GOVERNMENT POLYTECHNIC COLLEGE
PERUMBAVOOR

AUTOMOTIVE LAB MANUAL (5029)

SEMESTER 5

DEPARTMENT OF MECHANICAL ENGINEERING

VISION AND MISSION OF THE INSTITUTION

VISION

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

MISSION

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

DEPARTMENT OF MECHANICAL ENGINEERING

VISION

Excel as a centre of skill education in mechanical engineering moulding professionals whostrive for the betterment of society

MISSION

1 Provide state of art knowledge, skill and transform the students into responsible professionals for the sustainable development of society

2 To have good infrastructure facilities so that students will gain hands on experience by using various equipment and software .

COURSE TITLE : AUTOMOTIVE LAB

COURSE CODE: 5029

COURSE CATEGORY:

PROGRAM ELECTIVE

PERIODS/ WEEK: 3

PERIODS/ SEMESTER: 45

CREDIT: 1.5

COURSE OBJECTIVES

- To familiarize with the safety precautions to be followed in an automobile workshop.
- To familiarize with the uses of appropriate tools, gauges and equipments in automotive servicing.
- To practice the dismantling and assembling of two stroke and four stroke Petrol engines and associate equipments.
- To practice the dismantling and assembling of two stroke and four stroke Diesel engines and associate equipments.
- To practice the dismantling and assembling of automobile transmission system equipments.

CONTENT DETAILS

MODULE I

CO1 : Aware of safety precautions to be followed in an automobile workshop and familiarize the use of tools, gauges and equipments in automotive servicing.

- Introduction, understand various safety precautions to be followed in Automobile workshop.
- Understand the different tools and equipment used in Automobile workshop.
- Identify the application of measuring tools and specific tools.
- Carryout cleaning, greasing and oiling of equipments

Contents: Awareness on safety precautions to be followed in Automobile workshop. Identify Open end spanners, Ring Spanners, Combination Spanners, Socket spanners, Torque wrench, Adjustable wrenches, Allen Wrenches., HEX Key, Plier, Screwdriver Sets Familiarize Trolley Jack, Oil Pan/Drip Tray and Funnel, Oil Filter Wrench, and engine hoist. Understand Calipers, Micrometer, Laser Measure, Ruler, Compass, and Measuring Tape. Understand cleaning, greasing and oiling of equipments.

MODULE II

CO2 : Demonstrate the dismantling and assembling of two stroke and four stroke Petrol engines and their components

- Familiarize the engine components and parts. Understand the working principle of two stroke and four stroke Petrol engines and associate equipments engines.
- Acquire the basic skills related to engine servicing and maintenance. Create awareness about maintenance schedules.
- Perform the dismantling, cleaning and testing of A.C. mechanical pump
- Perform the dismantling, cleaning and tuning of carburetor and servicing of air cleaner
- Dismantling and assembling of the Distributor. Discover wiring in magneto ignition system Spark plug- removal, cleaning & gap resetting

- Perform dismantling, cleaning and assembling of water pump

Contents: Study of various makes of four-stroke and two-stroke spark-ignition engines and components by dismantling and assembling various parts. Comparison of engine components. Familiarize the Engine components - Cylinder block, cylinder liners- wet type and dry type, Cylinder head, cylinder head gasket, Pistons – types of pistons, Piston rings, compression ring, oil ring and special purpose ring, Gudgeon pin, Connecting rod. Crank shaft, Main bearings, Fly wheel, Valves, Cam shaft drives. Perform the cleaning and testing of A.C. mechanical pump, carburetors, air cleaner, Distributor, magneto ignition system, Spark plug, and water pump. Identify the components and fault diagnosis of air conditioning unit in an automobile.

MODULE III

CO3: Demonstrate the dismantling and assembling of two stroke and four stroke Diesel engines and their components.

- Identify the engine components and parts. Understand the working principle of two stroke and four stroke Diesel engines and associate equipments.
- Acquire the basic skills related to engine servicing and maintenance. Create awareness about maintenance schedules.
- Carryout dismantling and assembling of two stroke and four stroke diesel engines.
- Carryout Dismantling and assembling of the Fuel Injection pump. Carryout Dismantling, assembling and over hauling of fuel injectors.
- Carry out dismantling and assembling of the oil pump, fuel feed pump.
- Carry out Bleeding of diesel fuel system.

Contents: Familiarization of various makes of four-stroke and two-stroke Compression-ignition engines and components by dismantling and assembling various parts. Comparison of engine components. Familiarize the Engine components - Cylinder block, cylinder liners wet type and dry type, Cylinder head, cylinder head gasket, Pistons – types of pistons, Piston rings, compression ring, oil ring and special purpose ring, Gudgeon pin, Connecting rod. Crank shaft, Main bearings, Fly wheel, Valves, Cam shaft drives. Perform the cleaning and testing of Fuel Injection pump, fuel injectors, oil pump, and fuel feed pump. Bleeding of diesel fuel system.

MODULE IV

CO4: Apply the technical knowledge in dismantling and assembling of automobile transmission system.

- Dismantling, assembling and over hauling of clutch assembly
- Dismantling, assembling and over hauling of Gear box.
- Dismantling, assembling and over hauling of Differential assembly.
- Dismantling, assembling and over hauling of slider joints.
- Dismantling, assembling and over hauling of Master Cylinder.
- Dismantling, assembling and over hauling of Brake & wheel cylinders.

Contents: Dismantling, assembling and over hauling of Single plate, Multi plate, and centrifugal clutch assembly. Dismantling, assembling and over hauling of sliding mesh, constant mesh and synchromesh Gear box. Dismantling, assembling and over hauling of Differential assembly, slider joints, Master Cylinder, and Brake & wheel cylinders.

CONTENTS

EXPERIMENTS

GENERAL INSTRUCTIONS

Rough record and Fair record are needed to record the experiments conducted in the laboratory. Rough records are needed to be certified immediately on completion of the experiment. Fair records are due at the beginning of the next lab period. Fair records must be submitted as neat, legible, and complete.

INSTRUCTIONS TO STUDENTS FOR WRITING THE FAIR RECORD

In the fair record, the index page should be filled properly by writing the corresponding experiment number, experiment name date on which it was done and the page number.

On the right side page of the record following has to be written:

1. Title: The title of the experiment should be written in the page in capital letters.
2. In the left top margin, experiment number and date should be written.
3. Aim: The purpose of the experiment should he written clearly.
4. Apparatus/Tools/Equipments/Components used: A list of the Apparatus/Tools/Equipments/Components used for doing the experiment should be entered.
5. Principle: Simple working of the circuit or line diagram should be drawn.
6. Procedure: Steps for doing the experiment and recording the readings should be briefly described.
7. Results: The results of the experiment must be summarized in writing and should be fulfilling the aim.
8. Inference: Inference from the results is to be mentioned.

On the Left side page of the record following has to be recorded:

Observations:

i) Data should he clearly recorded using Tabular Columns.

ii) Unit of the observed data should he clearly mentioned.

iii) Relevant calculations should be shown. If repetitive calculations are needed, only show a sample calculation and summarize the others in a table.

4. Graphs: Graphs have used to present data in a form that show the results obtained as one or more of the parameters are varied. A graph has the advantage of presenting large amounts of data in a concise visual form. Graph should be in a square format.

GENERAL RULES FOR PERSONAL SAFETY

1. Always wear light shirt/lab coat, pants and shoes inside workshops.

2. REMOVE ALL METAL JEWELLERY since rings, wrist watches or bands, necklaces, etc. make excellent electrodes in the event of accidental contact with electric power sources.

3. DO NOT MAKE CIRCUIT CHANGES without turning off the power.

4. Make sure that equipment working on electrical power are grounded properly.

5. Avoid standing on metal surfaces or wet concrete. Keep your shoes dry.

6. Never handle electrical equipment with wet skin.

7. Hot soldering irons should be rested in its holder. Never leave a hot iron unattended.

8. Avoid use of loose clothing and hair near machines and avoid running around inside lab.

INTRODUCTION

BASICS OF SHOP SAFETY

SAFETY IN THE SHOP

Safety means protecting yourself and others from possible danger and injury. You do not want to hurt yourself or someone else. To prevent this, follow the safety rules in the shop. When everyone obeys the rules, the shop is a much safer place in which to work than your home!

Safety is your job! In the shop, you are "safe" when you protect your eyes, fingers, feet-all of you-from danger. Just as importantly, you must look out for the safety of others around you.

SHOP LAYOUT

The term shop layout means the location of workbenches, vehicle lifts, machine tools, and other equipment. Shop layouts vary. When you first go into a shop find where everything is located. Many shops have lines painted on the floor to mark off work areas. These lines guide customers and workers away from danger zones around equipment. The lines also remind workers to keep their tools and equipment inside their work areas.

SIGNS

Signs posted around machinery and on the walls remind everyone to operate the machinery safely. Many of these are OSHA signs. OSHA stands for Occupational Safety and Health Administration. This federal agency is responsible for studying and correcting conditions and equipment that may be hazardous to workers. Always follow the posted instructions. The most common cause of accidents in the shop is failure to follow instructions.

HAZARDS AND HOW TO AVOID THEM

SHOP HAZARDS

The National Institute for Occupational Safety and Health (NIOSH) is another federal agency. It studies working conditions and reports on potential hazards. The law requires that workplaces having hazards must eliminate them. Hazards are sometimes the fault of management and sometimes the fault of the workers. The following sections describe hazards due to faulty work habits, equipment defects or misuse, and faulty or improperly-used hand tools.

HAZARDS DUE TO FAULTY WORK HABITS OR CONDITIONS

Here are some major hazards. They are due to faulty work habits of the employees or unsafe working conditions.

1. ***Smoking while handling dangerous materials such as gasoline or solvents***. This can cause a fire or explosion.
2. ***Careless or incorrect handling of gasoline, alcohol. solvents, or other flammable fluids***.
3. ***Blocking exits***. Keep areas around exit doors and passageways leading to exits free of all obstructions. If there is an explosion and fire, a blocked exit could mean serious injury or death!
4. ***Spilled oil or antifreeze not cleaned up***. Serious injury can result if someone slips and falls in the shop.
5. ***Lack of shop exhaust system, or failing to connect the system to the tail pipe of a vehicle with a running engine.*** This is a hazard to everyone in the shop. Exhaust gas contains Carbon monoxide (CO) and other poisonous materials.
6. ***Allowing dangling hair, ties, sleeves, or jewelry to fall into the engine fan, drive belt, or other moving part***. Injury may occur.

HAZARDS DUE TO EQUIPMENT DEFECTS OR MISUSE

Here are common hazards in the shop due to faulty equipment or its improper use.

1. ***Incorrect safety guarding of moving machinery***. Ventilating fans should have proper guards and no exposed blades. Guards should be placed around the belts and pulleys on the shop air compressor.

2. ***Asbestos dust from brake and clutch lining.*** If the vehicle has asbestos brake lining, asbestos dust collects in the brake mechanisms at the wheels. Remove the dust before working on the brakes. Use a special vacuum cleaner with a High Efficiency Particulate Air (HEPA) filter. An ordinary shop vacuum cleaner will not filter out asbestos fibers. They can remain floating in the air for days if not trapped by the HEPA filter.

3. ***Misuse of compressed air***. Shop air nozzles or blowguns discharge compressed air to blow parts dry and clean. A diffuser on the blowgun reduces the discharge pressure to less than 30 psi [207 kPa). Never point a blowgun at another person or use it to blow dust off your clothes. Compressed air can Drive dust particles at high speed. These can penetrate the skin and eyes.

When drying rotating parts, such as a ball bearing avoid spinning them. A ball bearing spinning at high speed can explode. The flying pieces may seriously injure you.

4. Flexible electric cord with worn or frayed insulation. Do not use an electric cord that is worn or spliced. Flexible cord should not run through holes in the wall or be tacked onto the wall. Any of these could cause fire, shock, or electrocution.

5. Compressed-gas cylinders improperly stored or misused. Do not store gas cylinders near room heaters or other heat sources. Never store cylinders in unventilated lockers or closets. Have at least 20 feet [6.1meters (m)] between stored oxygen and acetylene cylinders. They must not stand free. A chain or lashing must secure the cylinders. Never use cylinders as supports or or rollers to move an object. The cylinder could explode.

6***. Hand-held electric tools not properly grounded***. They must have a a separate ground lead or double insulation to guard against electric shock.

7. Automotive lifts not properly used. Never raise a vehicle with passengers in it. To prevent damage, first close the doors, hood, and trunk lid. If the lift has a mechanical locking device, engage it before you go under the vehicle. Do not use a hydraulic lift that jumps, jerks, or settles slowly when it should not. Also, do not use a lift that works slowly or leaks oil from the exhaust line or packing gland.

8.Jacks or safety stands improperly placed. Vehicles and their major components are heavy. Always place jacks and safety stands so they support the vehicle or component. If a jack or safety stand slips out, damage or injury may result.

9***. Using a wheel-and-tire balancer without the hood in place***. OSHA regulations require all dynamic (spinner type) wheel balancers to have a hood. It protects you if a stone or other object flies out of the spinning tire tread.

10. Letting tester leads fall into the engine fan. This can damage the leads, topple the tester, and injure you.

11. Sudden startup of the electric fan for the engine cooling system. These fans can run even if the ignition key is off. To protect yourself, disconnect the fan-lead connector before you work around the engine. Otherwise, if the engine is still hot, the fan could start running and injure you.

12.Leaving a running power tool unattended. If you must leave it, turn it off. Otherwise someone might come along and, not realizing it is running, get hurt.

13. Playing with a fire extinguisher. Some people have thought it was fun to play with a fire extinguisher. But the liquid or spray discharge made the floor slick. Then someone was injured by a slip and fall. Other people have had eye damage from being hit by the discharge. Never play with a fire extinguisher. The discharge may cause an injury. Also, this leaves the extinguisher empty and useless if needed for a fire.

HAND TOOL HAZARDS

Keep hand tools clean and in good condition. Greasy and oily tools are difficult to hold and use. Wipe tools clean before and after using them. Do not use a hardened hammer or punch on a hardened surface. Hardened steel is brittle and can shatter from heavy blows. Slivers may fly out and enter a hand or an eye. There are other hand-tool hazards to watch out for. These include hammers with broken or cracked handles, chisels and punches with mushroomed heads, and broken or bent wrenches. Never use a tool that is in poor condition or not right for the job.

FIRES AND HOW TO PREVENT THEM

1. **FIRE PREVENTION**

Gasoline is very dangerous if not handled properly Sometimes people forget that, because gasoline is so common in the shop. A spark or lighted match in a closed place filled with gasoline vapor can cause an explosion. Even the spark from a light switch can set off an explosion Here are some safety rules.

1. Do not smoke or light cigarettes around gasoline or other flammable liquids.
2. Leaking or spilled gasoline quickly vaporizes. Keep the shop doors open and the ventilating system running. Wipe up the spilled gasoline at once. Put the rags or towels outside to dry.
3. Sometimes you must work on a vehicle that is leaking gasoline. Be very careful. Catch the leaking gasoline in a container or on rags. Put the soaked rags outside to dry. Do not make sparks, such as by connecting a test light to the battery.
4. Store gasoline in an approved safety container. Never store gasoline in a glass jug. The glass

could break. An explosion and fire could result.

5. Oily rags can catch fire, without a spark or flame, by spontaneous combustion. To prevent this, always store oily rags and waste in a fireproof safety container . Do not overfill the safety container. The lid should close completely.

2. FIRE EXTINGUISHERS

A fire extinguisher is a portable container filled with chemicals which can be discharged in a stream to put out small fires. The most common shop fire extinguisher is the multipurpose dry chemical type. It can be used to fight ordinary combustible fires, flammable-liquid fires, and electrical fires.

WORKING SAFELY

- **SHOP SAFETY RULES**

Some people say, "Accidents will happen!" But safety experts disagree. They say, "Accidents are caused. They are caused by careless actions. They are caused by inattention to the job. And they are caused by using damaged or incorrect tools." Fewer accidents occur in shops that are neat and clean. To help prevent accidents, follow these safety rules.

1. Work quietly and give your full attention to the job you are doing.
2. Keep your tools and equipment under control.
3. Keep jack handles out of the way .Stand the creeper against the wall when not in use.
4. Never indulge in horseplay or other foolish action. You could cause someone to get seriously hurt..
5. Never put screwdrivers or other sharp objects in your pocket. You could cut or stab yourself. Or you could damage the upholstery in a car.
6. Make sure your clothes are right for the job. Dangling sleeves or ties can get caught in machinery and cause serious injury. Do not wear sandals or open-toe shoes. Wear full leather shoes with nonskid rubber heels and soles. Steel-toe safety shoes are best for shop work. Keep long hair out of machinery by wearing a cap.
7. Do not wear any rings, bracelets, or watches when working around moving machinery or electrical equipment. Jewelry can catch in moving machinery with very serious results. Also, a ring or bracelet can accidentally create a short circuit of the battery. Then the metal of the ring or bracelet may become white hot in an instant. This will severely burn you.
8. Wipe oil and grease off your hands and tools. You need a good grip on tools and parts.
9. If you spill oil, grease, or any liquid on the floor, clean it up. Help prevent injury from slips and falls,

10. Never use compressed air to blow dirt from your clothes. Never point a compressed-air blowgun at another person.
11. Always wear eye protection when liquid spray or particles are flying about. Safety glasses, safety goggles, or a face shield should always be available. Always wear eye protection when using a grinding wheel.
12. Watch out for sparks flying from a grinding wheel or a welding job. The sparks can set hair or clothes on fire.
13. When using solvents or other chemicals, wear goggles to protect your eyes. If you get a chemical in your eyes, flush them with water at once. Then go to the school nurse, a doctor, or a hospital emergency room.
14. When using a floor jack, position it properly. It must not slip out. Never lift a vehicle while someone is working under it! People have been killed the jack slipped and the vehicle fell on them. Always put safety stands in place before going under a vehicle.
15. Always use the right tool for the job. The wrong tool could damage the part you are working on or could hurt you.
16. Keep your hands away from the engine fan and accessory drive belts when the engine is running. Your hand could get caught in the fan or between a belt and pulley. You could be badly cut or even lose fingers.
17. Do not stand directly in line with the engine fan when it is turning or the engine is running. Some fans, especially fans with flexible blades, have thrown off a blade while spinning. A flying fan blade may injure or kill anyone it strikes.

USING POWER TOOLS

In the automotive shop, you use many types of power tools. Study the operating instructions for any power tool or piece of shop equipment before using it.

WHAT TO DO IN EMERGENCIES

If there is an accident and someone gets hurt, tell your instructor at once. The instructor will know what to do. It may be to give first aid, phone for the school nurse, a doctor, or an ambulance. Be careful in giving first aid. Trying first aid on an injured person can do more harm than good if it is done wrong. For example, improperly moving a person with a serious back injury could make the injury worse. However, quick mouth-to-mouth resuscitation may save the life of a person who has suffered an electric shock.

HAZARDOUS MATERIAL

A hazardous material is anything corrosive, explosive, flammable, radioactive, reactive, or toxic (poisonous). These materials may endanger human health or pollute the environment if improperly handled. Many materials used in automotive service can be hazardous if not handled properly. Examples include air-conditioning refrigerant, antifreeze, brake fluid, gasoline, and engine oil. Other hazardous materials are asbestos dust (4-6), parts-cleaning solvent, grease, paint, and shop adhesives (glue and cement).

To protect workers from unsafe exposure to hazardous materials on the job, OSHA issued the Hazard Communication Standard. This is often called the "right to know" law. It requires the shop owners to inform people who work there of the risks. The workers must receive information and training on how to protect them. The shop must also maintain a file of Material Safety Data Sheets (MSDS) in a place that is accessible to all employees.

Many types of automotive service work create hazardous waste. This is any material that could pose danger to human health and the environment after it is discarded. Some hazardous waste, such as dirty solvent, is recycled. This means it is treated and used again. Both the Environmental Protection Agency (EPA) and OSHA have rules covering the labeling and disposal of hazardous waste.

HAND PROTECTION

Many automotive jobs require the technician to “feel" the action taking place. This usually prevents the wearing of gloves to protect the hands. However, automotive manufacturers recommend wearing gloves to avoid skin contact with hazardous materials. Various types of rubber and synthetic rubber gloves protect against contact with automotive fluids, battery acid, and fuel-injector cleaner.

Gloves should also be worn when replacing a deployed air bag. This includes the cleanup of any propellant dust that settles in the ventilating ducts and vehicle interior after the air bag deploys.

SERVICE TOOLS

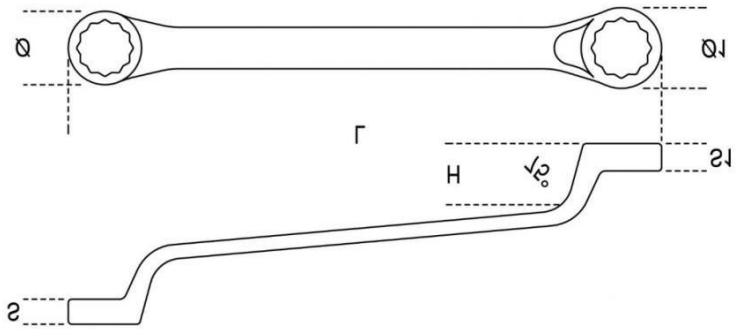
1. SPANNER

Spanner is used for tightening or loosening nuts and bolts with hexagonal or square heads. A variety of spanners are used in services and maintenance work. Commonly used spanners are made of drop forged steel.

a) Adjustable spanner (screw spanner)
b) Double end spanner
c) Box spanner(with ratchet)
d) Ring spanner
e) Tubular spanner

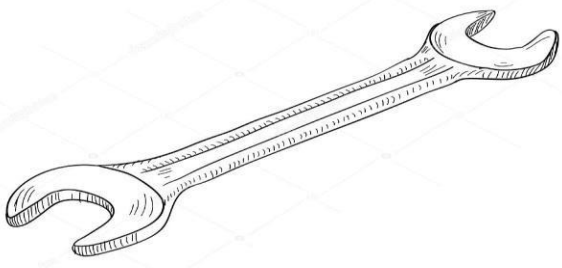
a) Ring spanner

The use of ring spanner is same as the double end spanner. They are strong and tighter than double end spanner and having usually double hexagon side.



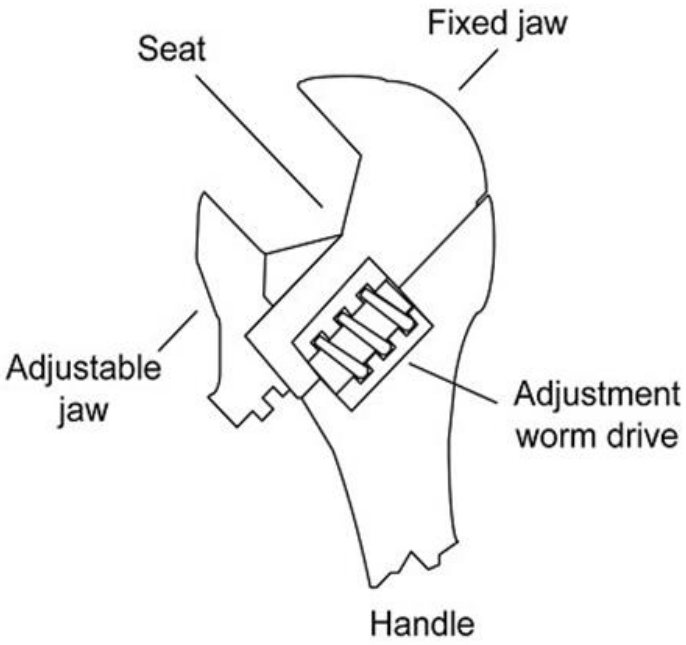
b) Double end spanner

These are also known as open spanner. It consists of two ends which are suitable for tightening or loosening nuts and bolts. They are made up of chromium vanadium steel. The sizes are: - 6-7, to 30-32 etc… in millimeters and $1/4^{th}$-$1/3^{rd}$ inches.



c) Adjustable spanner (screw spanner)

Adjustable spanner consists of an adjustable jaw and fixed jaw. The required distance between the jaws can be adjusted by turning the screw.



d) Box spanner set

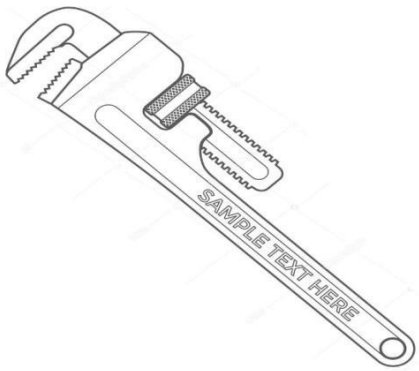
Where double end and ring spanner are not suitable for tightening or loosening the nut or bolt box spanner are used.It includes box spanner various denomination, extension rod small and large, universal joint, ratchet rod, and 'T'-rod

e) Tubular spanner (Pipe spanner)

Tubular spanner is used in the place where nut or bolt is placed in deep slots and grooves and where the double end or ring spanner cannot be used properly. Available in both sizes millimeters and inches.

2. PIPE WRENCH

It is used for holding and turning a wide range of pipes and fittings. It consists of fixed jaw and movable jaw.

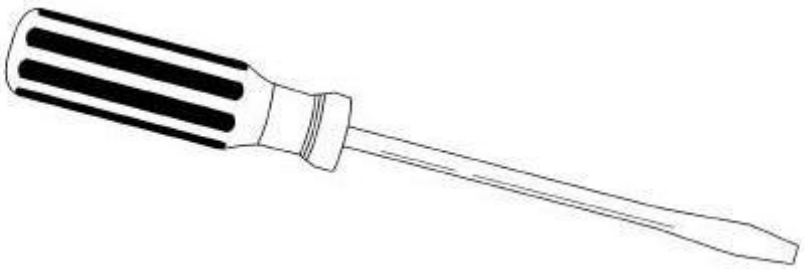


3. CHAIN WRENCH

This wrench mainly consists of a chain for holding,instead of jaws, for plumbing works.

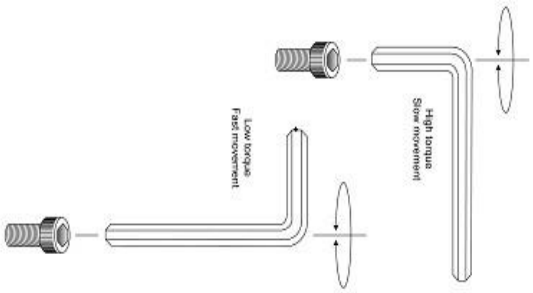
4. SCREW DRIVER

It is used to turn or drive screws with slotted heads. They are made in many sizes and several shapes. The size is made by the length of the blade which is made of the tool steel hardened end and tempered at the point.



5. ALLEN KEY

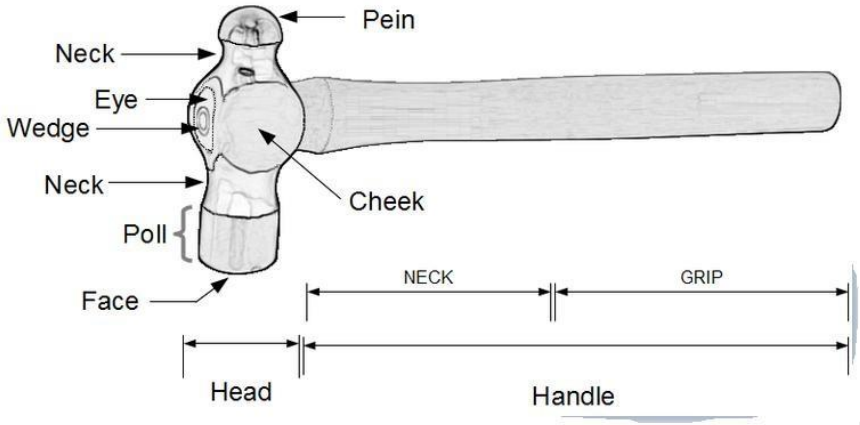
Allen key are used for tightening or loosening the Allen screws. It is made of hexagonal hard carbon steel and bends in the form of 'L'.



6. HAMMER

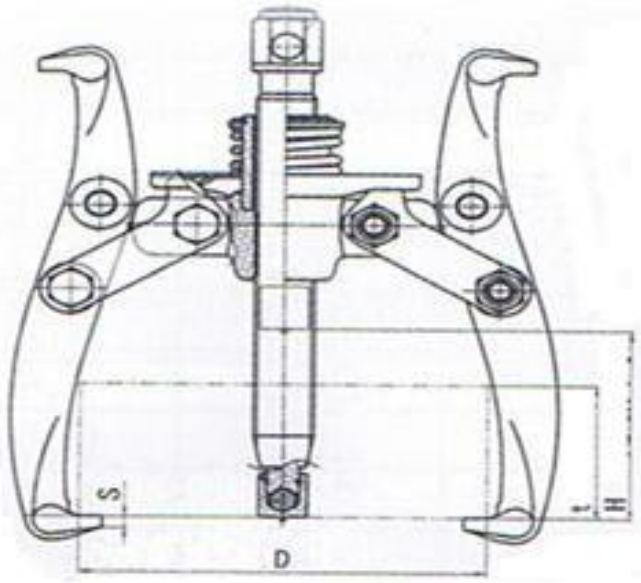
Hammers are used to strike on a tool, fastener of work piece. They are made of forged steel. They are classified according to the shape of peen and relative to handle.

a) Ball peen hand hammer
b) Cross peen hand hammer
c) Straight peen hand hammer
d) Sledge peen (double faced) hand hammer
e) Claw hammer
f) Chipping hammer



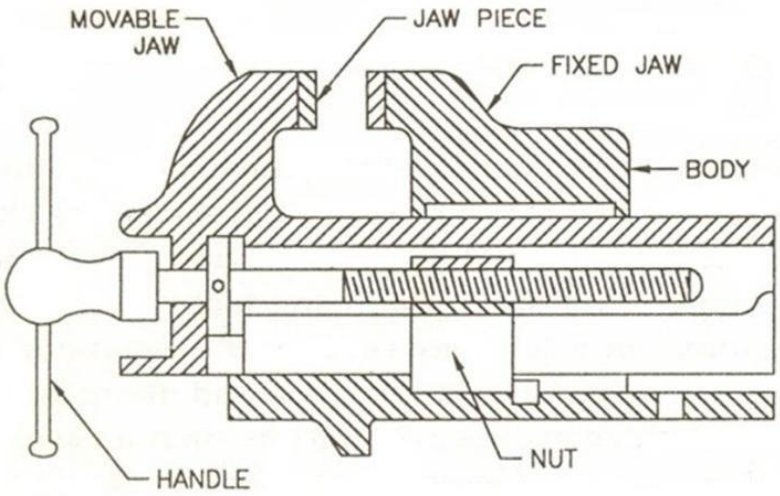
7. BEARING PULLER

Bearing puller is device used for pull of bearing from shaft, holes etc. it has their jaws and handle threaded screw.



8.BENCH VICE

Bench vice is used for holding the compotes tightly, while working. It is firmly fixed to a bench with nuts and bolt it consists of a cast iron or steel body, fixed jaw and a movable jaw.



9. STEEL RULE

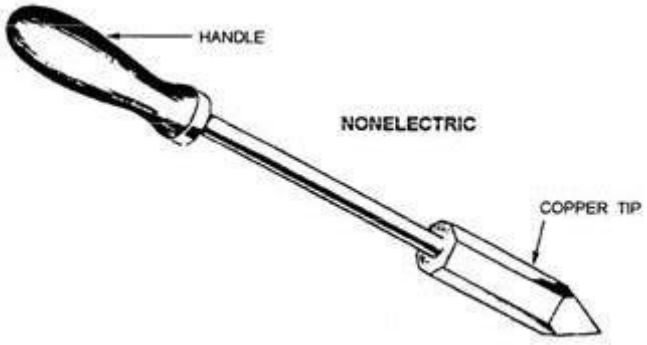
A steel rule is a strip of metal gradated in to units of measurement which can be used for measuring the actual dimension of an object with an accuracy of 1/64-inch British system and 0.5 mm in metric system.

10. CHUCK KEY

Chuck key is used to operate the jaw of chuck of lathe.

11. SOLDERING IRON

It is used for soldering joints with soldering wire or tin. Its size depends upon the wattage of the heating elements. A 65W soldering iron is very common for this purpose.



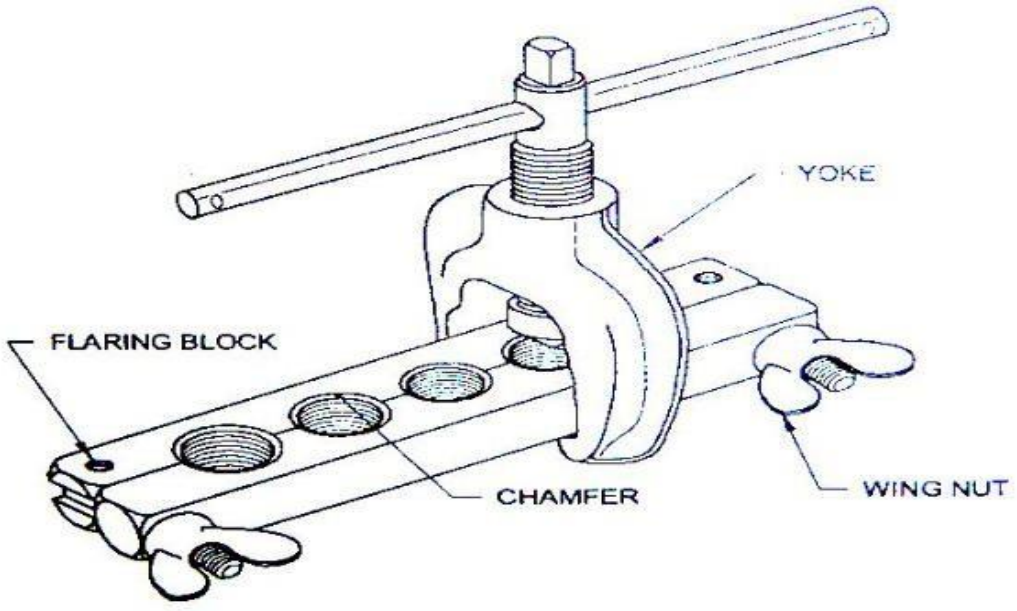
12. FLAIRING TOOL

a) YOKE

Yoke is used for marketing flair of different size of copper tubes. The yoke contains die or cone is rotated against the flair suet to produce flair.

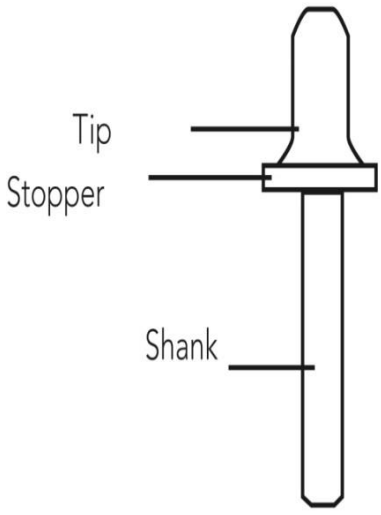
b) BLOCK

H – block is used to hold the tube with the flair and sawing purpose. H block consists of two bars forming holes of various sizes. They are clamped together with wing nuts and bolts.



13. SWAGING TOOL

It is used to expand the inner diameter of a tube in to the outer diameter of the same. Then the tubes are jointed on the swaged part by brazing. This is normally done in same diameter tubes for jointtogether.

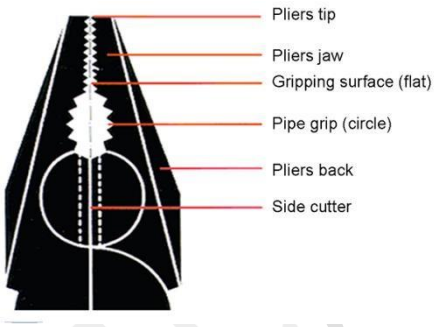


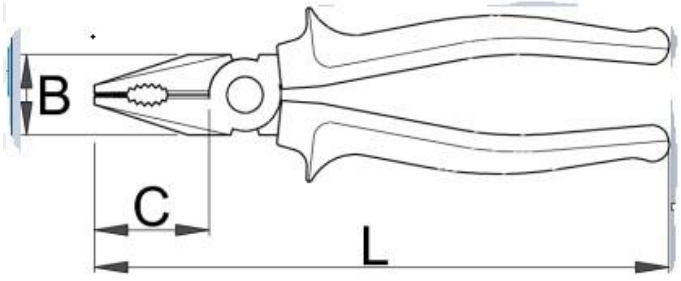
14. OIL CAN

It is a bottle containing oil to lubricating congested machine parts (bearing, bushes, pivot,etc…) by the long nozzle fitted on the device.

15. COMBINATION PLIERS

Combination of operations can be done by this type of pliers. That is why it is named so (cutting, gripping, pinching, holding etc…)

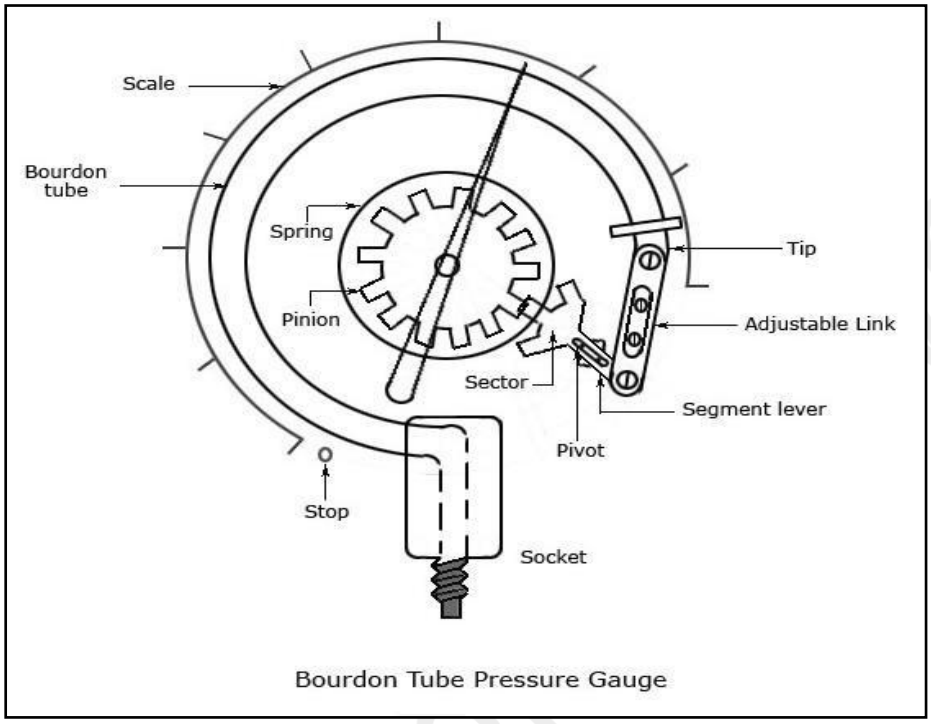




MEASURING INSTRUMENTS

1. PRESSURE GAUGE

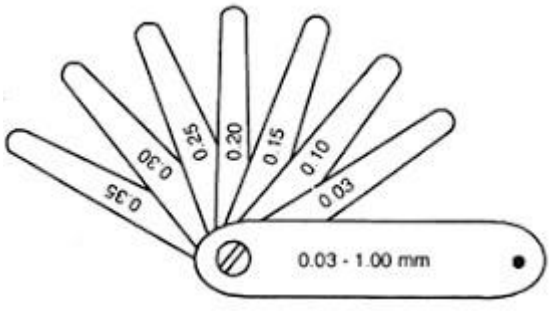
Pressure gauge is used to measure the pressure of refrigerant in a refrigeration machine it is graduated by a dial scale on lb / sq inch or kg /sq cm. The type of the gauges used in refrigeration trade onlytwo, that is high pressure gauge and a compound gauge.



Bourdon Tube Pressure Gauge

2. FEELER GAUGE

It is used to measure clearance between the two parts. It is the set of thin steel sheet strips (leaves) of various thicknesses looking like a knife. Each leaf is marked with its thickness which varies from 0.05mm to 1mm.



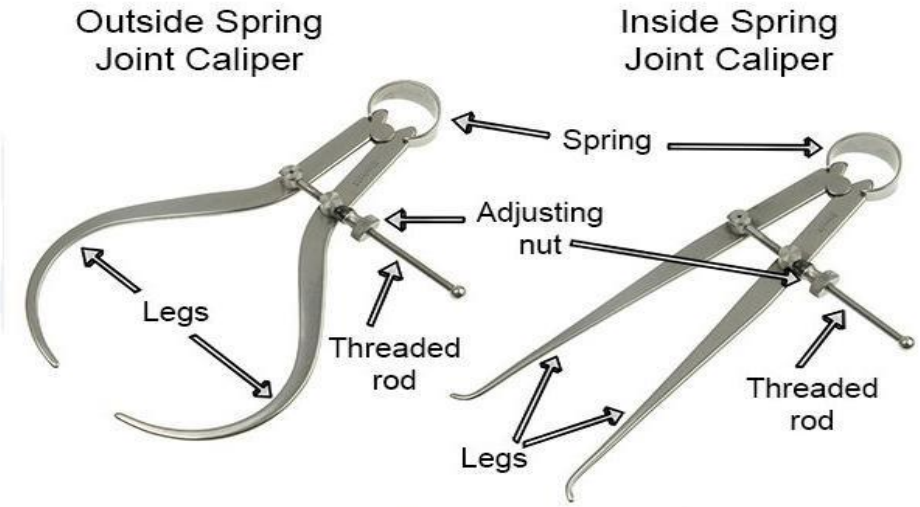
3. HAND VICE

The hand vice is used for gripping small items like screws, rivets, key etc.Which are too small to be held on a bench. The jaw width various from 40 to 44 mm and jaws are opened and closed by wing nuts.

4. CALIPERS

To measure the size of or to transfer a dimension to a component,calipers are used. A reasonable accuracy in dimension is obtained by using calipers.

a) Outside caliper
b) Inside caliper
c) Outside spring caliper
d) Inside spring caliper
e) Hermaphrodite (jenny or odd leg) caliper.



5. STEEL RULE

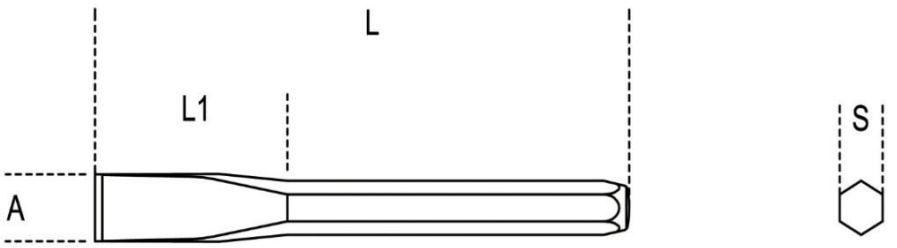
A steel rule is a strip of metal gradated in to units of measurement which can be used for measuring the actual dimension of an object with an accuracy of 1/64-inch British system and 0.5 mm in metric system.

CUTTING TOOLS

3. CHISEL

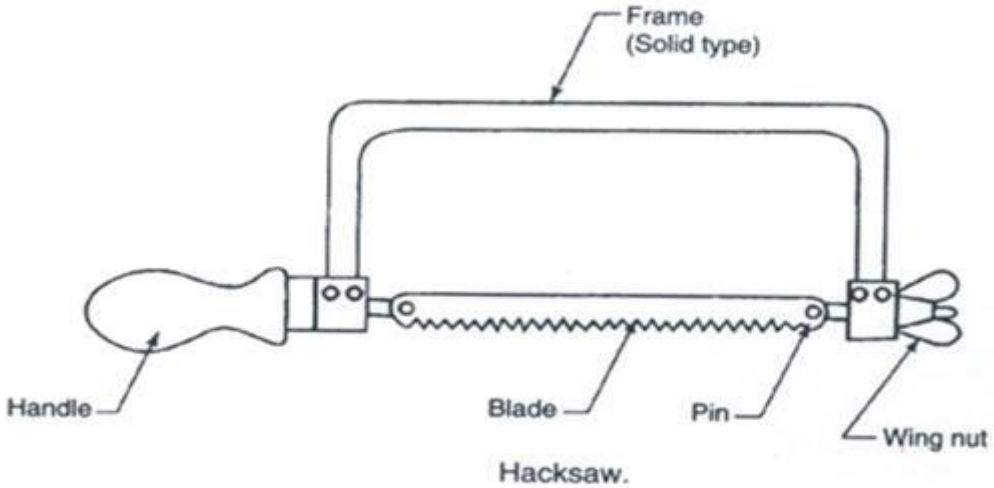
Chisel is used for cutting sheets, producing key way and for removing metal from surfaces. These chisels are forged from octagonal hard carbon steel.

a) Flat cold chisel
b) Crosscut cold chisel
c) Diamond –pointed cold chisel
d) Half-round cold chisel



4. HACK SAW

It is used for hand cutting of metals its frame is made from either a tube a solid flat. The blades are made up of high speed steel and are fixed in the frame to correct tension.



Hacksaw.

5. TUBE CUTTER

It is used to cut small diameter annealed copper or aluminum tubes. It consists of a v-block against which the tube rests and an adjustable round blade of carbon steel which cut the tube. After placing the tubes in the v-block blades is adjusted and tube cutter is revolved around the tube to cut it. The size of the tube cutter depends upon the maximum diameter of the tube which it can cut.