
2. Avoid breathing the welding fumes.
3. Use proper gloves, helmet, shield & protective clothing.
4. Read and follow correct welding procedure.
5. Always wear proper dress and shoes in the work shop.
6. A worker should not wear loose cloths, necktie etc.
7. The working places should be kept clean and free from oil and grease.
8. The work bench and machine should be clean.
9. The tools and measuring instruments should be kept in their proper places.
10. The adequate ventilation, lighting shall be provided.
11. The machine should not be left in running position while go for an urgent call.
12. Wear safety goggles face shield to protect eyes or face at the time of chipping, grinding and welding.
13. Fire extinguisher should be available.
14. The machine should be operated by skilled Workman.

INTRODUCTION

Welding is a process of joining similar or dissimilar metal pieces. Welding is a metal joining method in which the joining edges are heated and fused together to form a permanent bond. Riveting, assembling with bolt, seeming, soldering and brazing are temporary joints. Welding is the only method to join metals permanently. It is the strongest joint and any type of metals of any thickness can be joined. Welding process is employed in most of the modern fabrication work.

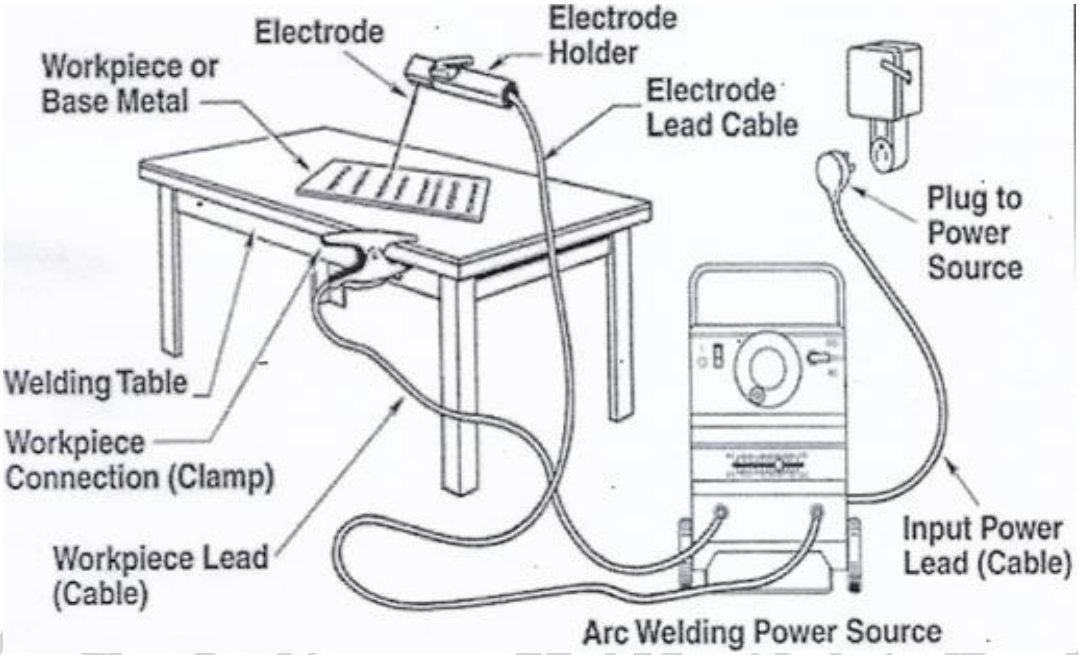
What is Welding?

Welding is a process by which metals are joined together by heating them to a suitable temperature with or without the application of pressure and with or without application of filler materials.

WELDING METHODS

WELDING METHODS			
Fusion welding			**Non fusion welding**
Without pressure welding		**With pressure welding**	**soldering**
Gas welding	Arc welding	Forge welding	Brazing
Oxy-Acetylene	Carbon arc	Resistance welding	Bronze welding
Oxy-coal gas welding	TIG welding	Friction welding	
Oxy-hydrogen welding	MIG welding		
Oxy-LPG gas welding	Submerged		

Arc welding is a type of welding that uses a welding power supply to create an electric arc between an electrode and the base material to melt the 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 usually protected by some type of shielding gas, vapor, or slag. Arc welding processes may be manual, automatic.



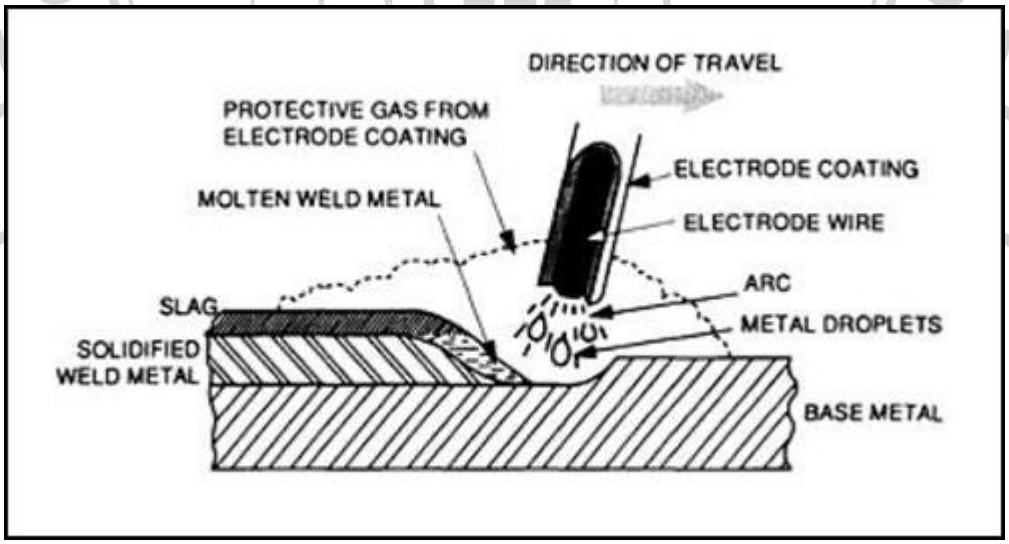
ARC WELDING MACHINES

Three types of welding machines are

a. Welding transformer.

b. Welding generator.

c. Welding Rectifiers



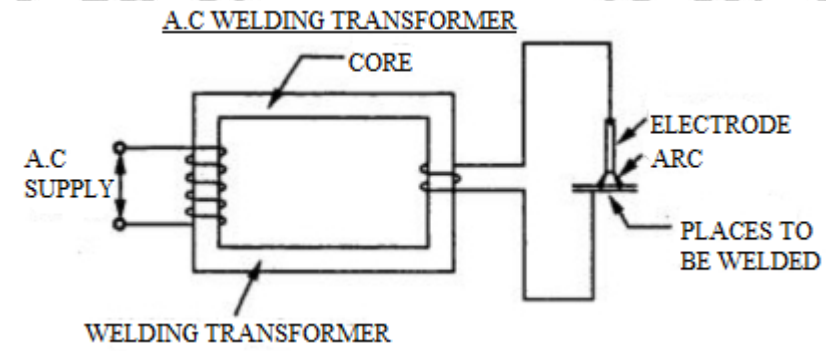
WELDING TRANSFORMER

Welding transformer is a transformer having thin primary winding with large number of turns. While the secondary is having more area of cross section and with less number of turns. This ensures very high current and less voltage in the secondary. Reduces the main supply voltage (220v or 440v) to welding supply open

circuit voltage (OCV) between 40 and 100 volts, Increases the main supply low current to the required high output welding current in hundreds of amperes.

One end of the secondary is connected to welding electrode and another end is connected to the pieces to be welded. Due to the contact resistance between the electrode and pieces to be welded, when a very high current flows, large amount of heat is produced. Due to this heat, tip of the electrode melts and fills the gap between the two pieces.

A winding used for the welding transformer is highly reactive or a separate reactor may be added in series with the secondary winding.



WELDING GENERATOR

It is used to generate D C for arc welding. It may be motor driven or engine driven. The generator is driven by an A C motor and main supply is essential to run the machine. In engine driven type the generator is driven' by a petrol or diesel engine. It can be used anywhere in field work away from electric lines.

WELDING RECTIFIERS

It is used to convert A C in to D C supply and does not have any rotating parts. Basically it is an A C welding transformer but the output of the transformer is converted with a rectifier to change the AC in to DC.

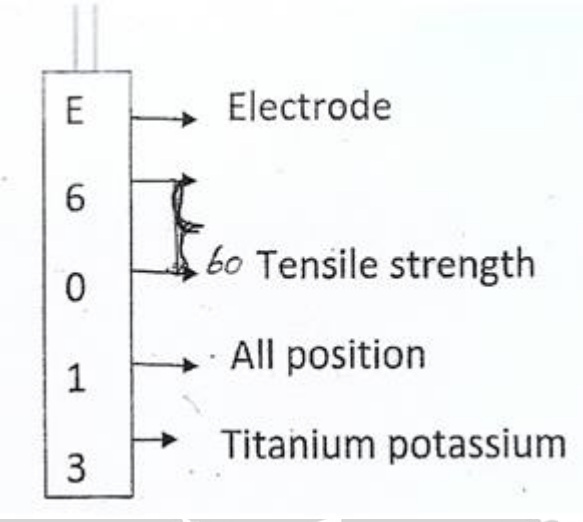
ELECTRODES FOR ARC WELDING

Arc welding electrodes are classified as

1. Non consumable electrode.

2. Consumable electrode

Non consumable electrodes may be of carbon graphite or tungsten. Which do not consumes during welding operation. Consumable electrodes may be made of metals depends upon the metals to be welded



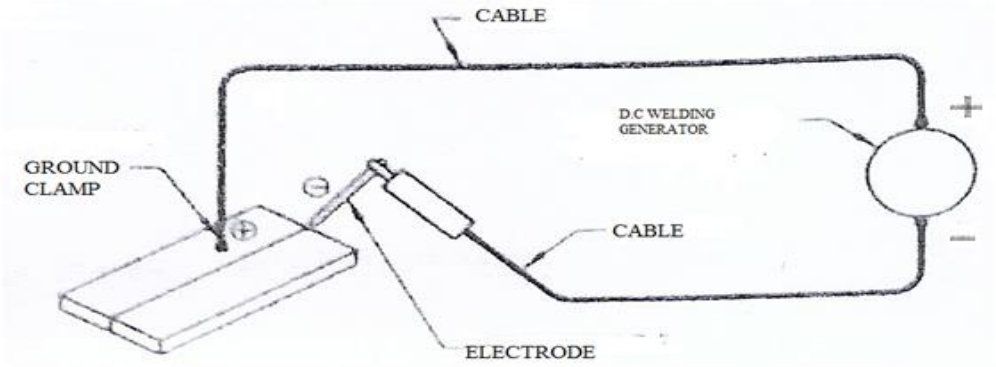
CODING OF ELECTRODE

WELDING POLARITY

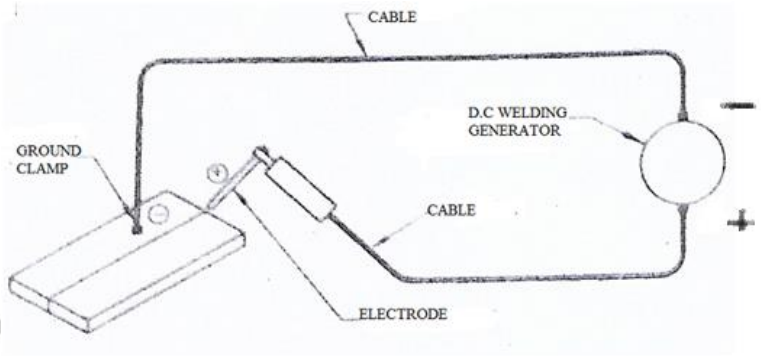
Arc welding polarity indicates the direction of current flow in the welding circuit.

Kinds of polarity

Straight polarity: In straight polarity the electrode is connected to the negative and the work to the positive terminal of the power source.



Reverse Polarity: In reverse polarity the electrode is connected to the positive and the work to the negative terminal of the power source



ADVANTAGES AND DISADVANTAGES OF A.C.WELDING AND D.C. WELDING MACHINE

Advantages of AC welding

- A welding transformer has;
- A low initial cost to simply and easy construction
- A low Operating cost due to less power consumption.
- No effect of arc blow during welding due to AC.
- Low maintenance cost due to the absence of rotating parts.
- Higher working efficiency.
- Noiseless operation

Advantages of DC welding

- Required heat distribution is possible between the electrode and the base metal due to the change of polarity (positive 2/3 and negative 1/3).
- It can be used successfully to weld both ferrous and non-ferrous metals.
- Bare wires and light coated electrodes can be easily used.
- Positional welding is easy due to polarity advantage.
- It can be run with the help of diesel or petrol engine where electrical mains supply is not available.

- It can be used for welding thin sheet metal, cast iron and non-ferrous metal successfully due to polarity advantage
- It has less possibility for electrical shock because of less open circuit voltage.
- It is easy to strike and maintain a stable arc.
- Remote control of current adjustment is possible.

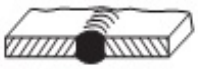
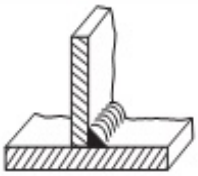
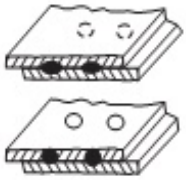
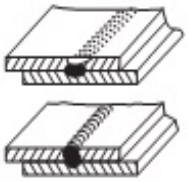
Disadvantages of AC welding

- It is not suitable for bare and light coated electrodes.
- It has more possibility for electrical shock because of higher open circuit voltage
- Welding of thin gauge sheets, cast iron and non-ferrous metals will be difficult.
- It can only be used where electrical mains supply is available. `

Disadvantages of DC welding

- Higher initial cost- a higher operating cost
- Higher maintenance cost- trouble of arc blow during welding
- Lower working efficiency- occupies more space.
- Noisy operation in the case of a welding generator

BASIC WELDING SYMBOLS

No.	*Designation*	*Illustration*	*Symbol*
1.	Butt weld between plates with raised edges (the raised edges being melted down completely)		
2.	Square butt weld		
3.	Single-V butt weld		
4.	Single-bevel butt weld		
5.	Single-V butt weld with broad root face		
6.	Single-bevel butt weld with broad root face		
7.	Single-U butt weld (parallel or sloping sides)		
8.	Single-U butt weld		
9.	Backing run; back or backing weld		
10.	Fillet weld		
11.	Plug weld; plug or slot weld		
12.	Spot weld		
13.	Seam weld		

CURRENT RANGE OF ELECTRODE

Electrode size (mm)	Current (Amps)
2.00	50 - 75
2.50	60 - 90
3.15	100 – 140
4.00	140 - 180
5.00	180 - 230

WELDING DEFECTS

External defects

1. Under cut
2. Cracks
3. Blow hole and porosity
4. Slag inclusions
5. Edge of plate melted off.
6. Excessive reinforcement.
7. Insufficient throat thickness
8. Lack of penetration
9. Excessive root penetration
10. Overlap
11. Irregular bead appearance
12. Spatters

Internal defects

1. Cracks
2. Blow hole and porosity
2. Slag inclusion
4. Lack of fusion
5. Lack of root penetration
6. Internal stresses

WELDING POSITION

The welding positions are classified as follows.

1. Flat position (1G). The work piece is placed in a horizontal plane over a flat surface and the welding is done on the upper side of the joint.

2. Horizontal position (2G). The axis of the weld lines in a horizontal plane and its face in a vertical plane.

3. Vertical position (3G). In this position, the axis of the weld remains either vertical or at an inclination of $<45^0$.

4. Overhead position (4G). In this position the welding is done from the underside of the joint and work pieces remain over the head of the welder.

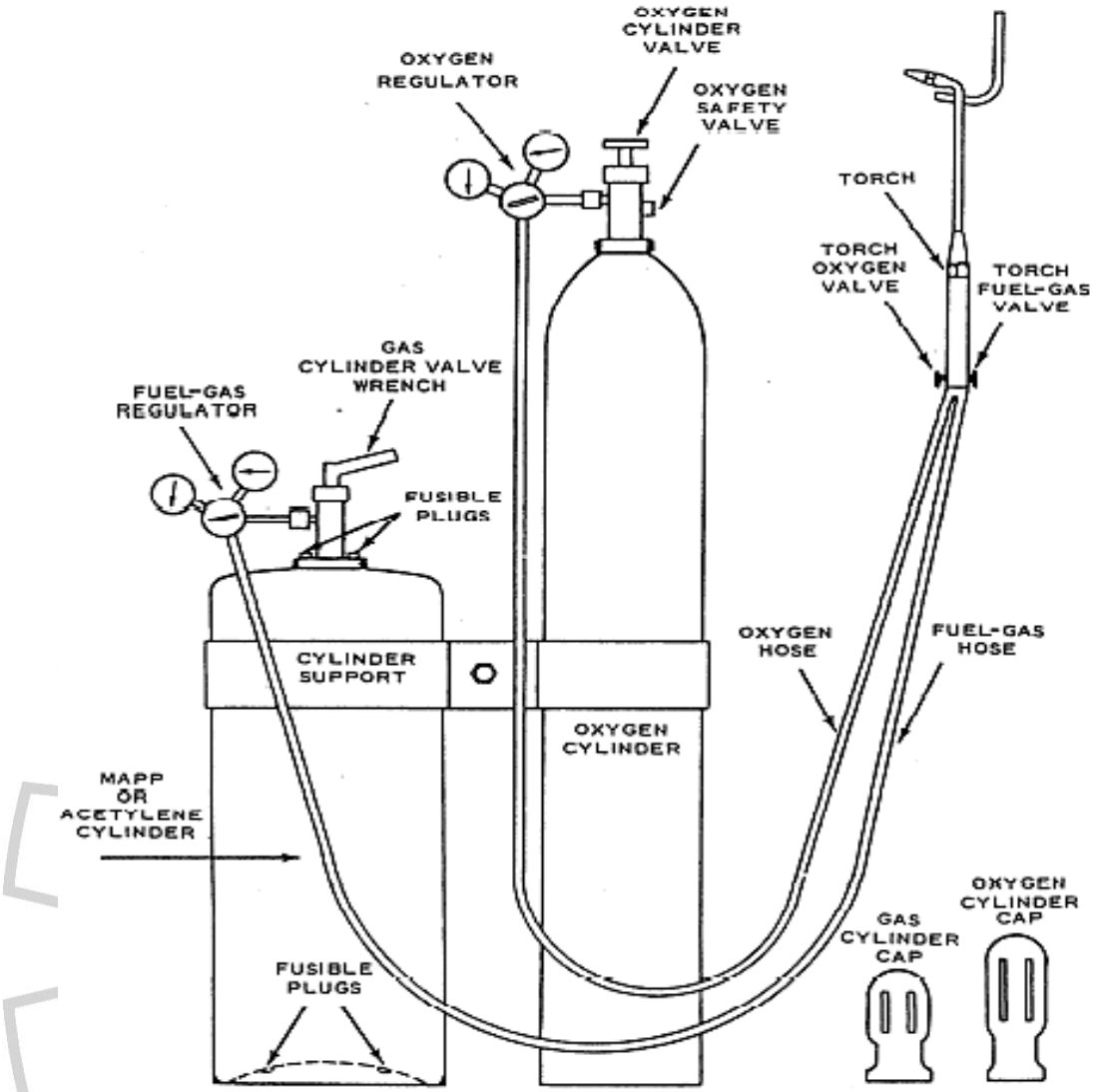
GAS WELDING

It is a fusion welding process in which metals are fused by a gas flame and joined together. A gas flame is obtained by the combustion of a fuel gas and oxygen. Different gas flame combinations commonly used for gas welding are

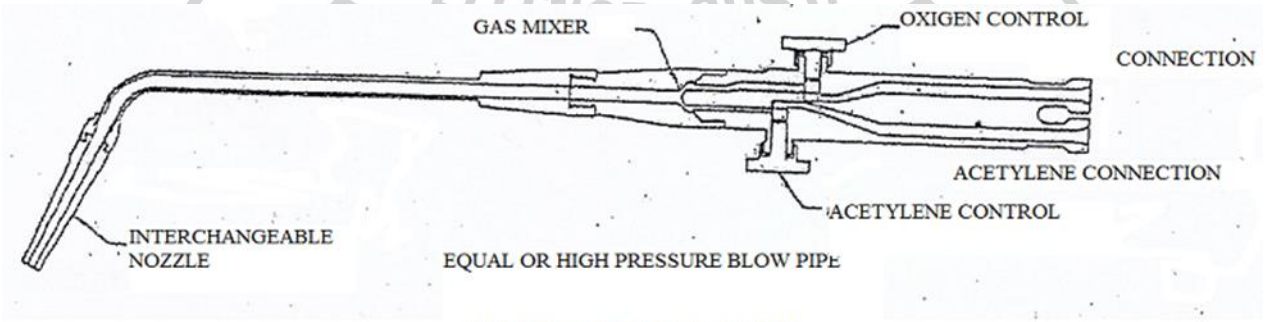
1. Oxy- Acetylene

2. Oxy - Hydrogen and

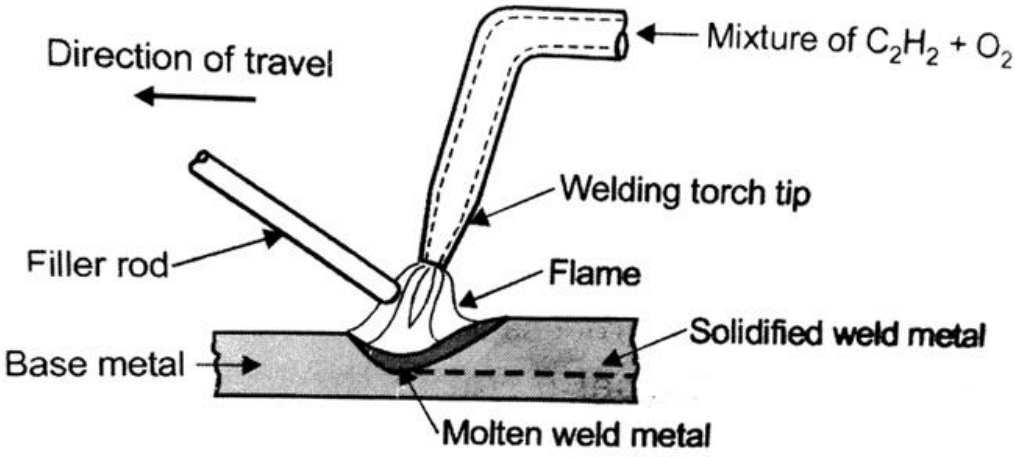
3. Oxy L.P.G. etc.,



OXY-ACETYLENE GAS WELDING UNIT



GAS WELDING BLOW PIPE



OXY -ACETYLENE FLAME

There are three kinds of flames.

1. **Neutral flame.**

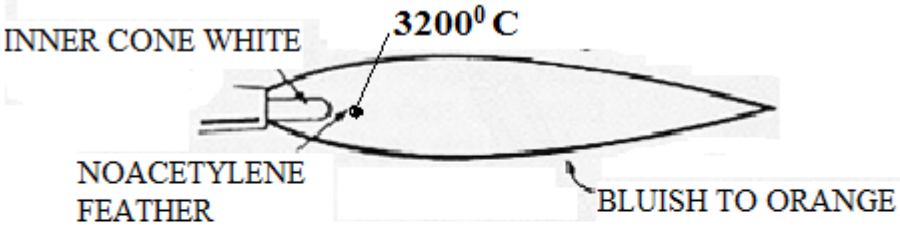
This type of flame is obtained by supplying equal volume of oxygen and acetylene. In this flame, the inner tip is white and the outer envelope is bluish. This flame is used for welding non-ferrous metal.

2. **Oxidizing flame.**

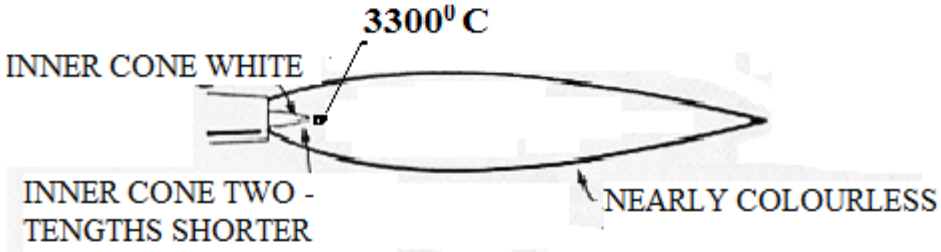
This type of flame is obtained by supplying excess of oxygen. It is similar to neutral flame but the inner cone is less luminous and shorter. It is used for welding brass and bronze.

3. **Carburizing flame.**

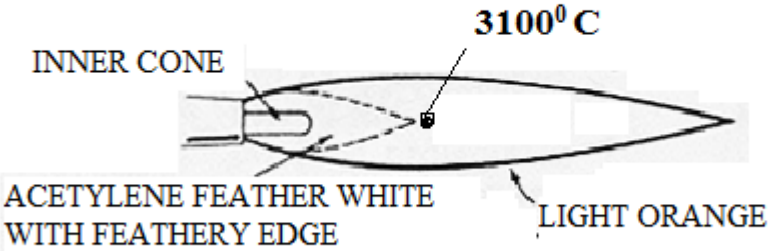
This type of flame is obtained by supplying an excess of acetylene. This flame has the following three zones. (a) inner cone (b) intermediate cone of whitish color (c) outer cone of bluish color. It is used a certain alloy steels and many of the non-ferrous metals.



NEUTRAL FLAME



OXIDIZING FLAME



CARBURIZING FLAME

OXY-ACETYLENE GAS WELDING FLAME

WHAT IS AN ALLOY?

lf two or more metals are chemically combined they form an alloy. example., Iron, Chromium Nickel and Carbon form an alloy called CHROMIUM NICKEL STEEL (Stainless Steel). Manganese, Iron and Carbon form an alloy called MANGANESE STEEL. Copper and Zinc form an alloy called BRASS.

CHEMICAL COMPOSITION OF CARBON STEEL

Low carbon steel (M.S.)		Medium carbon steel		High carbon steel	
Carbon	.10to.25%	Carbon	0.3-6%	Carbon	0.7-1.4
Manganese	0.8%	Manganese	0.8%	Manganese	0.8%
Sulphur	0.05%	Sulphur	0.05%	Sulphur	0.05%
Phosphorus	0.05%	Phosphorus	0.05%	Phosphorus	0.05%
Silicon	0.25%	Silicon	0.25%	Silicon	0.25%

MELTING POINT IN DEGREE CELCIUS

Mild Steel	1500 to 1530
Cast Iron	1150
Copper	1083
Aluminum	659
Brass & Bronze	850 – 950
Zinc	419
Tin	232
Lead	327
Nickel	1452
Soft solder	216

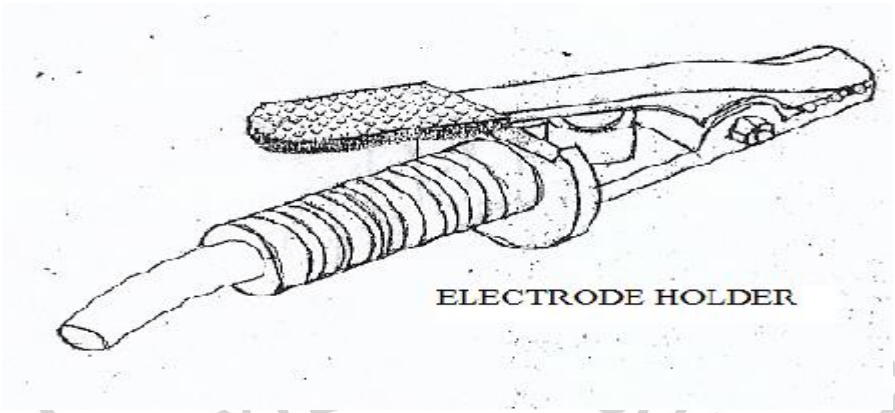
GAS WELDING FLUX

These are chemical compound used to prevent oxidation and other unwanted chemical reactions during welding. The common fluxes used are BORAX, SODIUM CARBONATE, SODIUM SILICATE for welding ferrous metals, mixture of SODIUM and POTASSIUM BORATES, CHLORIDES for welding copper alloys.

ELECTRODE HOLDER

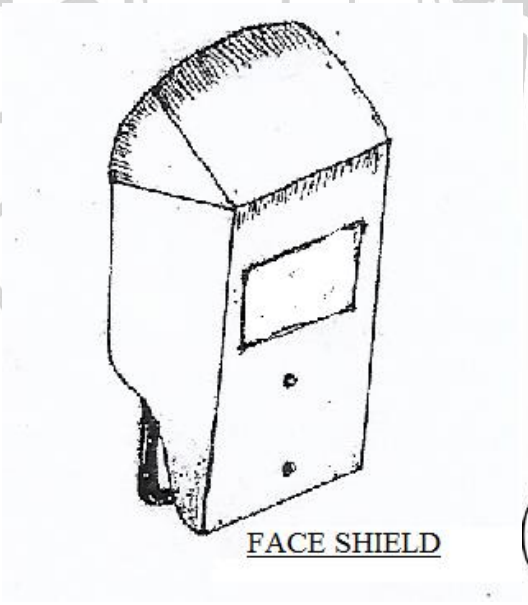
It is a clamping device used to grip and manipulate the electrode during arc welding. It is made of copper alloy for better electrical conductivity. Partially or

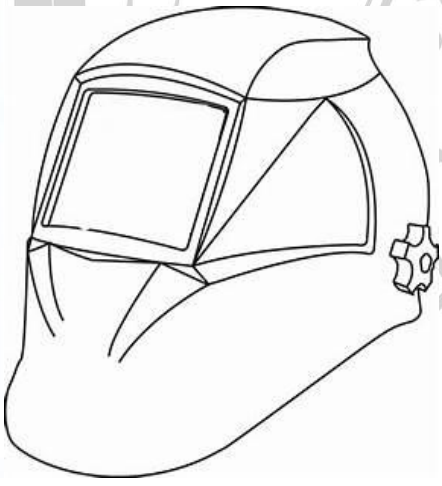
fully insulated holders are made in various sizes i.e. 200 -300 - 500 amps. The electrode holder is connected to the welding machine by a welding cable.



WELDING HAND SCREEN AND HELMET

These are used to protect the eyes and face of a Welder from arc radiation and sparks during arc welding. Screens are made of non-reflective, non-flammable insulated, dull colored, light material with colored (filter) glasses fitted with plain glasses on both sides to see the arc and molten pool while welding. Shade number of colored glass is 10 - 11 up to 100 to 300 amps.





WELDING HELMET

APRON `

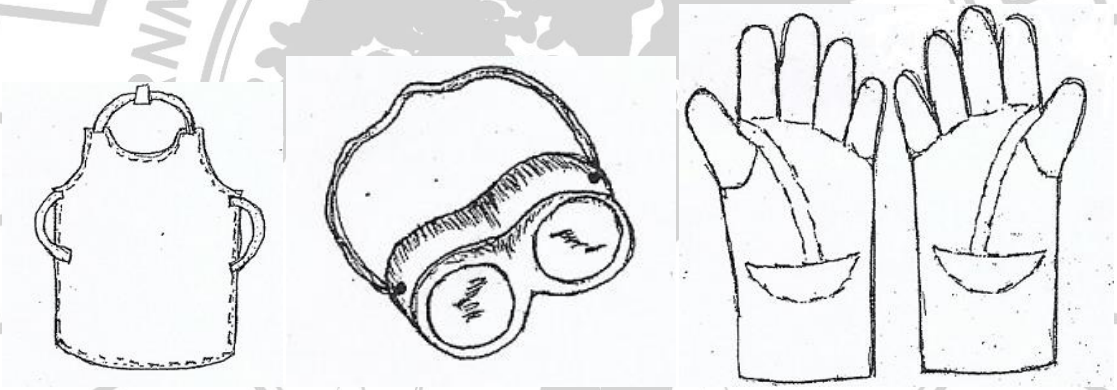
The leather apron is used to protect the body, neck and chest of the welder from the heat radiation and hot spatters from the arc and also from the hot slag particles.

GLOVES

The leather gloves are used to protect the hands, arms from the heat radiation and hot spatters from the arc.

GOGGLES

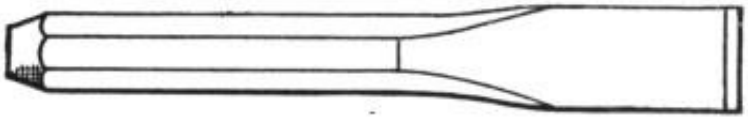
Goggles are used to protect the eyes while chipping the slag or grinding the job. It is made of Bakelite frame fitted with clear glasses and an elastic band to hold it.



APRON GOGGLES HAND GLOVES

FLAT CHISEL

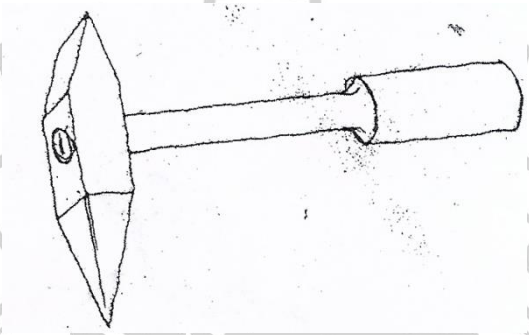
They are used to remove the taper or an uneven surface on the edge of the plate and make it flat and chip excess metal on weld joints and casting. Chisels are made from high carbon steel or chrome vanadium steel.



FLAT CHISEL

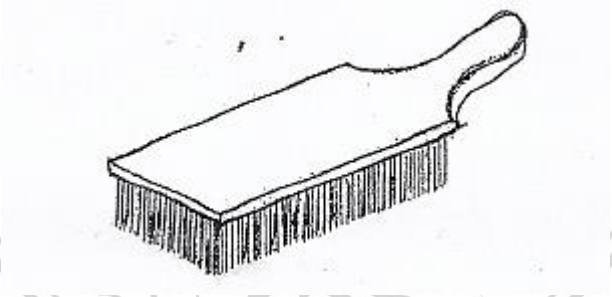
CHIPPING HAMMER

The chipping hammer is used to remove the slag which is deposited during welding. It is made of medium carbon steel with a mild steel handle. It is provided with a chisel edge on one end and other end is pointed for chipping off slag in any position.



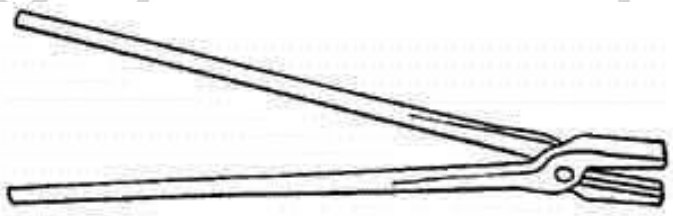
WIRE BRUSH

Wire brush is used for cleaning the work surface from rust, oxide and other dirt etc., prior to welding and cleaning weld bead. It is made of bunch of steel wire fitted on a wooden piece with handle.



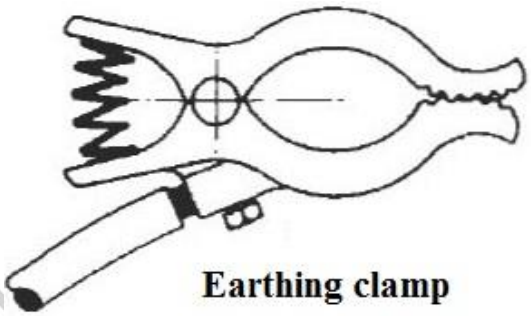
TONGS

Tongs are used to hold hot work pieces and to hold the job in position.



Flat Tongs

EARTH CLAMP: It is used to connect the earth cable from welding machine firmly to job or welding table. It is also made of copper/ copper alloys. Sizes of earth clamp are 200 - 300 - 500 amps.

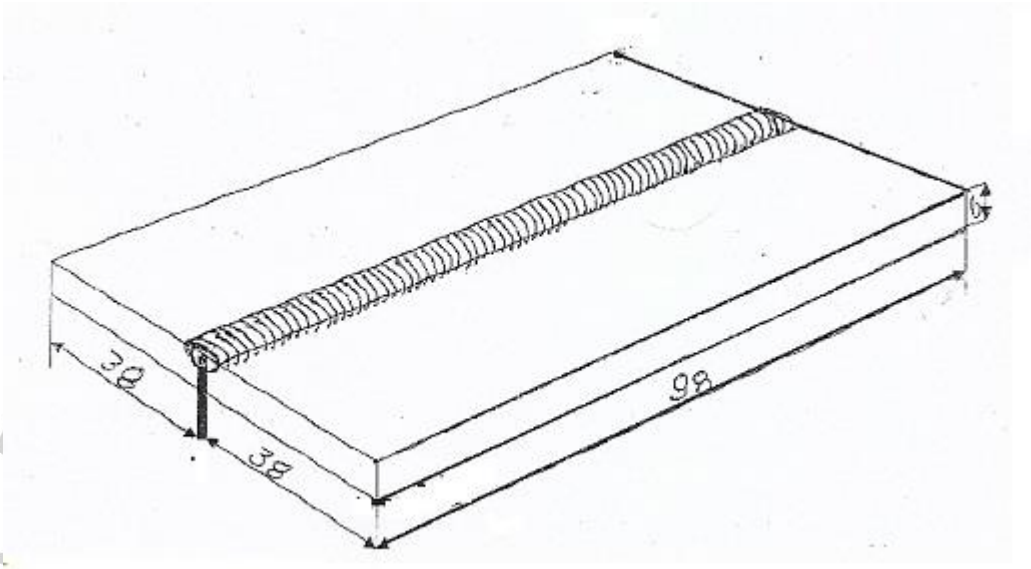


Earthing clamp

Ex.No:1

Date:

SQUARE BUTT JOINT



All dimensions are in mm

Ex.No1

Date:

SQUARE BUTT JOINT WELDING IN DOWN HAND POSITION

Aim

Square butt joint welding in down hand position

Materials required: -

102 x 40x 6 mm MS flat (2 Nos.), MS Electrode – (10 SWG) 3.15 mm.

Tools & Equipment's required: -

Steel rule, Scriber, Try square, Flat file, Dot punch, Ball peen hammer, Tongs, Chipping hammer, hacksaw, Wire brush, Gloves, Electrode holder, Bench vice, Welding transformer

Operations to be carried out: -

Marking, Punching, Cutting, filing, Welding, Chipping, Cleaning, Finishing.

Procedure:

1. Mark and cut the work piece to the required dimension using files, try square.
2. Switch ON the welding machine and adjust the welding current
   130 Amps - 150 Amps
3. Place the work piece on the weld table and tack the ends of the joint.
4, Weld through the square butt joint
5. Remove the slag and spatters from the weld bead.
6. Submit the model for inspection.

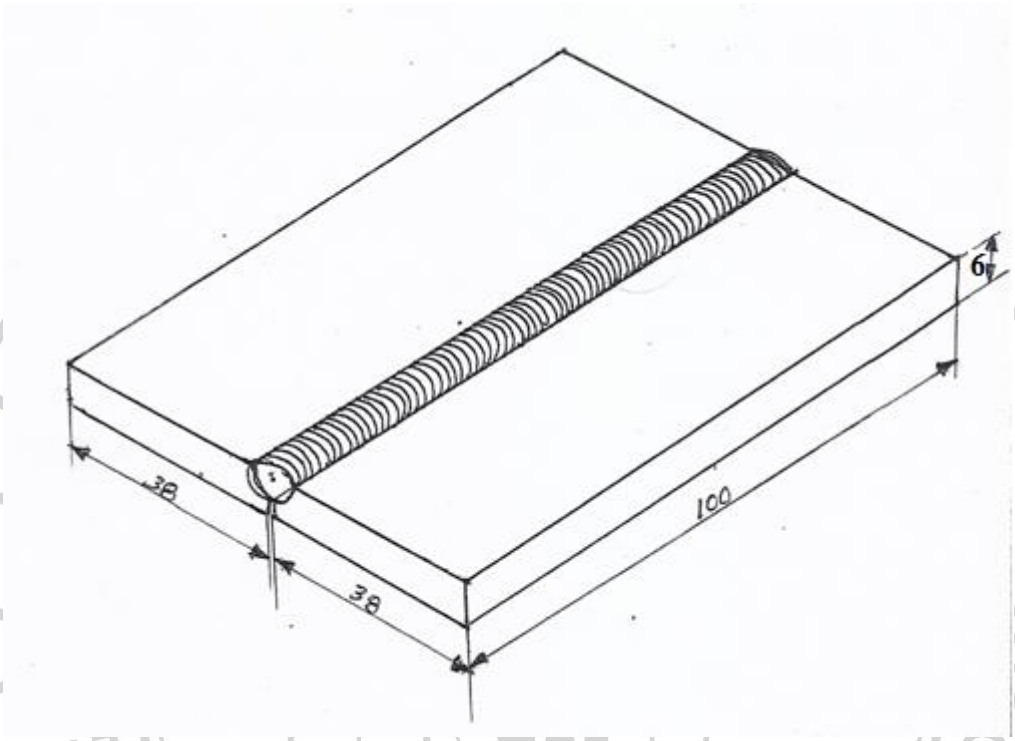
Result:

Square butt joint is obtained.

Ex. No:2

Date:

SINGLE 'V' BUTT JOINT



All dimensions are in mm

Ex. No:2

Date

SINGLE V BUTT JOINT IN DOWN HAND POSITION

Aim: To make a single 'V' butt joint in down hand position.

Materials Required:

102 x 40 x 6 mm MS flat (2 Nos.), MS Electrode – (10 SWG) 3.15 mm.

Tools and Equipment's Required: Steel rule, Try square, Hack saw, Flat file, welding shield, Chipping hammer, wire brush, Gloves, Flat tongs, Bench vice and welding transformer unit.

Operations to be carried out: Measuring, Marking, Cutting, Filing, Tacking, Welding, Chipping and cleaning.

Procedure

1. Mark and cut the required size as per dimensions.
2. File the edges of the work piece using flat file.
3. Check the earth connection and hold the electrode on the electrode holder.
4. Adjust the output ampere of transformer and switch it ON.
5. Place the work pieces on the work table and tack the ends of the joint.
6. Start welding from one end to other end of the joint.
7. After cooling, remove the slag from the weld bead using chipping hammer and wire brush.
8. Submit the model for inspection.

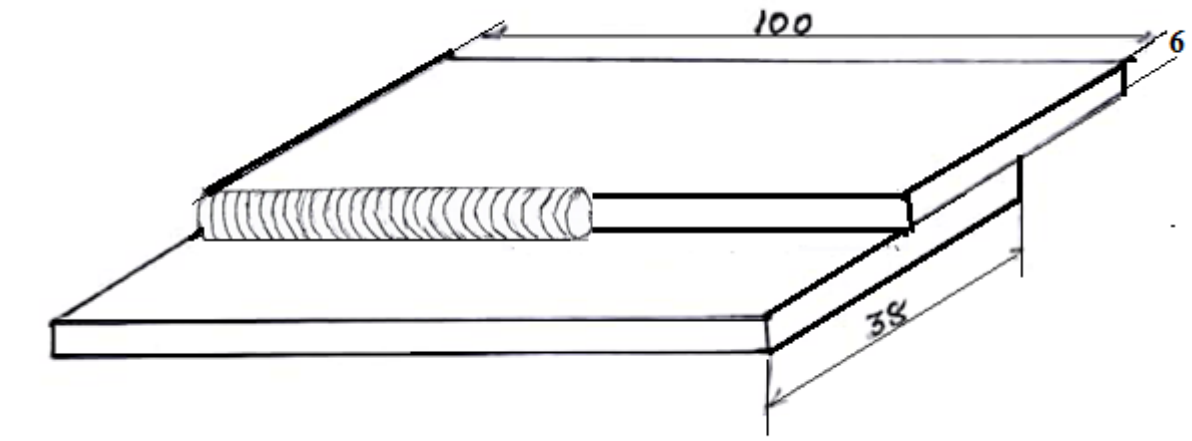
Result:

Single 'v' butt joint is obtained.

Ex.No.3

Date:

LAP JOINT IN HORIZONTAL POSITION



All Dimensions are in mm

Ex. No: 3

Date:

LAP JOINT IN HORIZONTAL POSITION

Aim:

To make a horizontal lap joint.

Materials Required:

102 x 40x 6 mm MS flat (2 Nos.), MS Electrode – (10 SWG) 3.15 mm.

Tools and Equipment Required:

Steel rule, Try square, Hack saw, Flat file, welding shield, Chipping hammer, wire brush, Gloves, Flat tongs, Bench vice and welding transformer unit.

Operations to be carried out:

Measuring, Marking, Cutting, Filing, Tacking, Welding, Chipping and cleaning.

Procedure

1. Check, mark and cut the required size of the work piece.
2. File the edges of the work piece using flat file.
3. Check the earth connection and hold the electrode on the electrode holder.
4. Adjust the output ampere of transformer and switch ON.
5. Place the work pieces on the worktable and tack them in horizontal position.
6. Start welding from one end to the other end of the horizontal joint.
7. After cooling, remove the slag from the weld bead using chipping hammer and wire brush.
8. Submit the model for inspection.

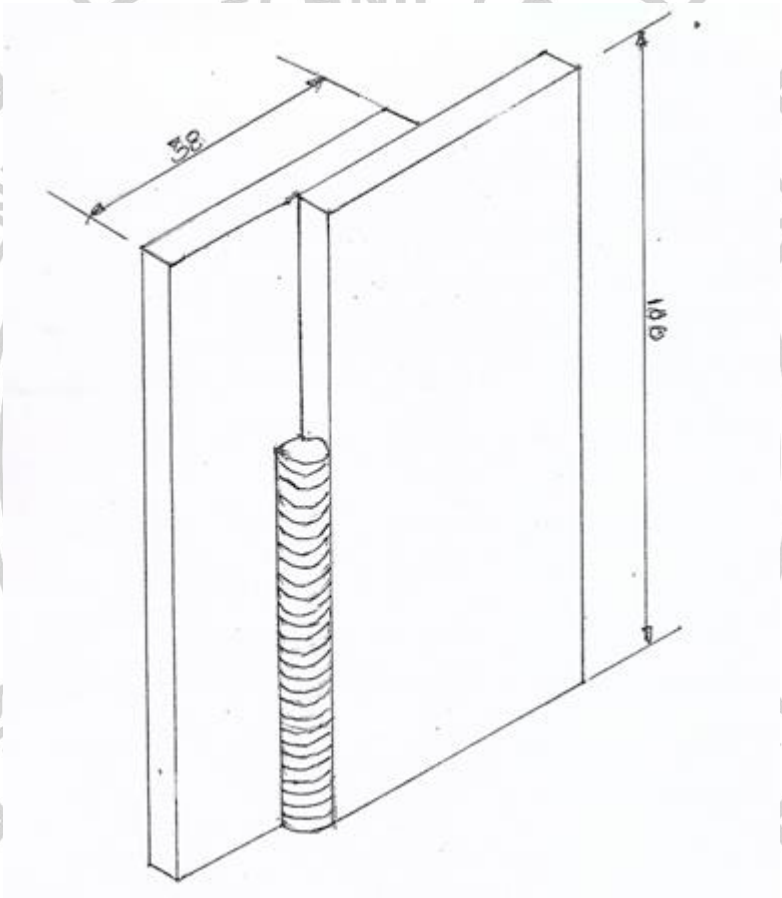
Result:

Horizontal Lap joint is obtained

EX. No: 4

Date:

LAP JOINT IN VERTICAL POSITION



All dimensions are in mm

Ex. No:4

Date:

LAP JOINT IN VERTICAL POSITION

Aim:

To make a vertical lap joint.

Materials Required:

102 x 40 x 6 mm MS flat (2 Nos.), MS Electrode – (10 SWG) 3.15 mm.

Tools and Equipment Required:

Steel rule, Try square, Hack saw, Flat file, welding shield, Chipping hammer, wire brush, Gloves, Flat tongs, Bench vice and welding transformer unit.

Operations to be carried out:

Measuring, Marking, Cutting, Filing, Tacking, Welding, Chipping and cleaning.

Procedure

1. Mark and cut the required size as per dimension.
2. File the edges of the work piece using flat file.
3. Check the earth connection and hold the electrode on the electrode holder.
4. Adjust the output ampere of transformer and switch it on.
5. Place the work pieces on the worktable and tack them.
6. Place the work piece on the worktable in vertical position.
7. Start welding from one end to other end of the vertical joint.
8. After cooling, remove the slag from the weld bead using chipping hammer and wire brush.
9. Submit the model for inspection.

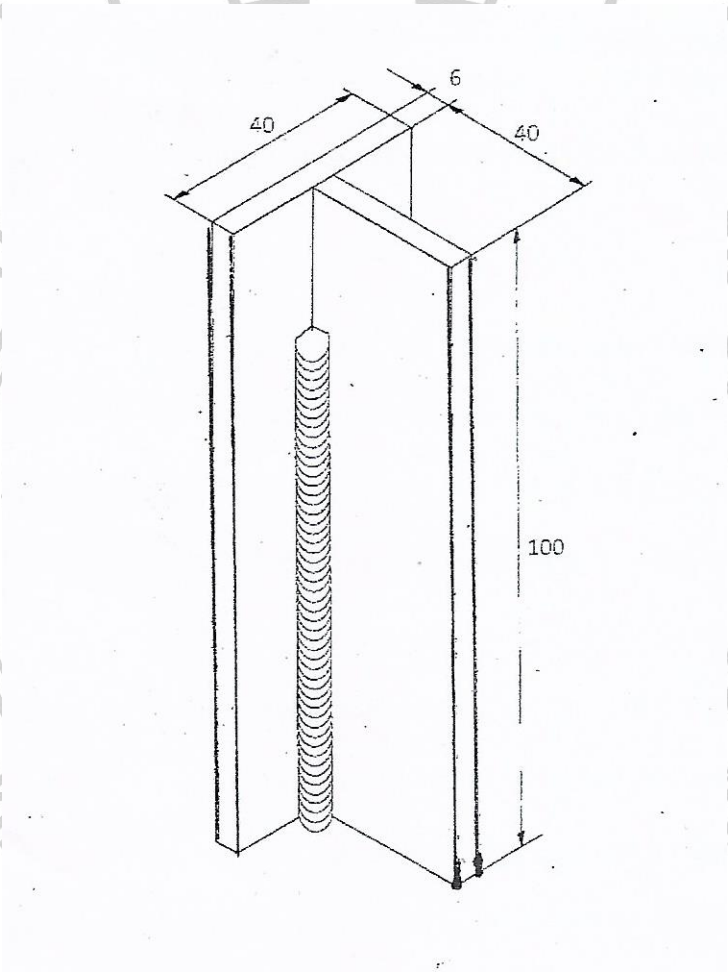
Result:

Lap joint vertical is obtained

Ex no: 5

Date:

T JOINT VERTICAL POSITION



All dimensions are in mm

Ex.No.5

Date:

'T' JOINT IN VERTICAL POSITION

Aim:

To make a vertical T joint.

Materials Required:

102 x 40 x 6 mm MS flat (2 Nos.), MS Electrode – (10 SWG) 3.15 mm.

Tools and Equipment Required:

Steel rule, Try square, Hack saw, Flat file, welding shield, Chipping hammer, wire brush, Gloves, Flat tongs, Bench vice and welding transformer unit.

Operations to be carried out:

Measuring, Marking, Cutting, Filing, Tacking, Welding, Chipping and cleaning.

Procedure

1. Mark and cut the required size of the work piece.
2. File the edges of the work piece to the required dimensions, using flat file.
3. Check the earth connection and hold the electrode on the electrode holder.
4. Adjust the output ampere of transformer and switch it ON.
5. Place the work pieces on the work table and tack them in vertical position.
6. Place the work piece on the work table in vertical position,
7. Start welding from bottom end to top end of the joint.
8. After cooling, remove the slag from the weld surfaces using chipping hammer and wire brush.
9. Submit the model for inspection.

Result:

Vertical T joint is obtained.

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