ENG 244.2
ENGINEERING WOKSHOP PRACTICE

BASIC CONCEPT/GENERAL INTRODUCTION

Engineering Workshop is a small establishment where manufacturing or handicrafts are carried out. It is also a place where students acquire knowledge on the operation of various processes involved in manufacturing and production. It is also a place where machines or some other hardware are made or repaired. **An ideal engineering workshop** is a place, where all categories of engineering workers, use the basic hand tools, equipment and machines, to fashion out an assembly or product from the raw material stage, to its finished or functional stage. It is a place where all forms of manufacturing or productions take place.

Engineering workshop is also regarded as a place, where the workpiece, and machines are pre-arranged in a clean and orderly manner. It must be definitely equipped with good lighting system, proper cross ventilation, easily accessible doors for smooth withdrawal in case of any emergency. There must be good gang ways for easy movement within the workshop as well as other essential facilities for an efficient and effective production. Trained and competent persons should be admitted to in mechanical works and permitted to operate the equipment.

Workshop is distinct (Different) from a factory. Factories are associated with batch (quantity) and mass production. Also, workshop requires skilled staff for successful operation while a factory can operate effectively with largely semi-skilled staff due to the specific production machines available. In workshop, trained and competent persons are admitted to work or operate in a workshop.

Workshop Practice: this provides the basic working knowledge required for the production of various engineering products. It also explains the construction, function, use and application of different working tools, equipment, machines as well as the technique of manufacturing a product from its raw materials. Workshop practice makes student competent in handling practical work in engineering environment.

Types of Engineering Workshop:

Engineering workshop may be of the manufacturing type or maintenance type..

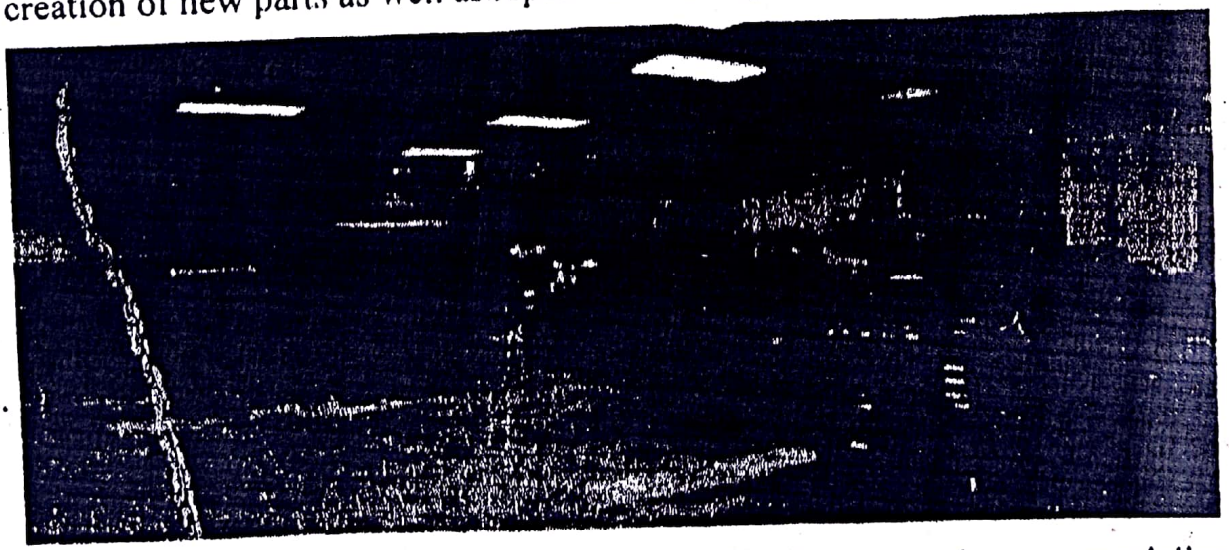
Manufacturing Workshop: classified into **(1) General-purpose workshop an Special-purpose workshop type.**

General Purpose workshops: are manufacturing workshop with a wide range of producti capability that may cover such as metal casting, forging, pressing, welding, heat treatin surface finishing etc. Example of this type of workshop are machine builders, tool maker et

Special Purpose Workshops: these are manufacturing workshop where one ma manufacturing process for a particular product is carried out. These workshops usually act a suppliers of parts to other manufacturers.

Engineering workshop are generally divided into different sections: machining, foundr forging, heat treating, welding and fabrication, wood making shop etc These are divide according to nature of work.

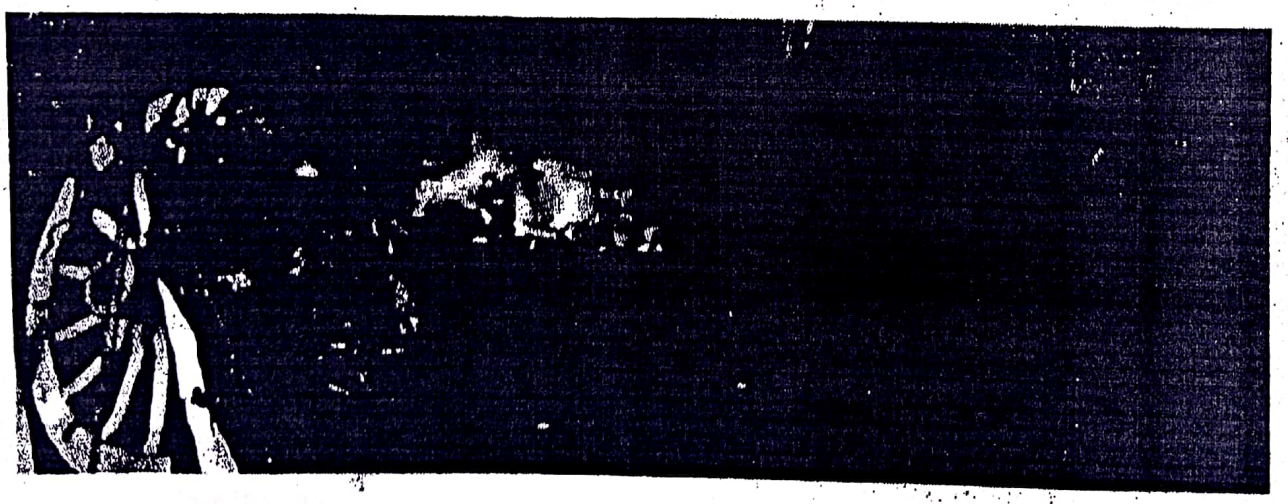
- **Machine shop**: this is a place where metal parts are cut, fabricated and finished to th required size to form a mechanical units or machines. Machine shops are used in th creation of new parts as well as repairs of existing equipment and automobile parts.



In machine shop, the personnel working in the shop must have a specialized tr depending on the type of work that is done in that particular machine shop. Most

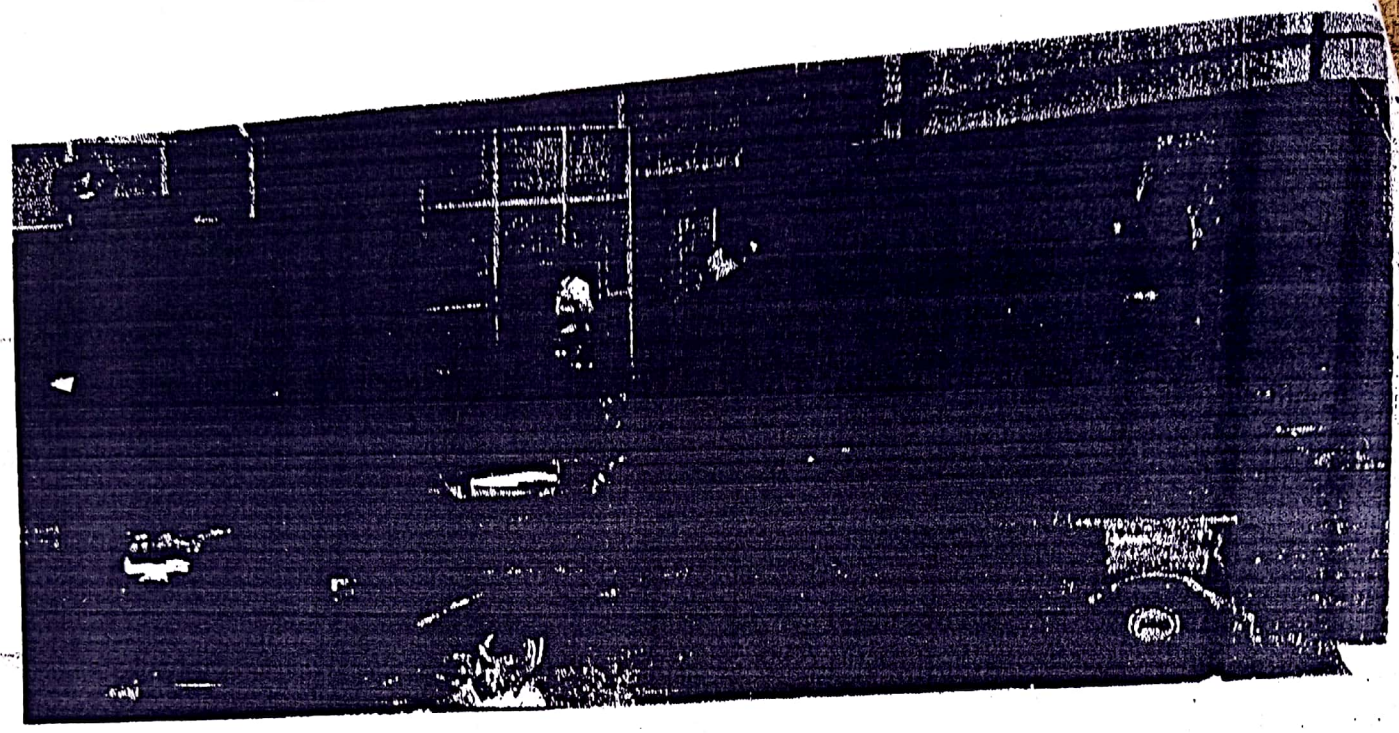
task done in the machine shops require specific unique skill set, deep understanding of the kind of work the finished parts will be used for. Machine shop can be seen in educational and research sector where students learn about machining in the context of repairs, as well as fabricating parts. **Equipment/machines that can be found in the machine shop are lathe machine, milling machine, multitasking machine, drilling machine/drill press, grinding machine and welding machine**

- **Forging workshop**: this is a type of workshop where metal is shaped by application of "pressure" from hammer or press after heating to its plastic deformation range either by forging, bending, twisting, drawing etc. in order to bring it to its final shape. The shaping of the metal is done either in hot state or cold state. Forging is a process in which metal are formed and shaped compressive forces through hammering, pressing or rolling after been heated above or below recrystallization temperature. A forging shop is a blacksmith shop. **Equipment/machines that can be found in the forging workshop are Forge furnace, surface grinder, electric drilling machine**



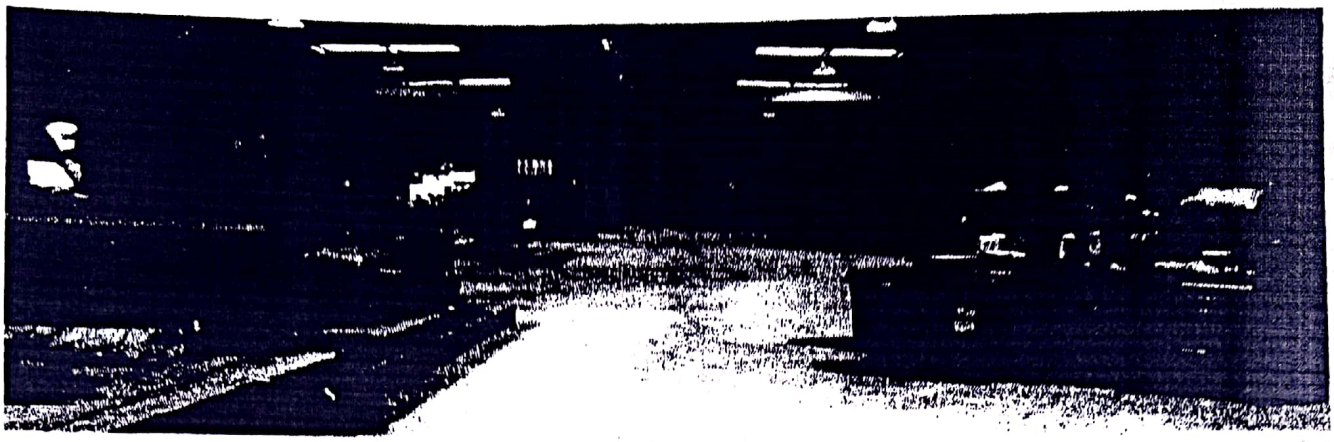
Equipment use in this workshop are forging furnace, surface grinder, electric drilling machine etc.

- **Fitting shop:** is a place where fitting or assembling is carried out. Also, some repair/maintenance can also be carried out in fitting shop. Fitting is the process of assembling of parts after bringing the dimension or shape to required size or form in order to secure the necessary fit. The operations of fitting are carried out on the workbench.



- **Foundry shop**: This is workshop where metal casting is done. That is a desired sharp of a metal is obtained by heating up to its molten state (liquid state) and pouring into a mould cavity to obtain the desired shape. The molten metal is allowed to cool and solidify.

- **Heat treatment shop**: for heating of metals
- **Welding/fabrication shop**: this is a workshop where two metals are fused together at the temperature of about 3200°C. Hence it is a workshop for welding and fabrication. The most common types of welding are: Electric Arc Welding, Gas Welding (Oxy Acetylene Welding), Resistance Welding, Forge or Fire Welding.



- **Woodwork/pattern shops**: this is a workshop where students are to work on wooden jobs by using various hand tools and machines.

Maintenance workshop: these are workshop where essentially repairs are carried out. Examples are automobile mechanic workshop, electric motor workshop etc.

CLASSIFICATION OF WORKSHOP BY FORM OF OWNERSHIP

Engineering workshop may be classified according to the form of ownership. These are (1) independent workshops and (2) captive workshop

Independent workshop: these are workshop legally register to do business as an independent entity like any other company.

Captive workshop: these are workshop which are mere departments in an organisation which serve the following functions:

- To serve as a maintenance workshop to the company.
- To serve as a training workshop as found in higher institution of learning.
- To serve as a production workshop for some particular components needed in the assembly of a product in the company.

WORKSHOP EQUIPMENT: all workshop require measuring tools, hand/bench tools, safety equipment along with other specialised tools and equipment as dictated by the nature of business of the workshop.

Measuring Tools: these include steel rule, Vernier callipers, combination set, depth gauges outside callipers, micro-meter screw gauge, micro-meter depth gauge etc.

Hand or bench tools: hammers, pliers, screw drivers, bench vise, files, scribers, chisels, hacksaws, centre punches, marking out tables etc.

Safety equipment: these include overalls, helmets, goggles, safety boots, first aid box etc.

Automobile mechanic's equipment: hydraulic screw jacks, battery charging and testing equipment, axle stand, air compressor, battery charging and testing equipment tyre repair equipment etc.

Foundry Equipment: these include patterns, flasks, furnaces, crucibles, ladlers, tongs, sand mullers and sand testing equipment

Welding equipment and consumables: these include gas welding equipment, filler rods, fluxes, welding gas lighters, nozzles and mixers, metal-arc welding equipment, electrodes, solders and brazing rods.

WORKSHOP ORGANISATION

Engineering workshop are generally divided into different sections: machining, foundry, forging, heat treating, welding and fabrication, wood making shop etc. Each of this section is headed by a **FOREMAN.**

A workshop foreman/a shop foreman is the manager/supervisor in a workshop.

- The foreman assigns duties and responsible for the monitoring and progress of a project.
- He keeps records of a project on track from time and budgetary standpoint.
- The foreman gives instruction to the workers working under each given production section.
- He ensures that workers are qualified and knowledgeable about their roles and assignments according to skills sets.

Workshop Arrangement: engineering workshops are arranged such that the highest productivity and quality production are obtained. For efficient operations, the following arrangement should be observed:

- The workshop should be free of unnecessary items, hence, it should always be tidy.
- Each item should be placed in its due location.
- Drawing of parts, process charts and jobs slips/role or function should be displayed on a special post at the workshop.
- Splashes, oil, grease should be wiped off the floor.
- A clear path between machines must be kept clear for easy passage.
- Finished work pieces should not be kept carelessly around the workshop rather they should be stacked in the containers intended for transportation.

WORKSHOP HAZARD, SAFETY AND SIGNS (CODE)

Objective
At the end of this topic student should be able to
- Know the general safety rules in workshop
- Understand safety precaution while working with tools

HAZARD is any condition which causes actual or potential loss or damage or undesirable effect on people and property (plant/equipment, raw materials, products, or environment). It can also referred as any object, situation or behaviour that can cause harm or injury or ill health to human life.

Hazard can also be a situation, condition or extreme event (natural or caused) with a certain degree of probability of having adverse results or consequences on safety or health of workers. It expresses any activity that has the potential to adversely or negatively impact human health, property, or the environment. It causes harm or injury. **These hazards could occur at some specific places known as *hazard points*.**

Hazard points are those points within the physical and operating environment that could cause injuries such as moving parts of machinery, working at heights, slippery surfaces, and contact with electrical energy, excessive noise, toxic substances, and lifting of heavy objects among several other sources.

Workplace hazards: These are hazards that are particularly domicile in the work environment. Theses could be as a result of human inefficiency, machine malfunction, inclement weather abrupt weather change) and/or accidental occurrences. Workplace hazard has both short term (safety implications) and long term health implications) effects when not put under checks.

Risk is defined as the probability/chance that exposure to a hazard will lead to negative effect or consequences. It can also referred as probability that a person will be harmed or experience an adverse health effect if exposed to a hazard.

Hazard exist in every workshop. Some are easily identified and corrected while some are necessary risk of the job and must be managed in other ways either by using protective equipment.

Some Workshop Hazard

- Lack of adequate ventilation and temperature
- Lack of guard (keep watch over) or screens of equipment or around dangerous areas.
- Chemical substances in an unwanted containers
- Incorrect tools use for task
- No safety signs, outdated safety signs and broken safety signs
- Chemical splashes
- Electric shocks, burns or fires
- *Machinery left unattended while in use.*

CLASSES OF HAZARD

The short term and long term effects of workplace hazards gives to two b broad classes of hazards viz ***safety hazard*** **and** ***health hazards.***

Safety hazards

Safety hazard refers to circumstances that can cause *immediate injury* to a worker. For example, if electrical equipment is not properly grounded, it could become energized and possibly electrocute an employee. Or, if a worker's hands come in contact with a moving saw blade, he or she could have one or more fingers cut off instantly or result in instant injury. Safety injuries are commonly associated with the physical environment. Physical environments that could cause *safety hazards* include but are not limited to the following:

1. Machine/machinery such as:
a. Point of operation
b. Rotary and reciprocating movements
c. In-running nip points (pinch points) etc.
2. Kickbacks from the machine due to sudden impact loading, sudden blow from workload etc.
3. Flying chips, thrown objects etc. such as flying stone propelled by mower blade etc.
4. Sharp projections from tool edges e.g. anvil edge, projecting object in load vehicles etc.
5. Fire and explosion hazards
6. Electrical shock, stunning, burn or electrocution as a result of contact with exposed or un-insulated life wire.

Health hazards

Health hazards are situations associated with *long term exposure* to certain substances or exposure to excessive noise levels or vibrations. Health hazards can cause both immediate (acute) and longer-term (chronic) health conditions. For example, exposure to turpentine, waxes and finishes, a chemical used in furniture industry, can result in a range of health

effects, ranging from temporary eyes irritation and more debilitating skin effects to severe kidney and bladder damage. Health injuries are commonly associated with the operating environment

Operating environments that could cause health hazards include:

1. *Excessive noise* resulting from long time exposure to continuous machine operation or exposure to noisy machine operation.
2. *Vibration:* Vibration as a result of working on platforms, working around heavy and undamped equipment or constantly being exposed to moving parts could cause muscular disorders.
3. *Wood dust*: These are particulate fine materials that seems harmless, however, long time exposure to them can heavy inhalation of quantity big enough to result in air track blockage thereby causing carcinogenic effects on the skin.
4. *Harmful chemicals*: Exposures to coatings, finishing, adhesives, solvent vapours could result in health hazards.

***TYPES OF* OF WORKSHOP HAZARD:** workshop hazard can be grouped into the following categories:

1. Physical Hazards: these are environmental factors that can harm an individual without necessarily touching them. They include slippery floors, objects walkways, unsafe or misuse machinery, excessive noise, poor lighting fire, radiation and pressure etc.
2. Chemical Hazard: these involved substances which can cause injury or death by being reactive, inflammable, toxic or corrosive such as gases, dust, fumes, vapours and liquids.
3. Ergonomic Hazards: these are hazards associated with adverse body condition which results due to poor positioning of the body in relation to the task being performed. These include poor design of equipment, workstation design, fatigue etc.

4. Biological Hazards: These involve micro-organism which can cause diseases such as bacterial, fungi and virus
5. Psychosocial Hazards: these involve staff/staff relationship, workload, dealing with public threat of danger, shift work.

Mechanical hazard: these involve hazards created by machinery such as vibration, cuts etc.

The following steps are taken to control workshop hazards:

1. Identify the hazards by carrying out a workshop risk assessment.
2. Determine how employees may be at risk
3. Evaluate the risk
4. Record and review hazards at least annually.

WORKSHOP SAFETY AND SIGNS (CODE)

Safety can be defined as the method of working without harm/injury/damage/ danger. It is the removal of hazards to both man and machines. Before you can use equipment and machines or attempt practical work in a workshop, you must understand basic safety rules. These rules will keep you and others safe in the workshop.

GENERAL WORKSHOP SAFETY RULES

1. Always remember "**SAFETY and HEALTH FIRST**" in all you do in the workshop because safety is the most important thing as you have to be alive and not disable for the work to be done. This is the motto of every students working at the workshop.
2. Always bear in mind if the process is not safe for you, it is not safe for others, so avoid it.
3. Always listen carefully to the teacher and follow instructions
4. Do not run in the workshop because you could bump into another and cause an accident.
5. Always put on appropriate safety wears in the workshop such as overalls, helmet, goggles etc.)

6. Always use the correct work method for a process
7. Do not operate a machine that you are not familiar with unless you have been trained.
8. Report any damage to machines/equipment as this could cause an accident.
9. Keep hands away from moving/rotating machinery
10. Bags should not be brought into a workshop as people can trap over them
11. Always be patient, never rush in the workshop
12. Smoking is usually prohibited in the workplace
13. The workshop floor must be kept clean, all unwanted objects must be put in their proper places.
14. Isolate machinery that is powered by electricity or compressed air when not in use etc.

SAFETY SIGNS AND COLOURS

Colours play an essential safety role in giving information for use in the prevention of accidents, for warning of health hazards, identification and safety use of cables and components in electronic and electrical installations as well as the correct use of fire-fighting equipment.

Note: The purpose of a system of safety colours and safety signs is to draw attention to objects and situation which affects or could affect health and safety.

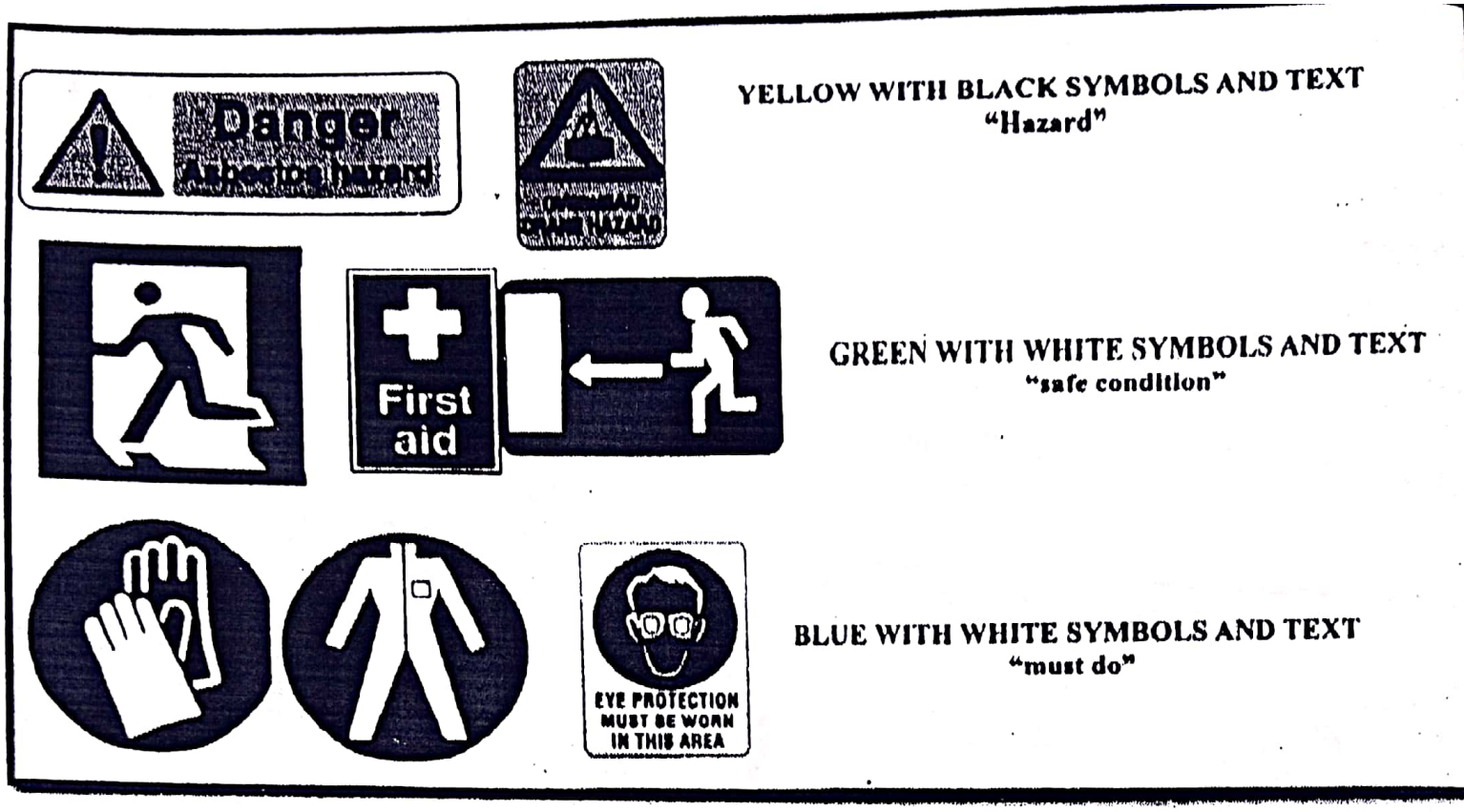
SAFETY COLOUR	MEANING	EXAMPLES OF USE
Red with white background colour with black symbols	**Stop**/prohibition (Don't Do)	-stop signs -emergence stops -prohibition signs
Red with white symbols and text	Fire equipment	-position of fire equipment -alarms, extinguishers etc.
Yellow with black symbols and text	Hazards (risk, danger)	-indication of hazards (electrical, explosive,

		radiation, chemical, vehicle etc. -warning of threshold, low passage, obstacles
Green with white symbols and text	Safe condition (the safe way)	-Escape routes -Emergency exist -emergency showers -First aid and rescue stations
Blue white symbols and text	Mandatory action (Must Do)	-obligation -to wear personal safety equipment

WORKSHOP SAFETY SIGNS AND COLOURS

RED (WHITE BACKGROUND COLOUR WITH BLACK SYMBOLS)
"Don't do"

RED WITH WHITE SYMBOLS AND TEXT
FIRE EQUIPMENT



YELLOW WITH BLACK SYMBOLS AND TEXT
"Hazard"

GREEN WITH WHITE SYMBOLS AND TEXT
"safe condition"

BLUE WITH WHITE SYMBOLS AND TEXT
"must do"

FIRST AID IN ACCIDENTS

First aid is an immediate treatment given to an accident victim using the facilities or materials available at the time before proper medical attention maybe provided. First aid saves life, prevent the condition of the victim worsening and may sometimes bring about complete recovery of the victim. It is important that every worker/ student under training knows how to apply first aid to common accident encountered in the workshop.

First Aid Box: The contents of the first aid box should include the following items:

Cotton wool, iodine, pair of scissor, forceps, clinical thermometer, bowl for dressing, bandage, plaster, splints, embrocation ointment, safety pin etc.

First Aid Treatment for Cut and Bruises

- Wash the wound generously with clean water in order to remove foreign matter
- Clean the wound with diluted antiseptic solution or a tincture of iodine

- Give the injured part of the body as much rest as possible
- If the cut or bruises is server and internal organs are affected, the victim must be carefully placed on a stretcher or bed after loosening or removing all tight cloth and send for the doctor immediately.

First Aid Treatment for Burns

- Immediately get the person away from the heat source to stop the burning
- Cool the burn with cool or lukewarm running water or place a sodium bicarbonate per glass of water on the burn. Don't use ice, iced water or any creams or greasy substances.
- If a person catches fire, quickly smother the burning clothes by covering the victim with some thick clothing. Example blanket which has to be pressed against the body in order to extinguish the fire.
- Douse the victim and the clothing with lukewarm water
- send to a doctor

First Aid Treatment for Carbon monoxide poisoning

- Remove the victim from the contaminated area into fresh air
- Make the victim smell some ammonium hydroxide
- If breathing is irregular/rare/ has stopped completely, apply artificial respiration. Continue it for a long time until the doctor takes over

First Aid Treatment for fractured bone

- Place the victim on a stretcher or on the ground and bandage the fracture with splints made of boards. This will prevent the ends of the fractured bone from shifting and it will ease the pain
- Broken arms should be treated the same way but there is no need to put the victim in a stretcher
- Immediately seek medical attention

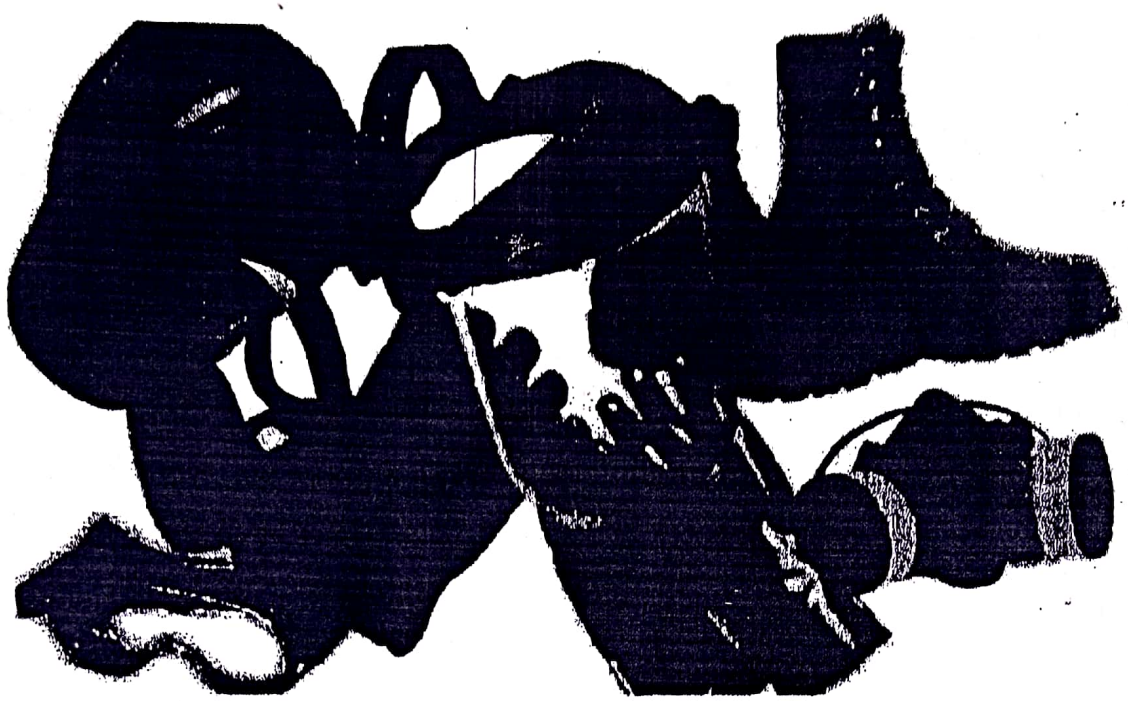
First Aid Treatment for Electric Shocks: Shocks through touching a bare electric wire my cause cramps in the arms and inability to let go of the wire. Severe shocks may result loss of consciousness, weak pulse and shallow breathing which sometimes may even cease completely. The following actions should be taken when someone has suffered an electric shock:

1. Firstly, cut off the current either with the switch or by cutting the electric wires with a dry wooden – handled or a plastic handled tool such as an axe, insulated pliers machete etc.
    - ❖ Note, any person doing this must be well insulated from the ground, otherwise he/she may suffer an electric shock.
    - ❖ Never stand on bare and wet ground when doing this
    - ❖ Always put on rubber gloves
    - ❖ Only after the victim has been released from the current can first be given to the person
2. If the victim is unconscious, place him/her on his back, loosen all his clothes, open all the doors and windows and send for the doctor immediately.
3. While waiting for the doctor's arrival, apply artificial respiration to the victim whether he/she shows sign of life or not.

PROTECTIVE WEARS IN THE WORKSHOP

1. Overalls
2. Safety shoes or boots
3. Helmet
4. Goggles
5. Earmuffs
6. Hand gloves
7. Respirators: are devices worn over the nose and mouth to allow breathing in a polluted atmosphere such as dust, smoke, carbon-monoxide etc.

8. Safety belts: belts worn when working at heights on ladders, scaffold etc. such that if slip is made while working, it prevents falling from such height.



INTRODUCTION TO BASIC MANUFACTURING PROCESSES

Manufacturing involves turning raw materials to finished product which can be used for various purpose. While **manufacturing processes** are steps or sequences of operations through which raw materials are transformed into a final products by using human effort or machines. Manufacturing process can also be describe as that part of the production process which is directly concerned with the change of form or dimensions of the part being produced. It does not include the transportation, handling or storage of parts, as they are not directly concerned with the changes into the form or dimensions of the part produced.

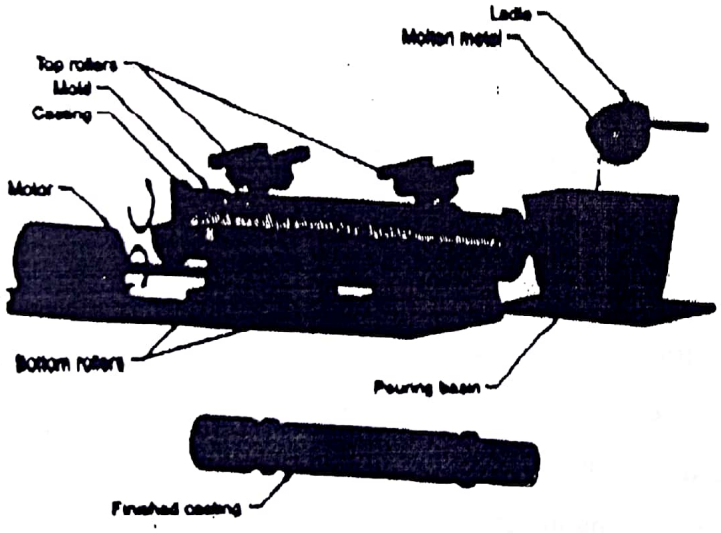
The process of manufacturing begins with product design and material specification from which products are made.

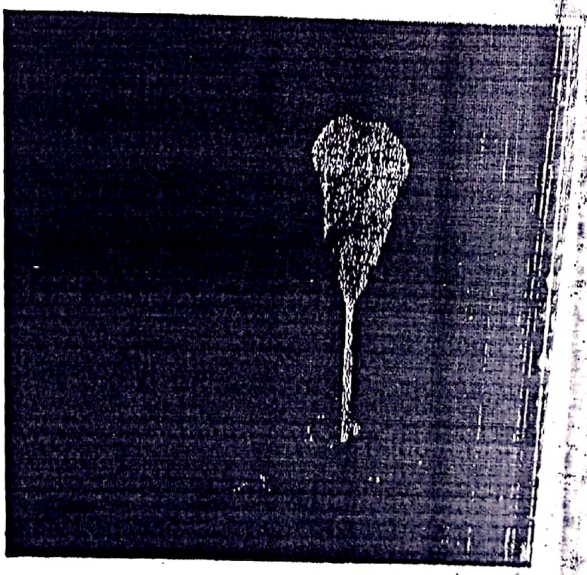
Manufacturing processes are broadly classified into five namely

- Casting
- Metal forming (forming process)
- Machining (material removal)
- Joining
- Moulding

Casting process: casting is a manufacturing process in which a liquid metal is usually poured into a mould which contains a hollow cavity of the desired shape and then allowed to solidify. The solidified part is known as a casting, which is ejected or broken out in order to complete the process.

Casting is one of the oldest known manufacturing process which can be used to manufacture a wide variety of production with an intricate (complicated) solid shapes. These shapes can be used in a wide range of applications including automotive components, aerospace parts, electronics, mechanical devices and construction supplies.



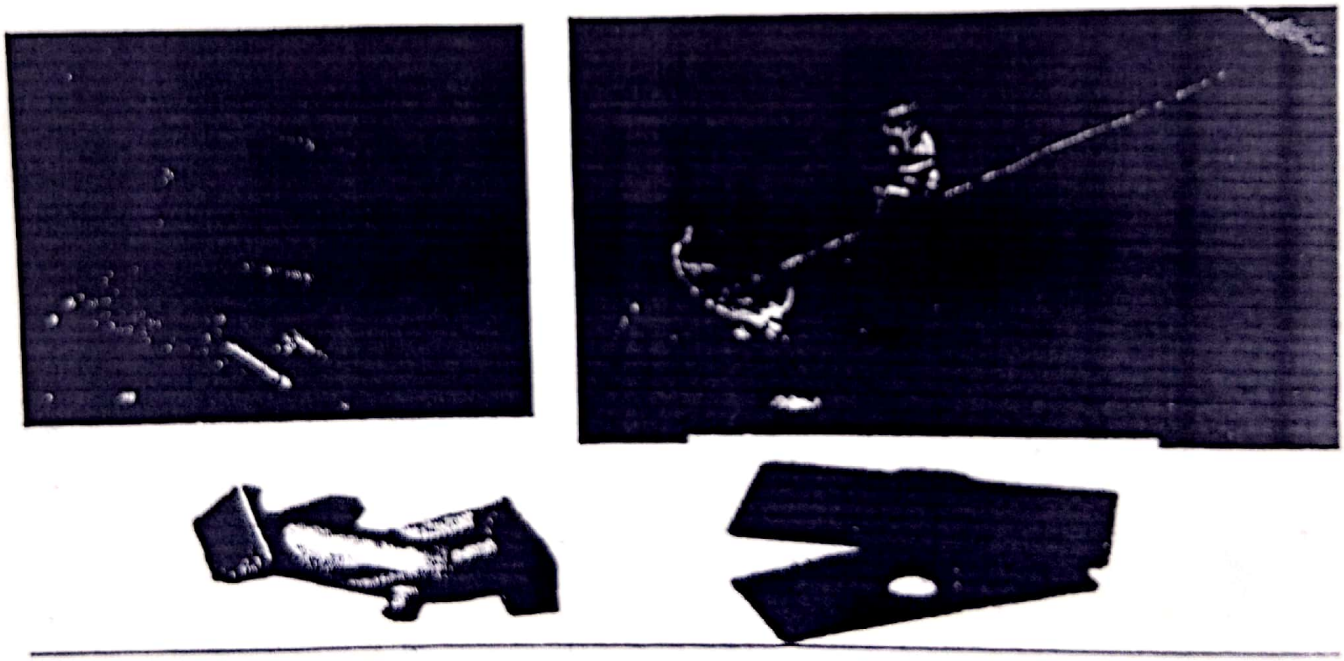


The workplace where castings are produced is called a foundry workshop. Casting processes are classified as follows:

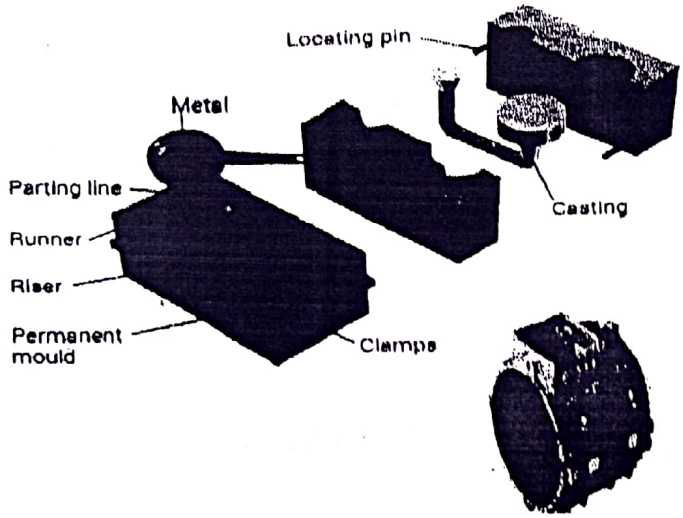
- Sand casting
- Die casting
- Centrifugal casting
- Investment casting

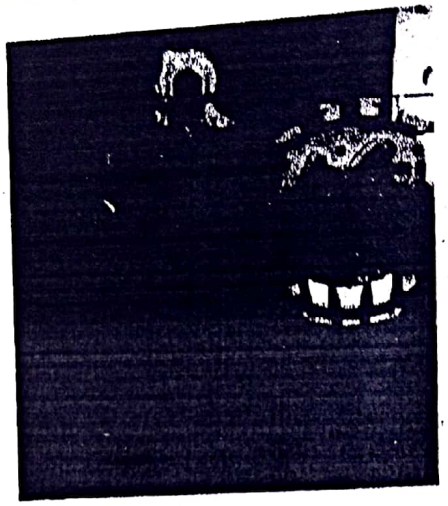
Sand casting: this is a casting process that involves the use of furnace, metal pattern and sand mould. The metal is melted in the furnace and then ladled and poured into the cavity of the sand mould which is formed by the pattern. Sand casting is normally used for the production of both large and small parts.

Generally, sand casting is a metal casting process which involves the use of natural sand along with adequate proportion of clay (as a binder material) to keep the sand grains together. Surface of the sand castings is normally rough with surface impurities for which a machining allowance is included.

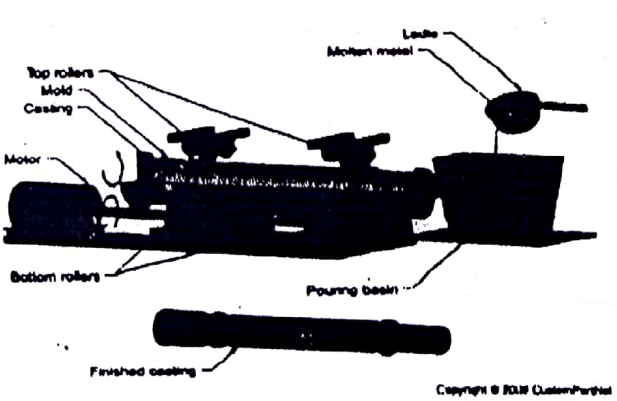


Die Casting: this is a metal casting process that can produce complex metal parts. The process involve pouring molten metal into a steel/metal mould called die. The mould also known as tool or dies which is specially designed for each project.

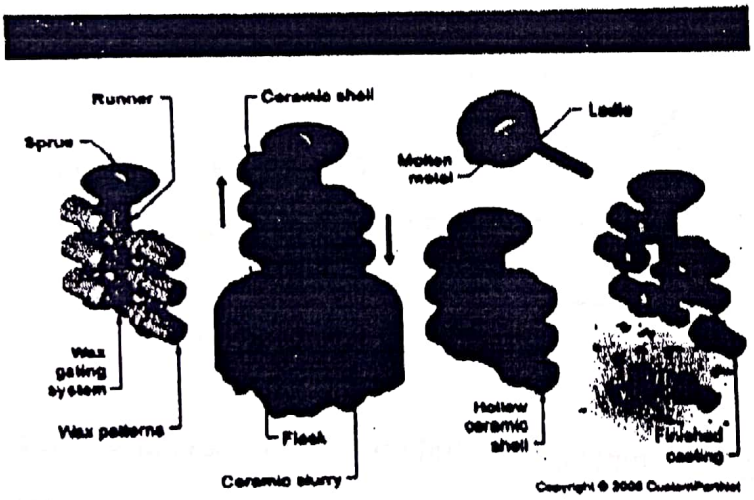




Centrifugal Casting: this process can also be called roto-casting. It is a metal casting process in which a molten metal is poured in a mould while it is rotating about an axis at a high speed thereby using centrifugal force to form cylindrical parts. Here, the molten metal is poured into a preheated spinning die. The die maybe oriented either on a vertical or horizontal axis depending on the configuration of the desired part.



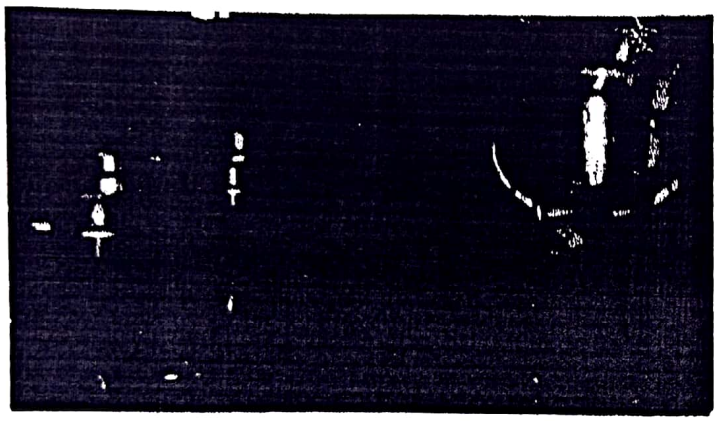
Investment casting: this is one of the oldest manufacturing processes that is used to produce castings of any intricate shape with very fine surface finish and accuracy. It is a casting process in which molten metal is poured into an expendable ceramic mould. The mould used for investment casting is formed using a "**wax pattern**". **The wax pattern is coated with refractory** ceramic material. The moulds use for an investment casting are prepared by dipping an expendable pattern in liquid refractory suspension/ mixture for several times and allowing it to dry. The expendable pattern with the gating system may be made up of either wax, plastic, tin or frozen mercury and is removed from the mould by melting, dissolving or burning of the pattern. The mould is then heated to higher temperature and molten metal is filled in the prepared mould through the gating system to the casting. Once the ceramic material is hardened (cooled/ solidify), the internal geometry takes the shape of the casting. The cast object is removed from the mould by breaking the mould.

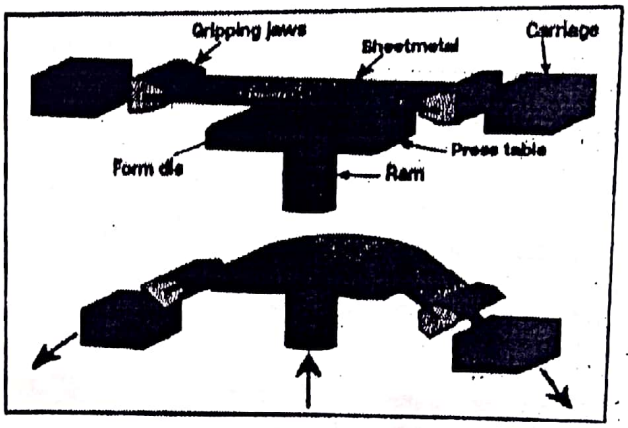


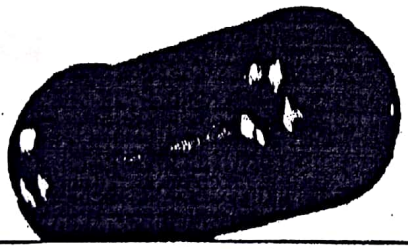
Metal Forming Manufacturing Process: metal forming is a manufacturing process in which metal is deformed into required shape by application of suitable stresses. The metal involve in this manufacturing process undergo plastic deformation in order to acquire required shapes and sizes. During metal forming, permanent deformation occurs without adding or removal of material. In forming process, no material is removed, it is completely displaced and

deformed into the required shape. Some of the commonly used forming process in the manufacturing industry are:

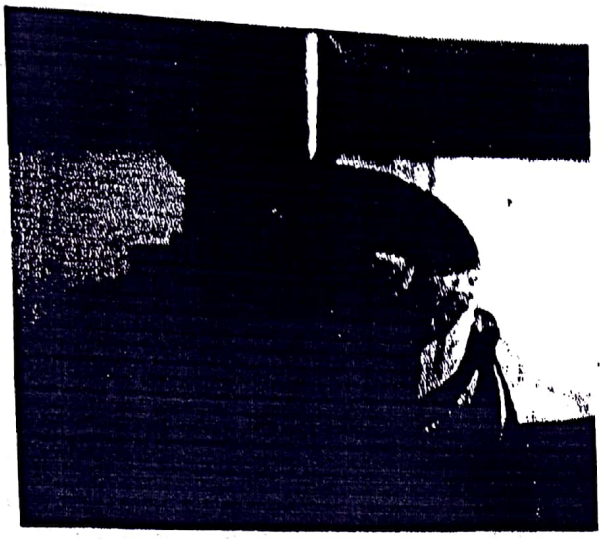
- Forging
- Rolling
- Extrusion
- Explosive forming etc.



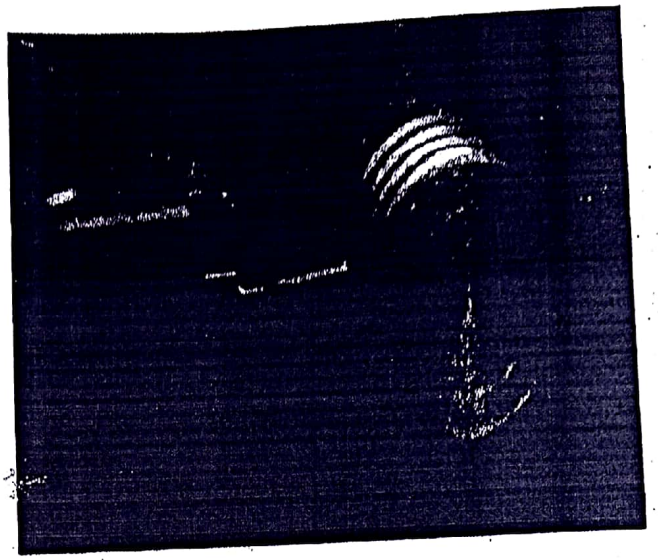




Machining Manufacturing Process: machining is a metal removal process in which cutting tool removes unwanted material from a work piece to produce the desire shape. Machining processes include turning, drilling, shaping, grinding, etc. Machining process is used to deliver a very good dimensional accuracy and good surface in terms of turning, milling, grinding etc.



Drilling



Turning

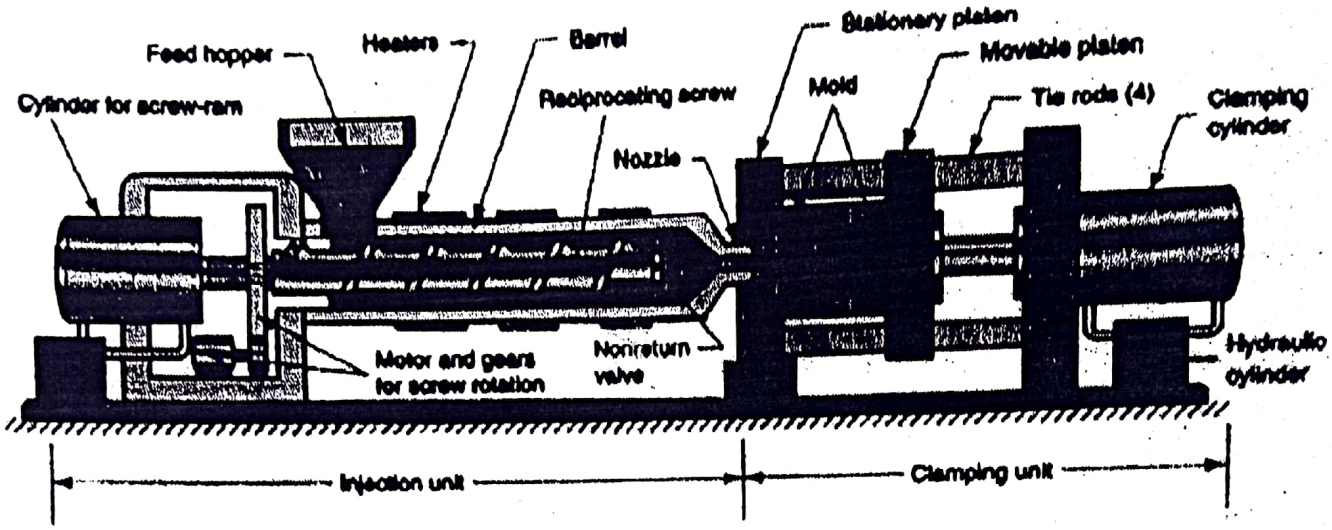
Joining process: joining is a process whereby two or more parts are brought together either permanently or temporally in order to give desired shape or act for a particular function. Joining of any two components together can be done with the help of the following operations: welding, brazing, soldering, adhesive joining, fastening etc.

Note that welding, brazing, soldering and adhesive joining can produce permanent joints while fastening generally produce semi-permanent or temporary joints.

Moulding process: moulding is a manufacturing process of non-metallic materials in which a machining operation is not required. It can also said to be a manufacturing process of non-metallic materials such as plastic, rubber, etc. in moulding, no machining operation is required. Example, household plastic components such as bottles, toys, water, tanks, buckets etc. Different moulding processes are:

- Injection moulding: wall hanger, bottle caps, plates etc.
- Blow moulding: used in producing bottles
- Compression moulding: car tyres, boat hull
- Rotational moulding: shipping drums, storage tanks, (hollow shaped objects)
- Extrusion moulding: pipes for plumbing work

MOULDING MACHINE



BENCH WORK AND FITTINGS

Bench work denotes the production of an article (i.e. components) by hand on the bench. Generally it can be defined as the work performed on the bench. While, **Fittings** is the assembling together of metal parts through removal of metal to secure the necessary fit or to obtain the required fit. In fitting work the parts are assembled after bringing the dimension or shape to required size or form so as to secure the necessary fit. Fitting work involves a large number of hand operations to finish the work to desired shape, size and accuracy. These two types of work require the use of a large number of hand tools and other devices or equipment that involve a number of operations for accomplishing the work to the desired shape and size.

Bench work and Fitting workshop

The operations of fitting are usually carried out on the bench. Also the person working in fitting shop is called **FITTER.** Both the bench work and fitting requires the use of number of simple hand tools and considerable manual effort.

The operations that are carried out on the bench and fitting works are:

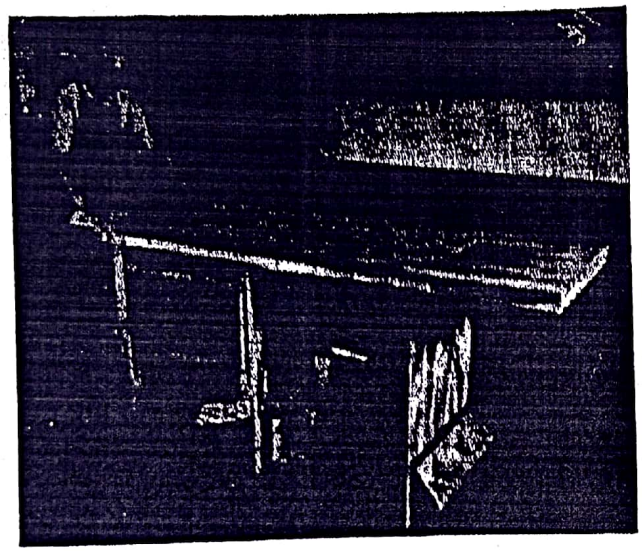
BENCH WORK AND FITTINGS TOOLS

Various hand tools and equipment found in the bench work and fittings workshop include:

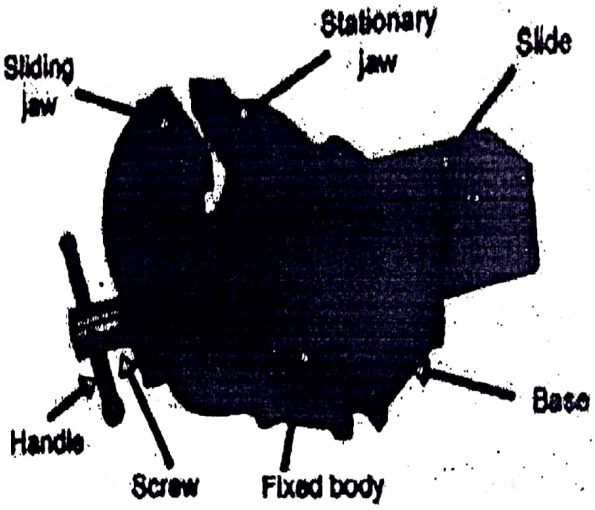
HOLDING TOOLS: this also known as work holding devices in the bench work /fitting workshop. They are used to hold all types of components between jaws (fixed jaws and movable jaws). Various work holding devices or tools are:

- **Work bench:** this a sturdy table at which manual work is done. It is used to hold various components on its surface. Also, it gives support to human while performing various operations.
- **Bench vice: this is a tool used** to hold a workpiece rigidly. It can also said to be a device which is used to hold the specimen or workpiece between the two jaws.

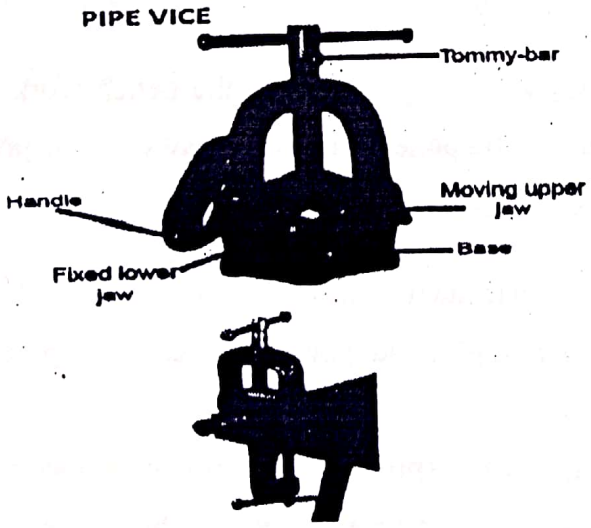
- **Pipe Vice:** this is used for holding circular/cylindrical component such as tubes, pipes etc.
- **Hand vice: this** is a too designed to hold/grippe workpiece in between the jaws of the bench vice. It is basically used for gripping workpiece which are to be conveniently held in the bench vice.
- **Tool Marker's vice:** this is used for holding small work which requires filling or drilling.

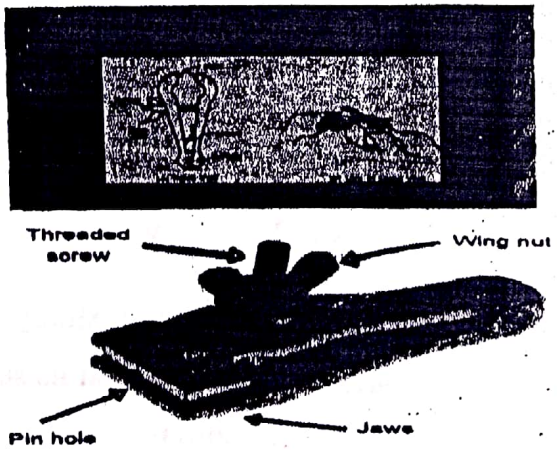


WORK BENCH

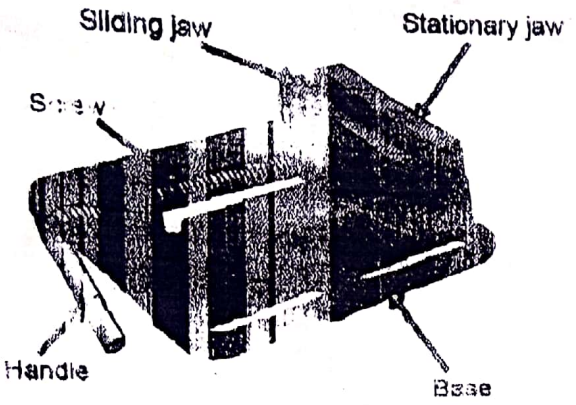


BENCH VICE

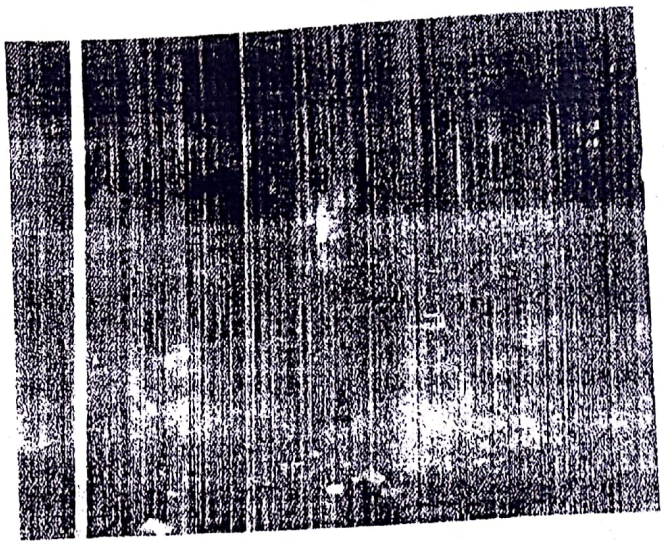




HAND VICE



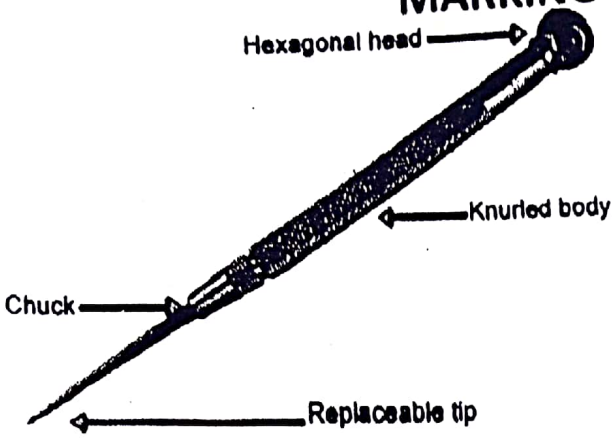
TOOL MAKER'S VICE



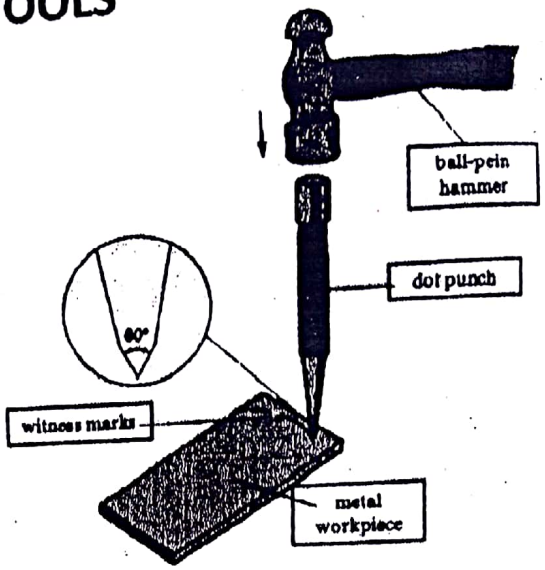
MARKING OUT TOOLS: these are tools used to mark the given measurement on the surface of the workpiece. Types of marking out tools are

- **Scriber:** this is a steel tool used to scribe or mark lines on metal workpiece. It can be used in conjunction with a try square.
- **Punch:** this is used for marking out work locating centres. There are various types of punch used in fitting workshop. These are:
- **Dot punch:** this is used to specify the path of cutting. Marked path with a scriber and with the help of dot punch. the path is hit ed by harmer.
- **Prick punch:** this is used to make small punch marks on layout lines in order to make the mark last longer.
- **Centre punch:** this is mostly used only to make the prick punch larger at the centres of holes that are to be drilled.

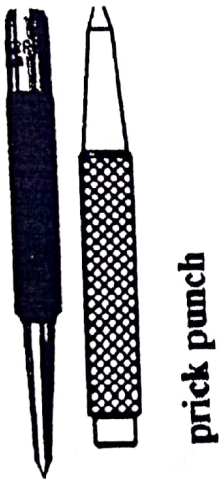
MARKING OUT TOOLS



SCRIBER

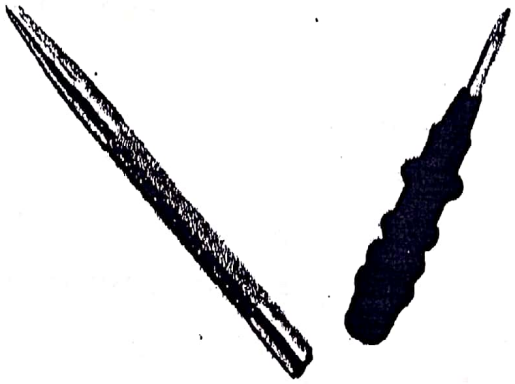


DOT PUNCH



prick punch

PRICK PUNCH



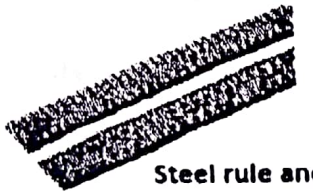
CENTER PUNCH

MEASURING TOOLS: these are tools used to measure any component with respect to (w.r.t) the dimensions. Without these tools, it is very difficult to measure the accurate values/dimension of the given component. Measuring tools used in the fitting workshop are as follows:

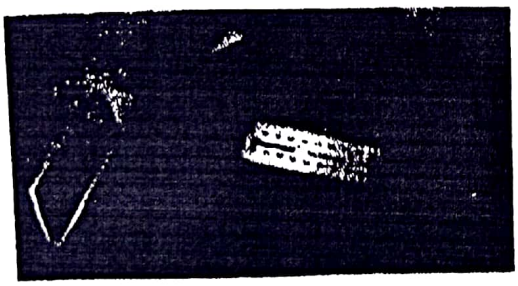
- Steel rule & measuring tape

- Surface plate
- Try square
- Inside calliper
- Divider
- Outside calliper
- Odd leg calliper
- Vernier calliper
- Micrometre screw gauge

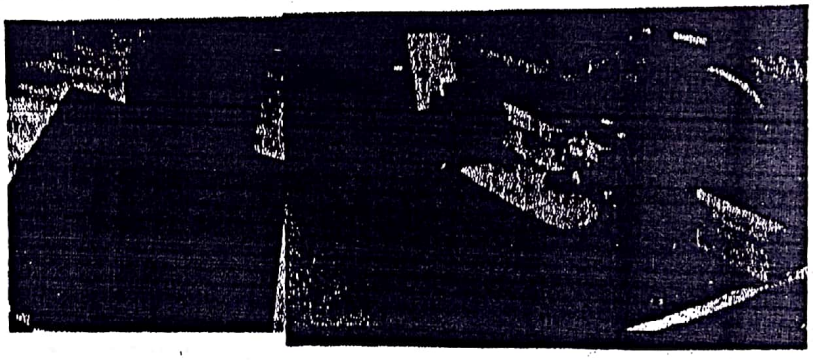
MEASURING TOOLS



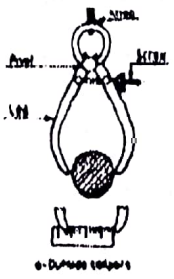
Steel rule and measuring tape

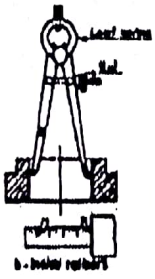


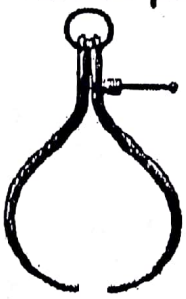
TRY SQUARE



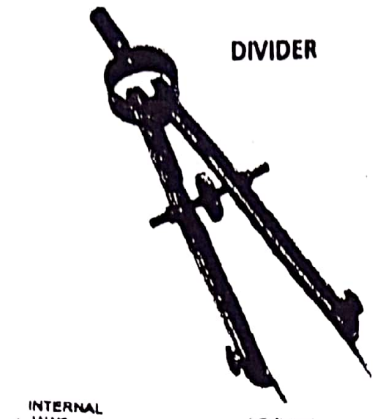
Surface plate

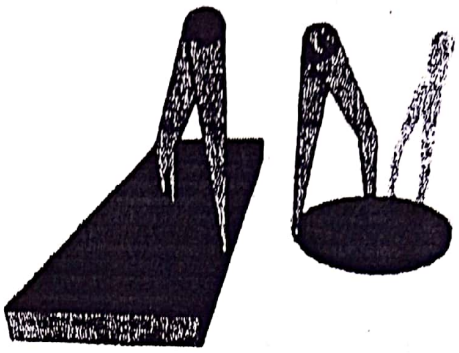


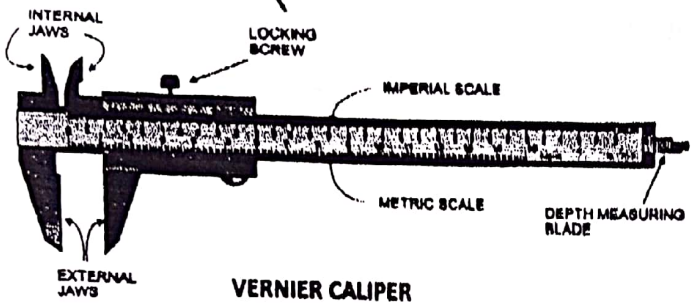




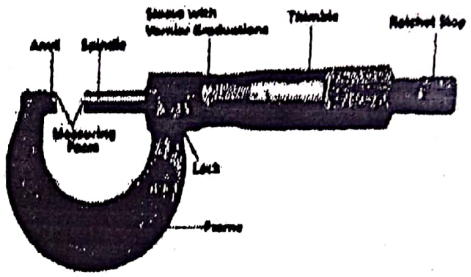
Outside and Inside caliper







VERNIER CALIPER



MICROMETER

Before knowing the measuring tools, there is need to know the units of measurement in bo[illegible] C.G.S (centimetre-grams-seconds) system of units and M.K.S (meter-kilogram-secon[illegible] system.

Metric system (C.G.S)

Length is measured in centimetre (cm)

Mass is measured in grams (g)

Time is measured in seconds (s)

S.I system (M.K.S)

Length is measured in metre (m)

Mass is measured in Kilogram (kg)

Time is measured in seconds (s)

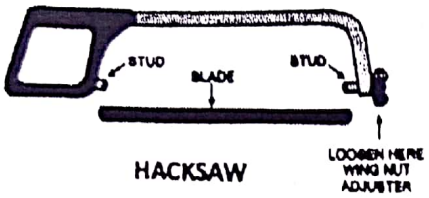
- **Steel rule: and Measuring Tape:** this is an instrument in geometry which is us[illegible] measure the length breadth, and height of the given workpiece. Measuring tape[illegible] flexible form of ruler that is calibrated in mm, cm and inches.

- **Surface plate:** this is used for testing the flatness of workpiece. It is used as the main horizontal reference plane for precision inspection, marking out etc. it is more precise than the marking table. It also used for testing of flatness of surfaces.
- **Try square:** it is used for marking and checking right angles (flatness and squares) of given workpiece.
- **Inside calliper: it is** to measure the internal size of an object.
- **Outside calliper: this is** used measure the external size of an object.
- **Divider:** this is tool used for marking circles, arcs, laying out perpendicular lines, bisecting lines etc. on a given workpiece/specimen.
- **Odd-leg calliper: this is** used for marking parallel lines from a finished edge and also for locating the centre of round bars.
- **Vernier callipers: this** is an instrument used for measuring both inside and outside diameters of a workpiece. It measures internal dimension, outside dimension and depth.
- **Micrometres:** this is used to measure dimensions like dimeters only. That is it is used to measure the diameter of the given specimen only. It is not used to measure the depth of an object which can be done by Vernier depth.

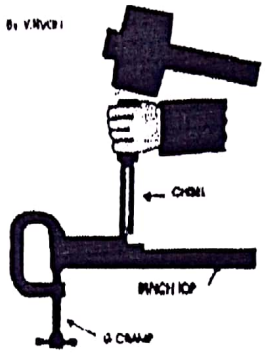
CUTTING TOOLS: these are tools used to cut the given specimen/workpiece with respect to the given dimension. The cutting tools used in fitting workshop are:

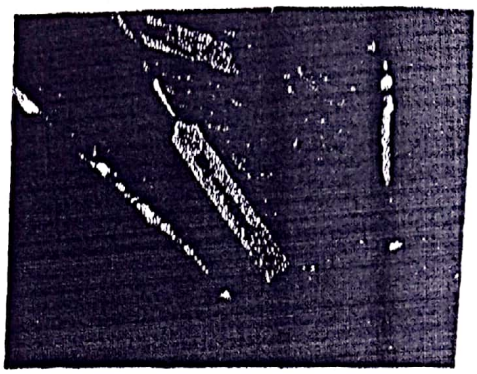
- **Hacksaw:** it is used for cutting metal
- **Chisels: are** used for removing surplus metals and cutting thin sheet. Also, chisels can be used for cleaning corners of a workpiece and equating small holes.
- **Twist drill: this is** used for making holes in a metal
- **Tap (Taps wrenches):** this is used to cut threads on the inside of a hole of bolt and nuts (i.e. to cut internal threads in cylindrical holes).

CUTTING TOOLS

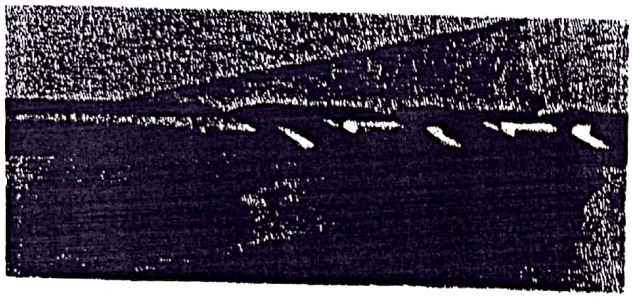


HACKSAW



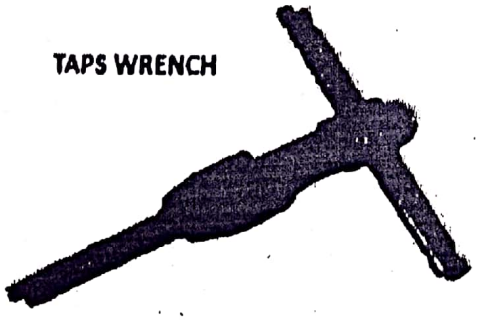


CHISELS



TWIST DRILL

TAPS WRENCH

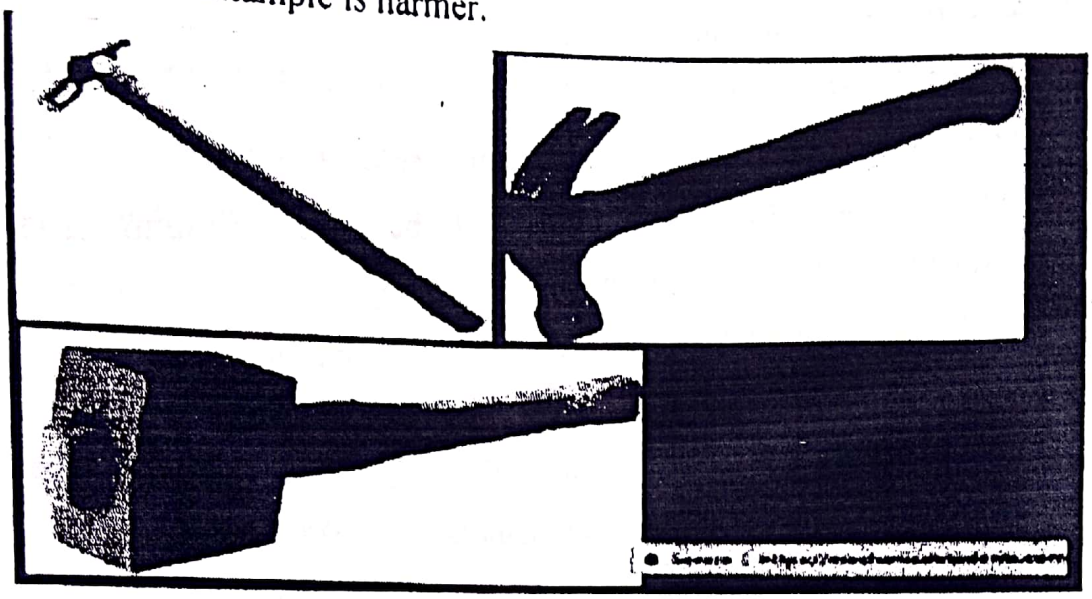


FINISHING TOOLS: these are tools used to remove the material from the surface of the workpiece in order to get a high surface finish. Examples of finishing tools are:

- **Files:** they are used to remove the material by rubbing on the metal (workpiece) to get a good surface finish. Files can also be used to cut, smooth or fit metal parts.

FILES (filing operation)

STRIKING TOOLS: these are tools used to strike or hit the workpiece by application of external force. Example is harmer.



VARIOUS OPERATION COMMONLY PERFORMED IN BENCH WORK AND FITTING WORKSHOP ARE:

- Chipping
- Filling
- Scrapping
- Sawing
- Marking
- Drilling
- Reaming
- Tapping etc.

SAFE PRACTICE IN BENCH WORK AND FITTING SHOP

The following are some of the safe and correct work practices in bench work and fitting shop, with respect to the tools used

1. Keep hands and tools clean and free of dirt, oil and grease. Dry tools are safer to use than slippery tools.

2. Do not carry sharp tools inside the pockets.
3. Wear leather shoes and not sandals.
4. Don't wear loose clothes.
5. Do not keep working tools at the edge of the table.
6. Position the work piece such that the cut to be made is close to the vice. This pr... prevents springing, saw breakage and personal injury.
7. Apply force only on the forward (cutting) stroke and relieve the force on the return s... while sawing and filing.
8. Do not hold the work piece with hand while cutting.
9. Use the file with a properly fitted tight handle.
10. After filing, remove the burrs from the edges of the work, to prevent cuts to the fing...
11. Do not use vice as an anvil.
12. While sawing, keep the blade straight; otherwise it will break
13. Do not use a file without handle.
14. Clean the vice after use.

MACHINING

Machining is a term used to describe a variety of material removal processes in which cutting tool removes unwanted material from a workpiece to produce the desired shape. It can also be described as a material removal process in which a sharp cutting tool is used to mechanically cut away material so that the desired part geometry remains. Machining can be used to create a variety of features including:

- Holes
- Slots
- Flat surfaces
- Complex surface contours.

LATHE MACHINE AND LATHE MACHINE OPERATIONS

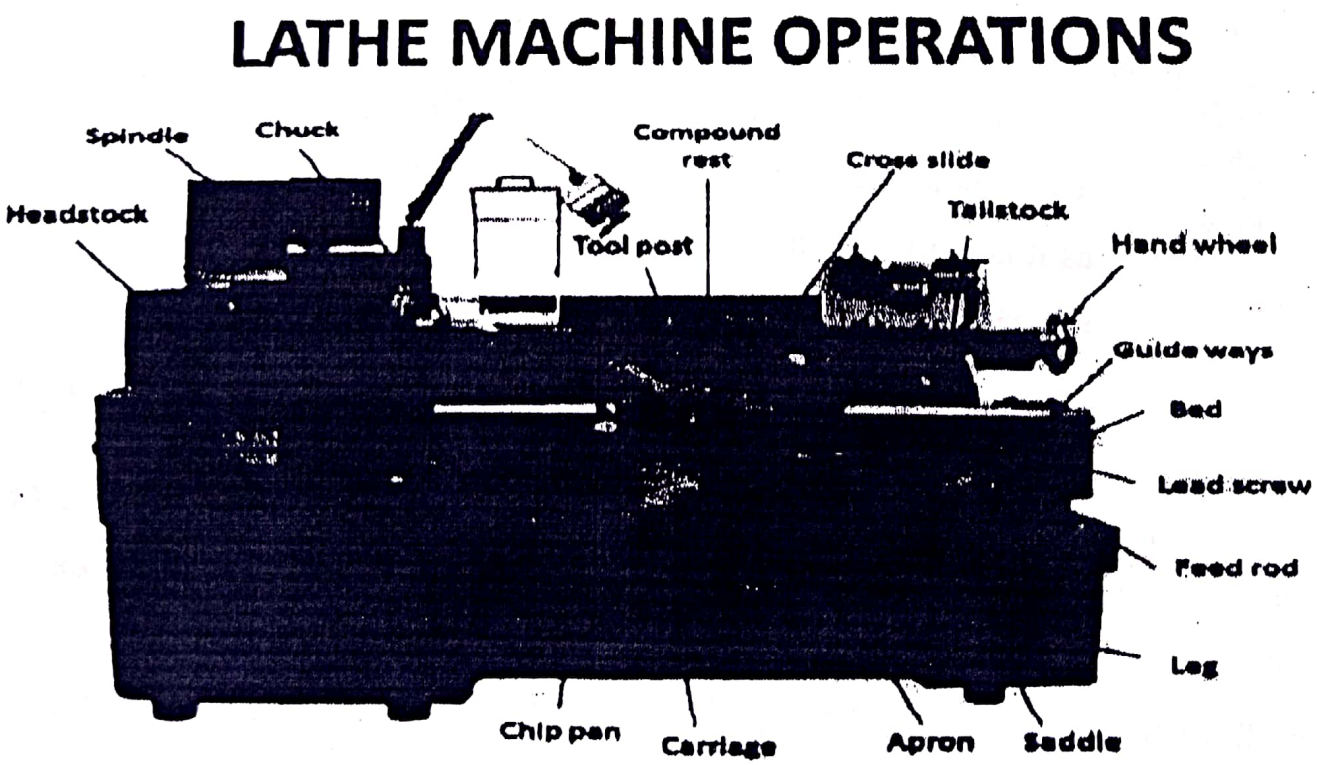
LATHE MACHINE

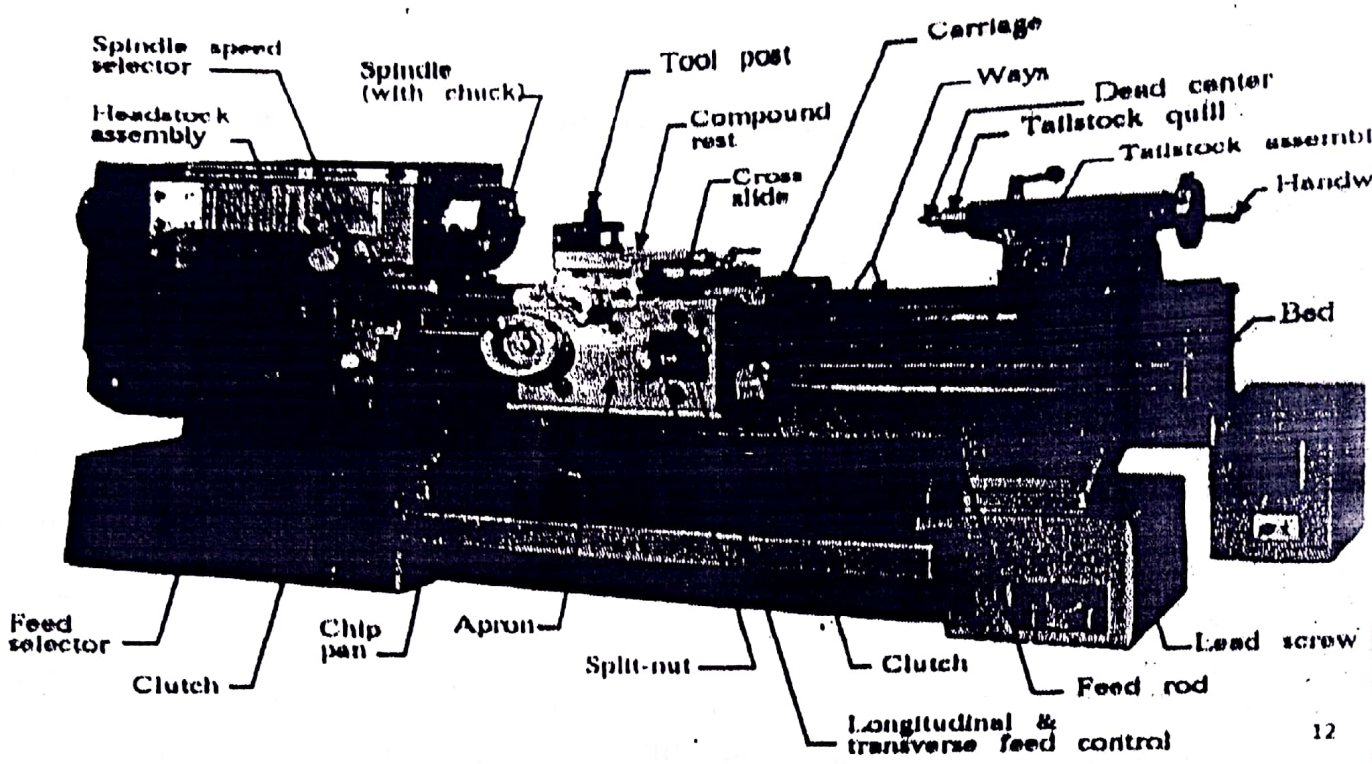
Lathe machine is single point cutting tool machine which removes the metal from a rotating piece of work to generate the required cylindrical and desired shape and size. Lathe machine is used to remove metals from a workpiece to give a desired shape and size. This machine is mostly used in performing work such as metal working, metal spinning, thermal spraying, glass working and parts reclamation.

Types of lathe machine

- **Engine** /centre lathe machine. This is the most common form of lathe machine
- **Bench** lathe machine
- Speed lathe machine
- Tool room lathe machine
- Capstan and turret lathe machine
- Automatic lathe machine (computer controlled lathe machine)

Some major parts of lathe machine





Bed: this is the base on which all other parts of lathe machine are mounted. It massive rigid single piece casting made to support other active parts of lathe.

Headstock: the headstock transmit power to the different parts of lathe machine. T headstock contains the high precision bearing which hold the horizontal axle know as spindle.

Tail stock: this is used to apply support to the longitudinal rotary axis of a workpie as it is being machined.

Carriage: this is located between headstock and tailstock and it holds the tool in b cross and longitudinal directions. Also, carriage contains some other parts of lat machine such as apron, cross slide, compound rest and tool post.

Chin pan: this collect the metal chips while operation is going on.

Spindle: this is a hallow horizontal axel with interior and exterior thread by whic workpiece can be mounted on.

Legs: this is used in holding the lathe machine and in elevating the lathe bed to working height.

Feed rod: this is a power transmission mechanism which provide precise longitudinal movement of the carriage.

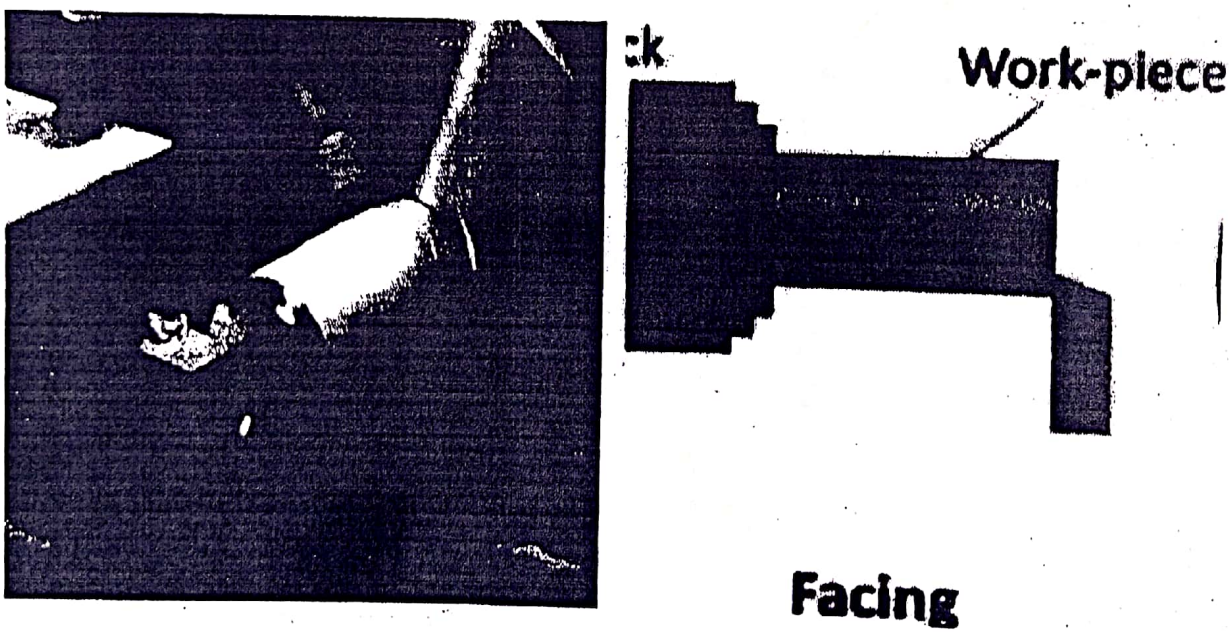
Lead screw: this is found just between the feed rod. It also provide precise longitudinal movement to the carriage. It engage in thread cutting operation.

Tool post: this is used to hold the tool at correct position.

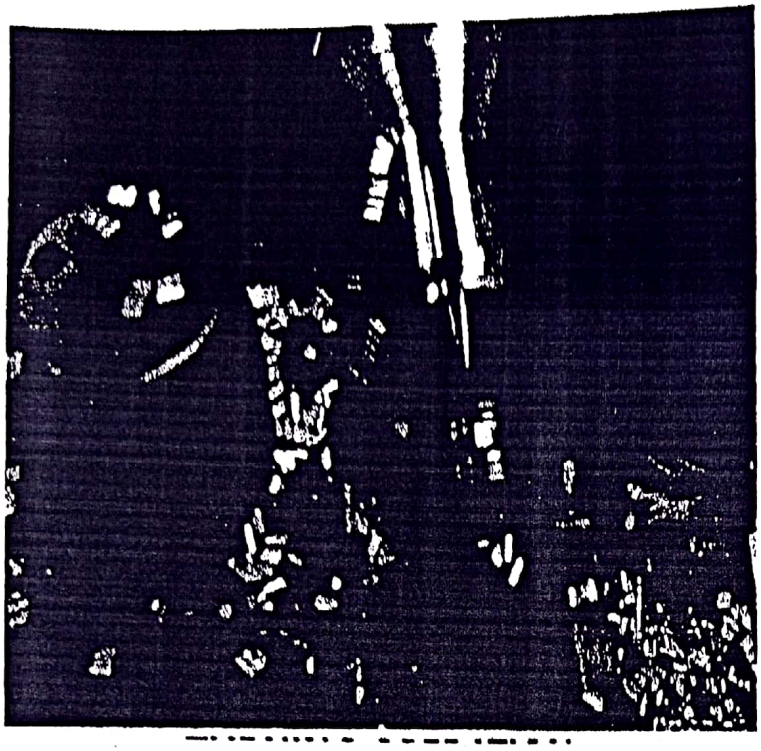
Chuck: this is used to hold the workpiece.

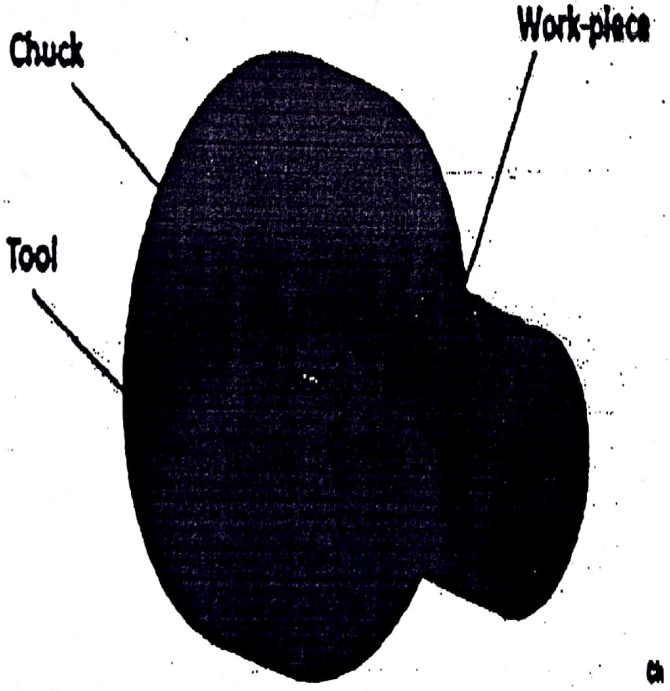
VARIOUS LATHE MACHINE OPERATIONS

Facing: this is a process of making a flat surface on a lathe machine. In facing operation, a single point turning tool moves radially along the end of the workpiece removing a thin layer of material (metal piece) in order to provide a smooth flat surface.



Turning: this is operation of lathe machine which can be of many kinds such as rough turning, shoulder turning, taper turning, eccentric turning etc. Generally, it is operation that removal of metal takes place from the surface of the cylindrical workpiece. It removes metal from the outer diameter of a rotating cylindrical workpiece.





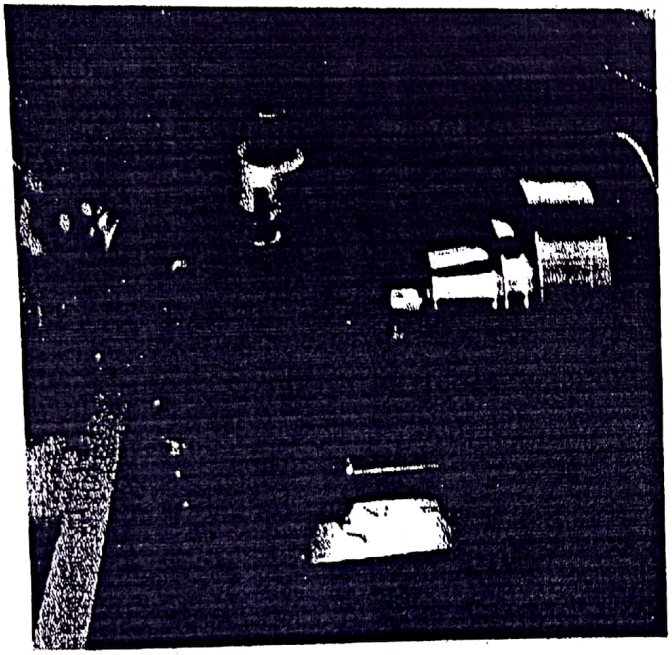
Turning process is a form of machining operation, a material removal process whic used to create rotational parts by cutting away unwanted material. It is a process th used to produce parts that have many features such as holes, grooves, threads, ta

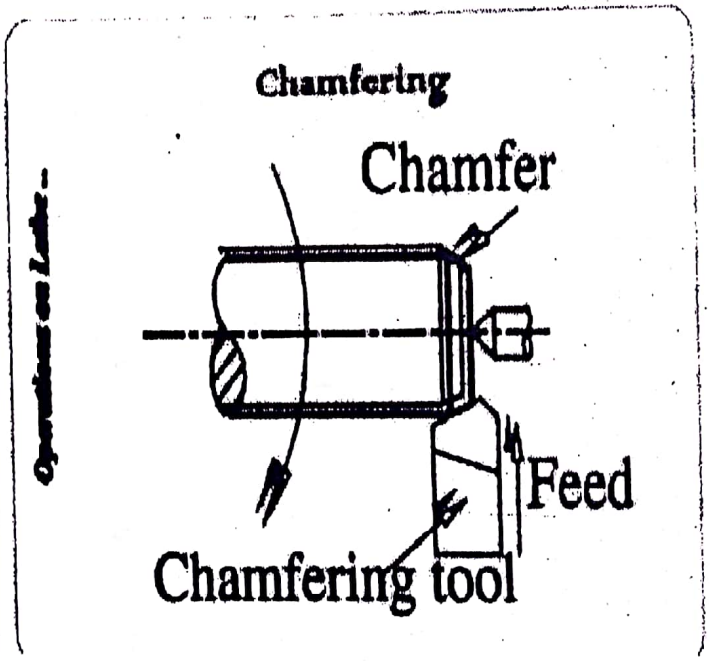
various diameter steps and contoured surface. Turning process is carried out using **lathe machine.**

Straight turning which also can be called **cylindrical turning is** the process of reducing workpiece diameter to a specific dimension as the carriage of the lathe machine moves the tool along the workpiece.

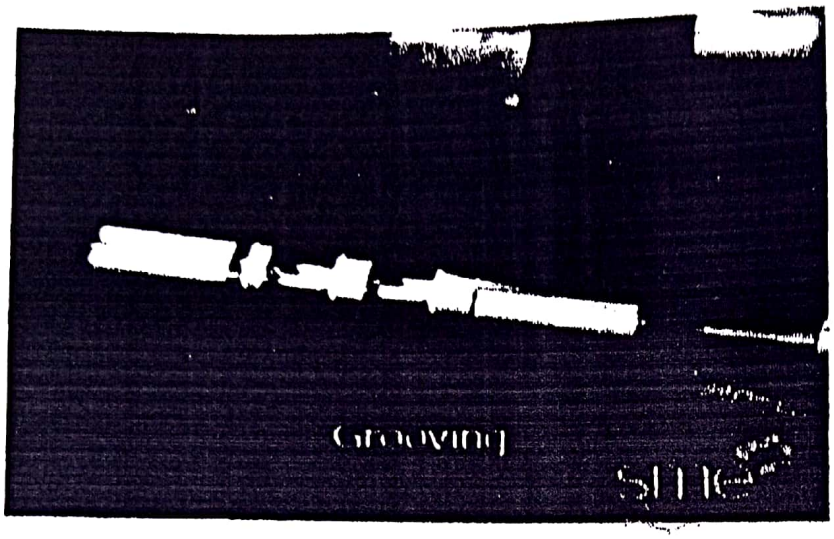
Step turning: is a process where excess material is removed from workpiece to obtain various steps of different diameter and shapes.

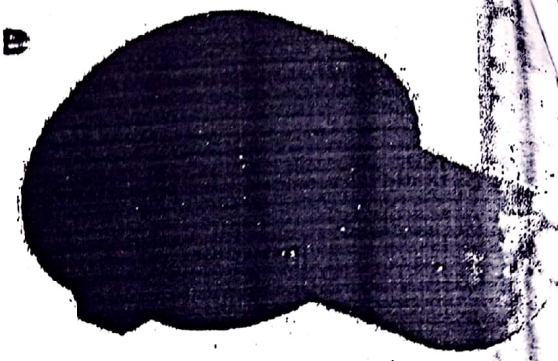
Chamfering: this is operation of getting a bevelled (i.e. surface that slopes away from horizontal or vertical) surface at the edge of a cylindrical workpiece. This operation is done in terms of bolt and shafts end.





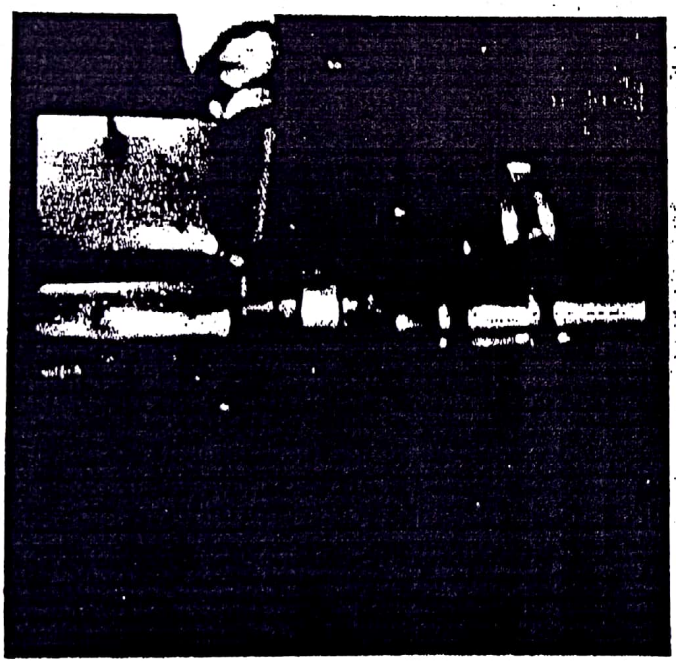
Grooving: this is the process of reducing the diameter of a workpiece over a very narrow surface. In grooving operation, a single point tool moves radially into the side of the workpiece, cutting a groove equal in width to the cutting tool.

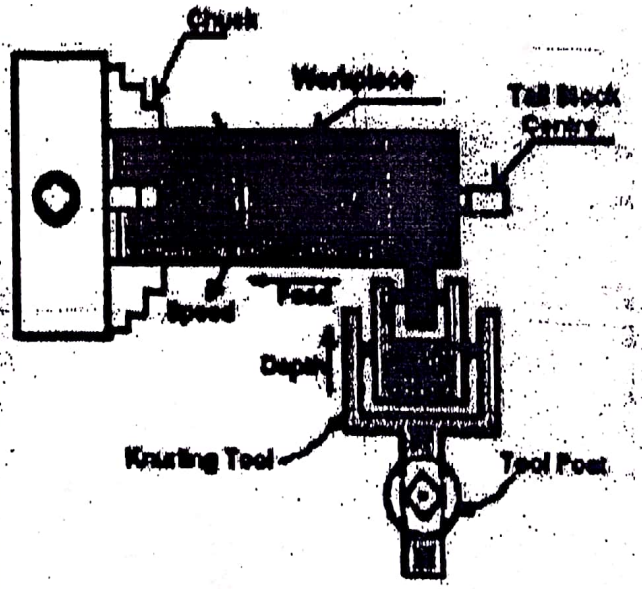




Groovi

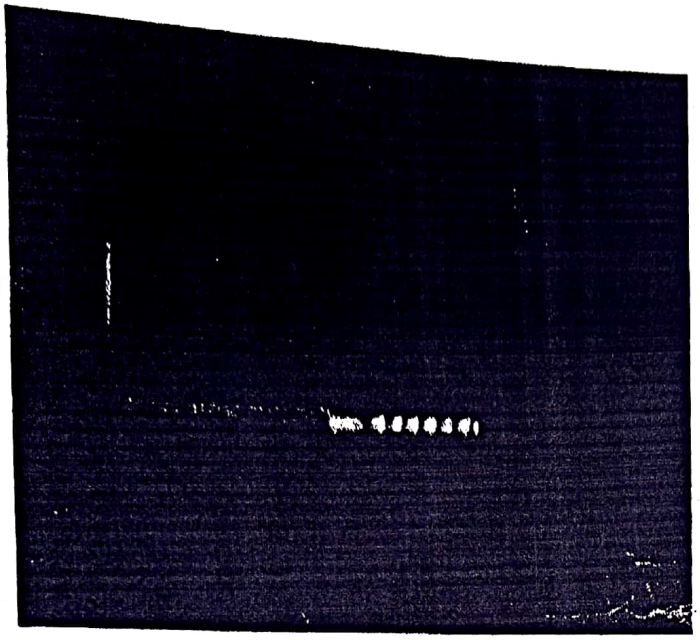
Knurling: this is a lathe machine operation used to obtain a diamond shape on a work use for gripping purpose.

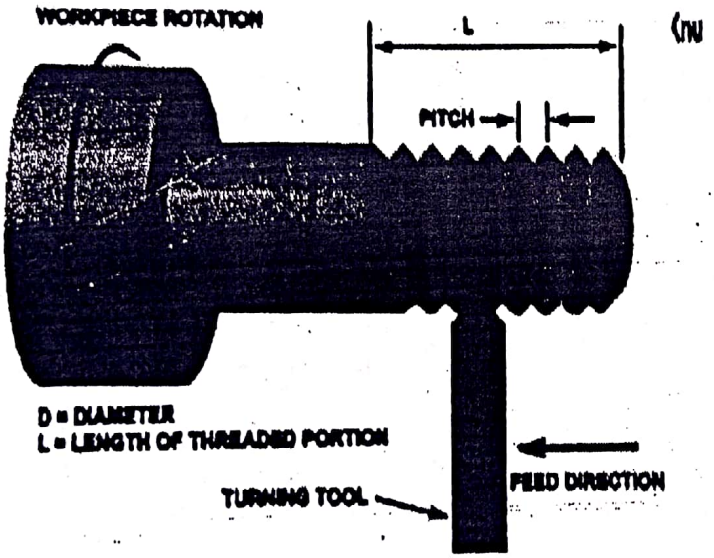




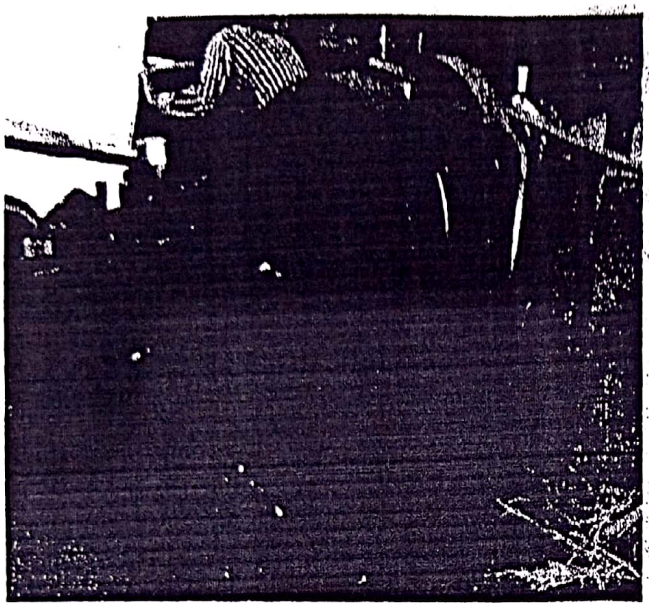
Knurling

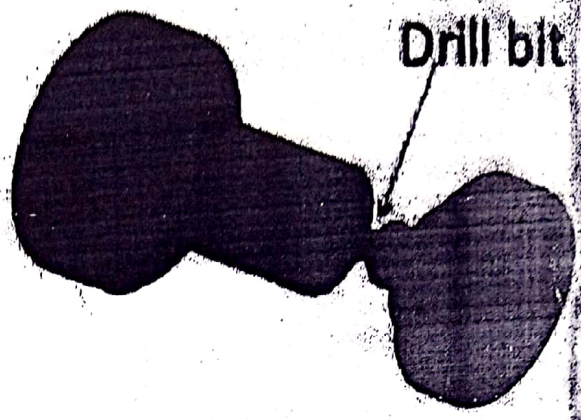
Threading cutting: this is an operation performed on lathe machine to produce a he (spirally) shape grooved workpiece. The thread is usually formed on the cylindrical st workpiece.





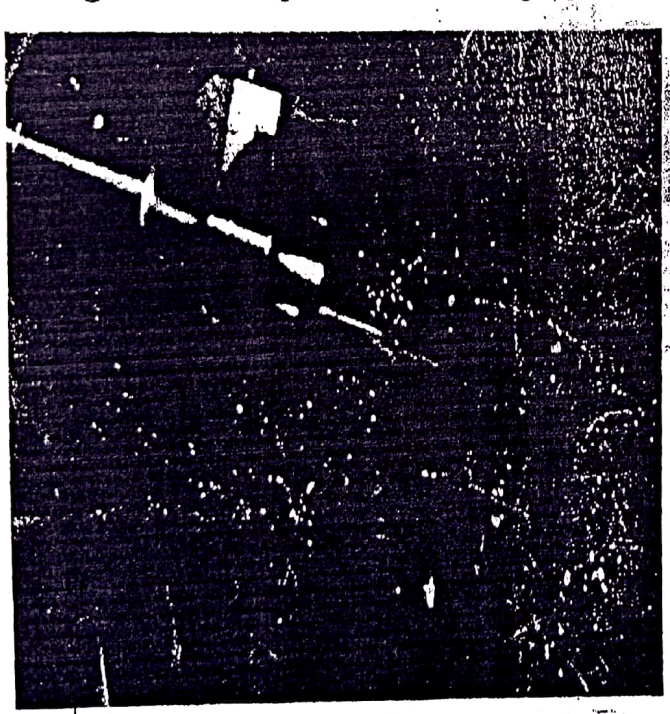
Drilling: this is an operation of producing a cylindrical hole in a workpiece. It is done by a rotating tool, the rotating side of the cutter know as drilling drill (making holes in th workpiece with the help of drill tools).

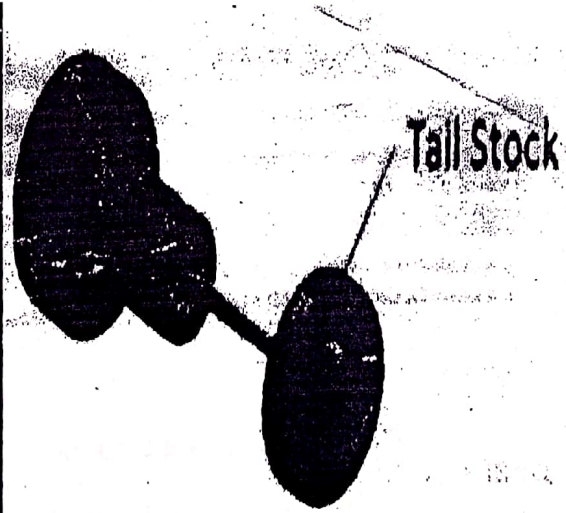




Drilling

Boring: this is an operation of enlarging the hole which is already drilled, punched or forged





Boring