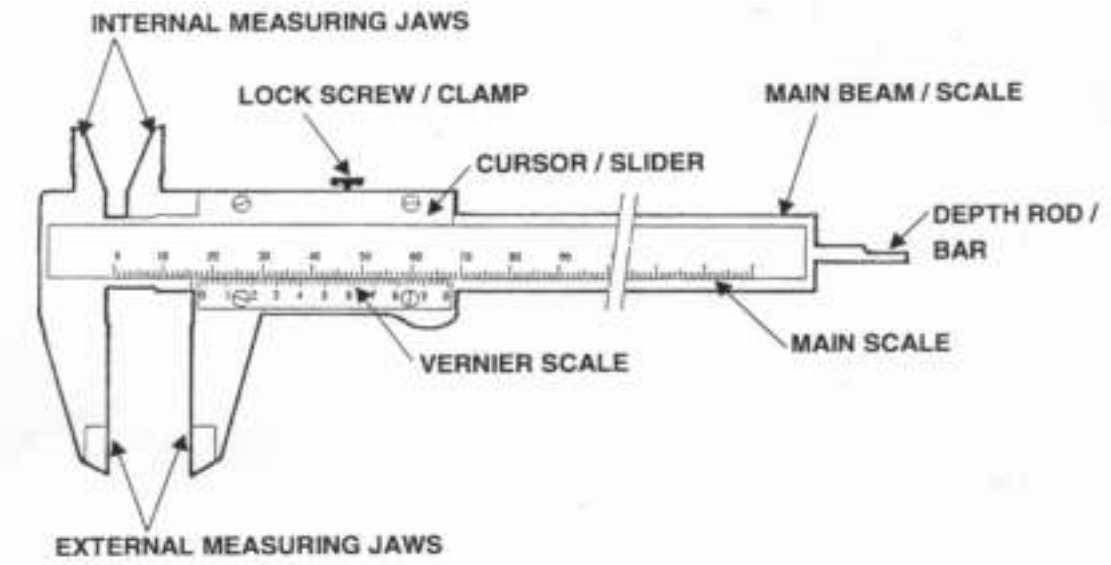
Automotive Body Repair and Paint Work

Level-II

Based on March, 2022, Curriculum Version 1



Module Title: - Use Tools, Equipment and Measuring Instruments

Module code: EIS BRP2 M 02 0322

Nominal duration: 50 Hour

Prepared by: Ministry of Labor and Skill

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Addis Ababa, Ethiopia

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Acronym

TTLM	(teaching and training learning material)
V	(volt)

R	(resistance)
OHS	(occupation health and safety)

Contents

Introduction to the Module

In vehicle body filed; tool and measurement and test estimation of body repair project helps to know the specific result of work; to estimate the value of testing, measuring and to determine the cost of the work; to estimate the expect project completion time and to know the exact condition of the vehicle performance.

This module is designed to meet the industry requirement under the automotive body repair and Paint Workoccupational standard, particularly for the unit of competency:Using Tools, Equipment and Measuring Instruments

This module covers the units:

- Prepare work station

- Carry-out measurements
- Use tools and equipment
- Maintain tools and equipment

Learning Objective of the Module

To Prepare work station

To carry-out measurements

To Use tools and equipment

To maintain tools and equipment

Module Instruction

For effective use this modules trainees are expected to follow the following module instruction:

1. Read the information written in each unit
2. Accomplish the Self-checks at the end of each unit
3. Perform Operation Sheets which were provided at the end of units
4. Do the "LAP test" giver at the end of each unit and
5. Read the identified reference book for Examples and exercise

Unit one: Prepare Work Station

This unit is developed to provide you the necessary information regarding the following content coverage and topics:

- OHS measures and warnings
- tools, equipment and testing devices
- Tagging unsafe tools and equipment

This unit will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Ready Workstation

- Use workshop manuals
- Identify tools and equipment
- Identify/select testing devices, tools and equipment
- Identify Unsafe or faulty tools and equipment

1.1. OHS measures and warning

Safety means protecting yourself and others from possible danger and injuring in the shop, you are ' Safe' when you protect your eyes, your fingers, your hands all of yourself from danger as well as others.

The preparation of work shop to supply equipment helps to -

- Keep environment well being
- Finish with specified our time pre-summing
- Identify the work and its implementing tools and equipment the purpose designed for.
- Decide the work procedure
- Keep tools, equipment and resource prevent ourselves from injury
- Done the work with quality

Hazards in the work shop

a) Faulty work habits
b) Misuse of equipment
c) Misuse of hand tools

a) **Faulty work habits**

i) Smoking around fuel and solvents
ii) Incorrect handling of paint, thinners, solvents, flammable liquids etc..
iii) Blocking exits. A block exit could mean serious injury or even death during an emergency case such as fire.

b) **Misuse of equipment's**

i) Incorrect safety guarding of moving machinery

ii) Misuse of flexible electric cords or worn cords. When used through holes the may cause fire

iii) Improperly stored composed gas cylinders

iv) Using hand held electric tools improperly grounded

c) **Misuse of hand tools**

i) Keeping hand tools dirty and in poor conditions

ii) Improper storing of hand tools

iii) Using defective hand tools

iv) Keeping sharp tools in pockets

For acquiring procedures and information you have to be read and interpret manuals and specification the tools/equipment used for measuring activities. The general procedures for measuring activities are as follows.

- know the problem to be measured
- select tools/equipment the purpose designed for
- check safe operation of selected tools/equipment's
- connect measuring tools /equipment's with the parts to be measured
- carryout measurement
- record the measured value in a specified format
- compare the measured values with the standard/manufacturers specification and take an action

To help prevent accident, follow these safety rules.

01.) Work quietly and give your full attention on the job you are doing.

02.) Keep your tools and equipment under control.

03.) Keep jack handles out of the way and stand the creeper against the wall when not in use.

04.) Never include in horseplay or other foolish action. You could cause someone to get serious hurt.

05.) Never put screwdriver or other sharp objects in your pocket. You could cut or stab your self. or you could damage the upholstery in a car.

06.) Make sure your clothes are right for the job. Dangling sleeves or ties can get caught and machinery and cause serious injury.

07.) Do not wear any rings, bracelet, or watches when working around moving machinery or electrical equipment.

08.) Wipe oil and grease off your hands and tools. You need a good grip on tools parts.

09.) 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. Nor never point a compressed – air blow gun at another person.

11.) Always wear eye protection when liquid spray or particles are flying about. Safety glasses, safety goggles, or face shield should always be available. Always wear eye protection when using a grinding wheel.

12.) Watch out for the spark 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.) Always observed safety pre-caution in using the floor jack, position it properly - it must not slip out. Never lift a vehicle while someone is working under it! People have been killed when the jack slipped and the vehicle fell on them. Always put safety stands in place before going under a vehicle.

15.) Always used 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 an 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.

Personal safety requirements

An auto shop contains many potential hazards some are obvious, some are hidden or un expected working safely in these conditions is not a matter of luck.

Accidents are not a result of being unlucky. Accidents are preventable. Don't wait until you get hurt to say, 'next time I will be more careful' you can't afford to learn safety through experience.

Generally safety means protect our self from any injury and danger. safe working habits in workshops is essential to prevent accidents which may result in personal injury or health hazards damage tools , equipment and property.

Common causes of accidents are

- Improper use of tools and equipment
- Failure to use protective equipment
- Failure to follow correct procedure
- Improper disposal of materials (waste materials)

So from the above points of description there are some solutions to overcome accidents in the shop.

- Wear protection clothes and goggles
- No horse play in the work shop
- All tools must be used for the purpose they are designed for
- Sharp edge / pointed-tip tools/ should be handled with care
- Keep tools and cored away from heat
- Report immediately any damage tool / equipment or one that gives off miner shock

Safety precaution

- Do not wear jewelry that may cause a short circuit with an electrical connection.
- Always wear protective clothing and the appropriate safety equipment.
- Make sure that you understand and observe all legislative and personal safety procedures.

Tools and Equipment Safety

- Do not dump residue from steam cleaning in sewers.
- Wear protective gloves and a face shield.
- Use only approved cleaning solutions.

- Observe all environmental regulations.
- Keep tools in good condition.
- Use the proper tool for the job.
- Do not put tools in your pocket.
- Keep tools with cutting edges sharp.
- Keep tools clean and free from grease.

Pull wrenches toward you, do not push

Health precautions you are likely to get a localized rash up your arms and hands if you handle the mat with no precautions. If you are allergic, do not continue. Get someone else to do the job as the allergy can cause severe swelling, rashes and can be extremely painful. Cover up your arms when cutting or handling mat and use washing-up gloves of necessary. If, like me, you cannot stand gloves then always use a barrier cream which is available from Boots, most chemists, resin shops, etc. Resins normally give people no problems, apart from the smell which may upset you. Always give yourself good ventilation when doing a job since the heavy vapor given off (styrene) can cause headaches and even unconsciousness if you are exposed to it for too long. If you ever feel drowsiness coming on get out immediately into the fresh air.

The warning signs for resins are an itchy nose and running eyes. When you reach this stage stop and recover. When grinding, cutting or sawing a laminate you must always wear a mask and goggles and always grind outside, never in a garage etc., as very fine pure glass particles are thrown everywhere and once they are inhaled the body doesn‘t get rid of them. Silicosis can result (and this is similar to asbestosis). For the one-off job a simple face mask is enough provided you keep your mouth shut, because your nose is an extremely good filter. When doing long periods of grinding in an enclosed area then a full face mask must be used. If any hardener gets on your skin wash it off immediately as it will bleach your skin and, if it is in your eyes, wash them for at least 10 minutes. If resins are on your skin, wipe them off immediately with a cloth dampened with acetone (you‘re not supposed to do this because prolonged contact with acetone may give rise to dermatitis, since it bleaches out the natural skin oils), then wash in warm soapy water and finally rub a skin cream over the affected part (Nivea is very good). If any is swallowed, drink quantities of water and induce vomiting — seek medical aid immediately. If any hardener spills on the ground or clothing, wash it away

with plenty of water. With resins cover with earth or sand and, when soaked in, dispose of safely; wipe the residue off the ground with acetone

1.2. Tools, equipment and testing device

Hand tools should only be carried to work area in a proper toolbox or with the use of a tool-belt.

1. Special care should be taken to prevent other persons gaining access to the work area where long handle tools are being operated. When necessary, the work area should be fenced off to prevent unauthorized entry.
2. Before working, work pieces should be checked for protruding metal parts that may cause damage to hand tools.
3. Precautions should be taken to prevent tools slipping out from hands while working at height.
4. Precautions should be taken when working on or near electrical conductors.
5. Hand tools should be operated in correct posture and strength.
6. Proper steps and procedures should be followed when operating a hand tool, e.g. the face of the hammer head instead of the peen should be used for hammering nails; the handle of a spanner should not be hammered or extended by tubes for applying greater strength in screwing of bolts or nuts.
7. When hand tools with sharp corners or edges are used, their direction of movement should be away from the body. Suitable personal protective equipment such as helmets, aprons or gloves should be used when necessary.
8. When flying fragments, particles or noise are generated during the operation of hand tools, suitable personal protective equipment, e.g., goggles, masks or ear-muffs, that conform to safety standards should be worn.
9. The operator should use clamps to secure a work piece that is liable to move into a stable position.
10. One should concentrate on the job when using a hand tool. Playing with hand tools should be strictly prohibited

Venire caliper

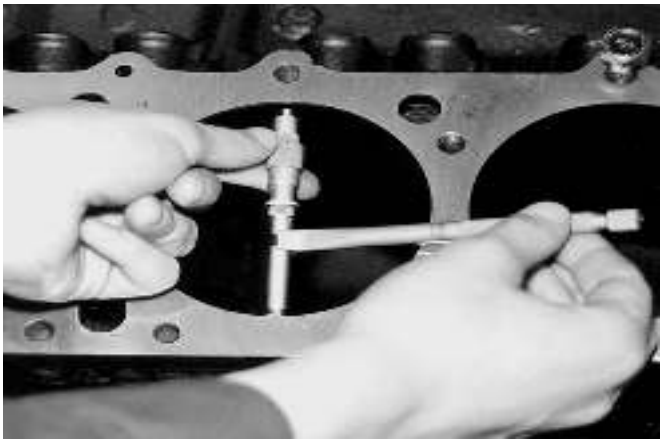
A venire caliper is used to take measurements that are accurate to within .001 of an inch or .02 of a millimeter, depending whether the venire is imperial or metric. This set of

instructions will focus on imperial, but the same methods can be applied to a metric venire caliper.

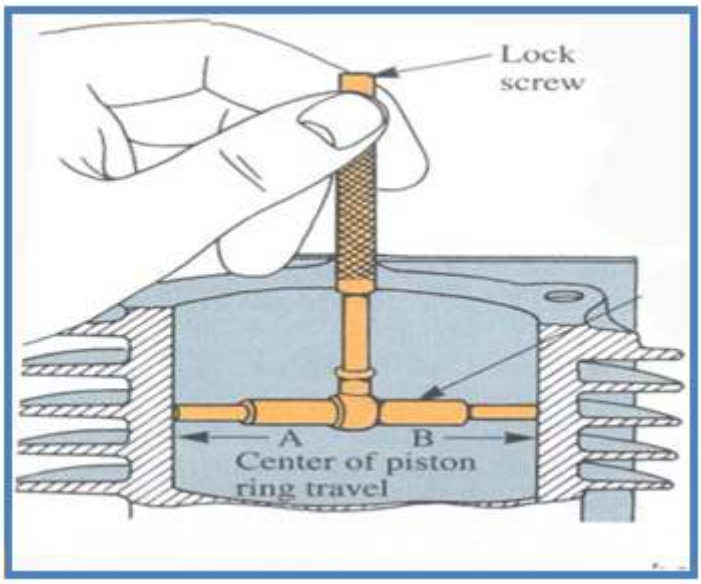
To use caliper

1. Make sure that whatever you are measuring is clean and has no burrs on the edges.
2. Open the jaws of the caliper and position them on both sides of the piece you are measuring
3. Push the jaws firmly against the work piece
4. Lock the clamp screw so that the jaws don't move
5. On the venire scale is a small number 0. Look at how many inch divisions it is past on the bar scale
6. See how many smaller (numbered) divisions the small 0 has gone past. This represents how many tenths of an inch the work piece is measuring in addition to the number of whole inches
7. How many smaller divisions has the small 0 gone past the last numbered division, this number multiplied by 25 is how many hundredths of an inch
8. Determine which division line on the venire scale best lines up with a division on the bar scale. This is how many thousandths of an inch
9. By adding the inch measurement, the tenths of an inch, the hundredths, and the thousandths, you will have a measurement to a 3 decimal place accuracy.

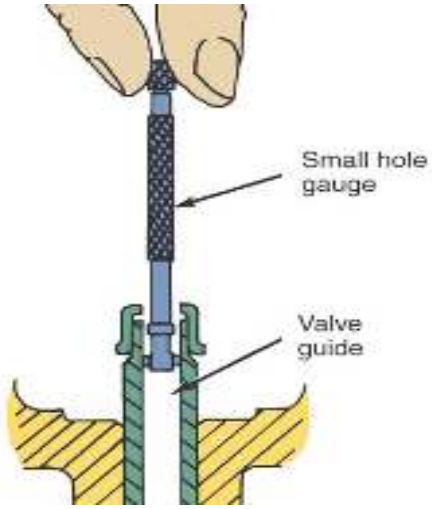
Telescoping Gauge



- Do not take direct measurements
- Is commonly used to measure larger bore diameters, such as an engine cylinder. And slots
- A micrometer is used to read the telescoping gauge setting.
- Less expensive and easier to use than inside mics
- Can fit in very small locations



- **Small hole gauge**
- Is used for measuring small bores, such as an engine valve guide.
- A micrometer is used to read the hole gauge setting.

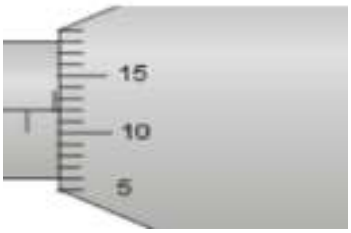


Micro meter reading

Types of Micrometer

- Outside Micrometer
- Depth Micrometer
- Inside Micromer

Add:



Full millimeters

(8X1)=**8.00 mm**

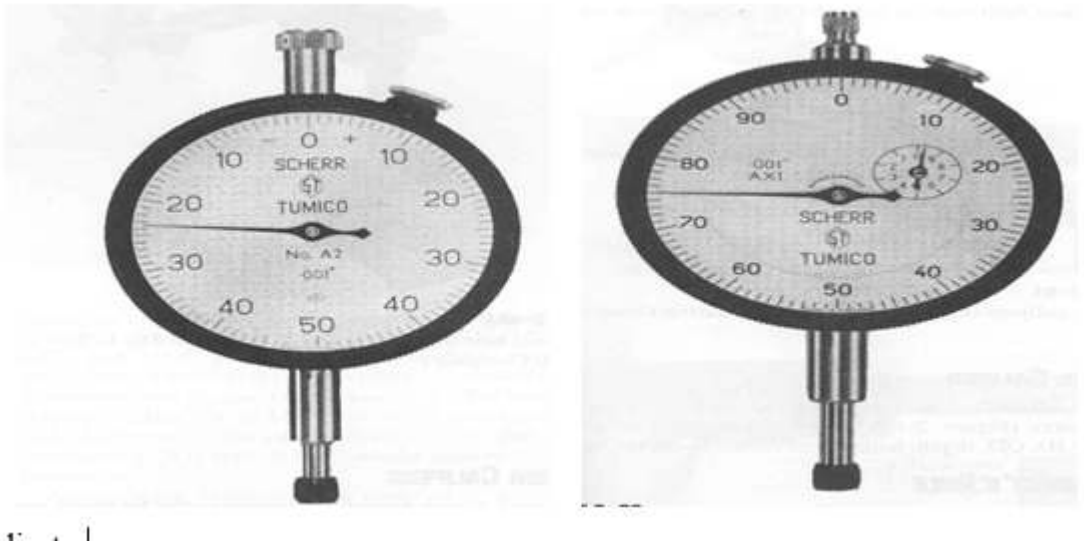
Insie micrometer

- Used for measuring cylinder bores, housing bores
- Screw pitches same as outside micrometer
- Used more often with 'transfer' measurements

The 2 types of dial indicators are

- Balanced
- Continuous
  - Regular range (2 ½ revolution of travel

Long range indicator with range



Dial Indicator

- Used for a variety of measurements
  - End play,
  - Gear lash,
  - Side clearance
- Used in conjunction with one another
- Base is usually magnetic for versatility
- Is a very sensitive instrument consists of small gears activated by spindle movement
- Movement is transmitted through a small gear to indicating hand on a dial
- Indicators are comparison instruments, because an indicator reading must be compared to a known measurement
- When measuring thrust (forward and backward movement) no compression is necessary

Using dial indicator

A. Tools and materials

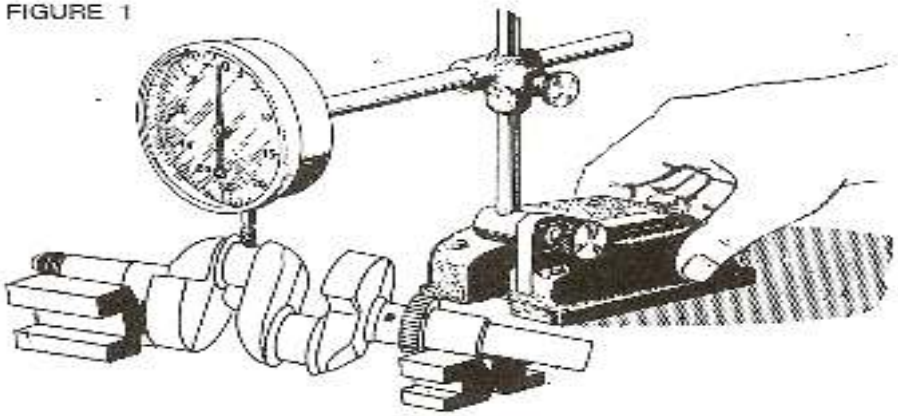
1. Dial indicator
2. Dial indicator holder
3. Magnetic base
4. V blocks — 2
5. Appropriate assortment of machined parts

(NOTE: All workpieces should be numbered or lettered for reference.)

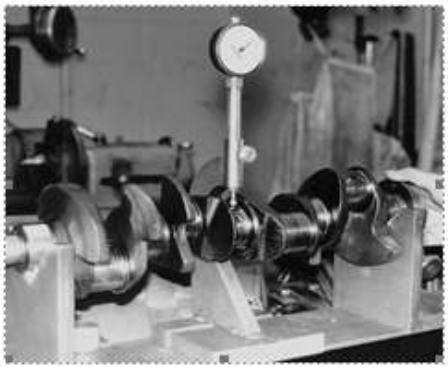
B. Procedure

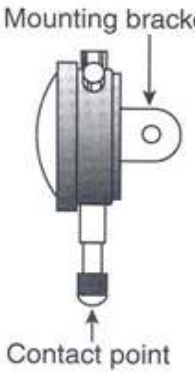
1. Select workpieces that are clean and free of burrs, nicks, or dents.
2. Attach dial indicator to holder.
3. Secure holder to work surface.
4. Mount workpiece according to type of measurement to be made. (Figure 1)

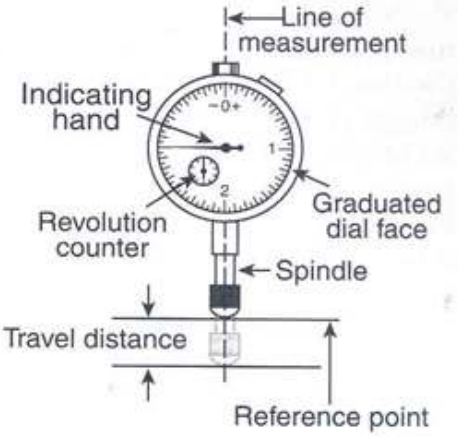
FIGURE 1



5. Position holder so that dial indicator plunger contacts workpiece.
6. Adjust holder so that plunger is depressed two revolutions of pointer and tighten holder.
7. Rotate bezel until the zero marking is in line with pointer.
8. Measure workpiece for taper, concentricity, and run-out.
9. List readings according to the letter or number on the workpiece.
10. Record your reading _____.
11. Disassemble dial indicator and holder and return to the correct storage.
12. Hand in the listed readings to the instructor for evaluation.



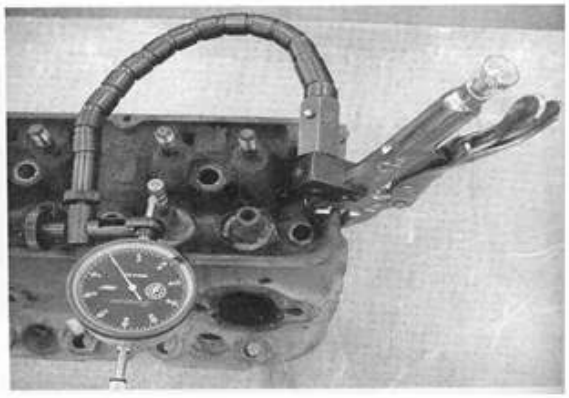


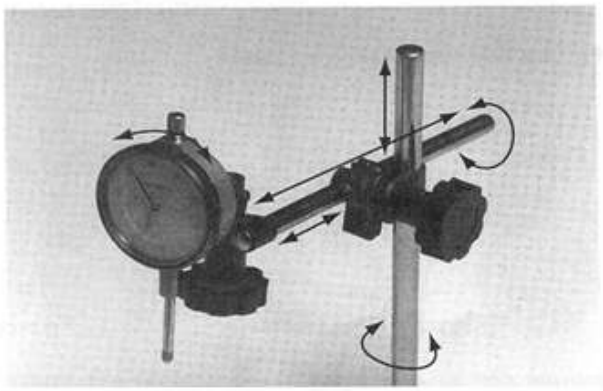


- Dial indicator clamping can be

  Magnetic Base

  Various attachments for clamping it to the work piece
- The most popular and versatile indicator among technicians is Vice-Grip





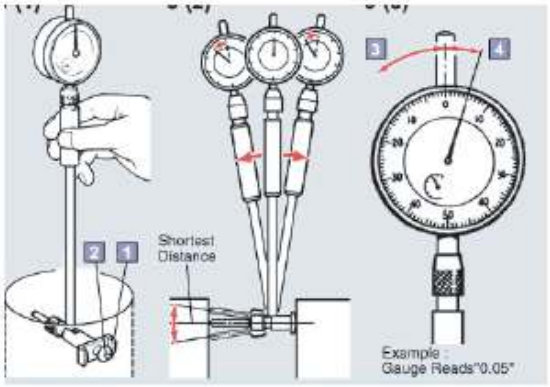
Cylinder bore measurement

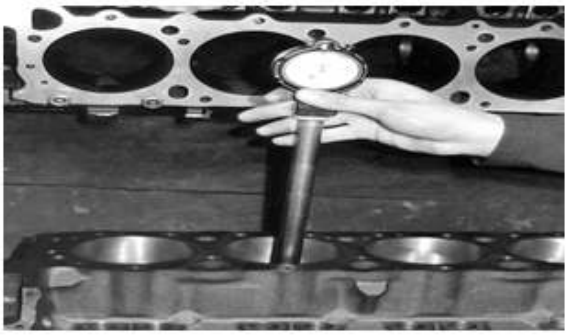
(1) Gently push the guide plate and carefully insert the gauge into the cylinder bore.

(2) Move the gauge to seek the position with the shortest distance.

(3) Read the dial at the position with the shortest distance.

1. Guide plate
2. Probe
3. Extension side
4. Contraction side





Feeler gauge

- Is used to measure clearances, such as a spark plug gap.
- Feeler gauges can also be used along with a straight edge to measure surface irregularities.

Thickness Gauge

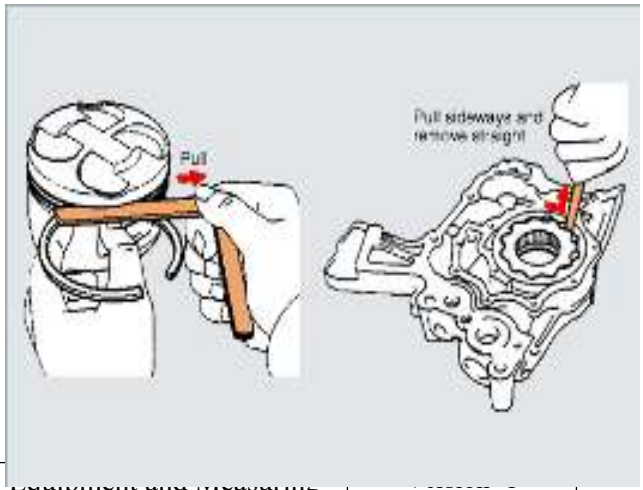
Application

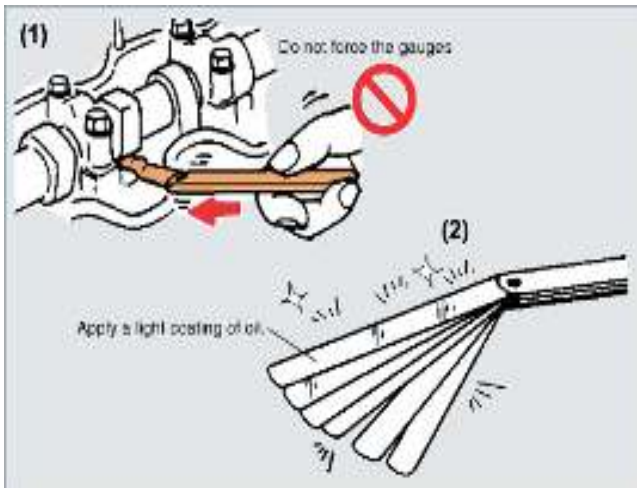
Used for measuring the clearance of the value or the piston ring grooves, etc.

Instructions

(1) Used for measuring the clearance of the value or the piston ring grooves, etc.

(2) If the space cannot be measured with a single gauge, use a combination of up to 2 or 3 gauges. Combine the blades so as to use the minimum number as possible.





NOTICE:

(1) To avoid bending or damaging the tip of the gauge, do not force the gauge into the area to be measured.

(2) Before putting the blades, away, clean the surfaces and apply oil to prevent them from rusting.

Plastic-gauge

Used for measuring the oil clearance of the areas that is tightened with caps, such as the crankshaft

Journals and crankshaft pins. Plastic gage is made of soft plastic, and comes in three colors, each indicating a different thickness Clearance measurement ranges:

Plastic-gauge

- Used to measure primarily oil clearance
- The thin plastic strip is the actual measuring devise
- When crushed the plastic spreads at exact amounts

The wrapper has markings to denote the measurement

Green: 0.025 ~ 0.076mm

Red: 0.051 ~ 0.152mm

Blue: 0.102 ~ 0.229mm

Procedure

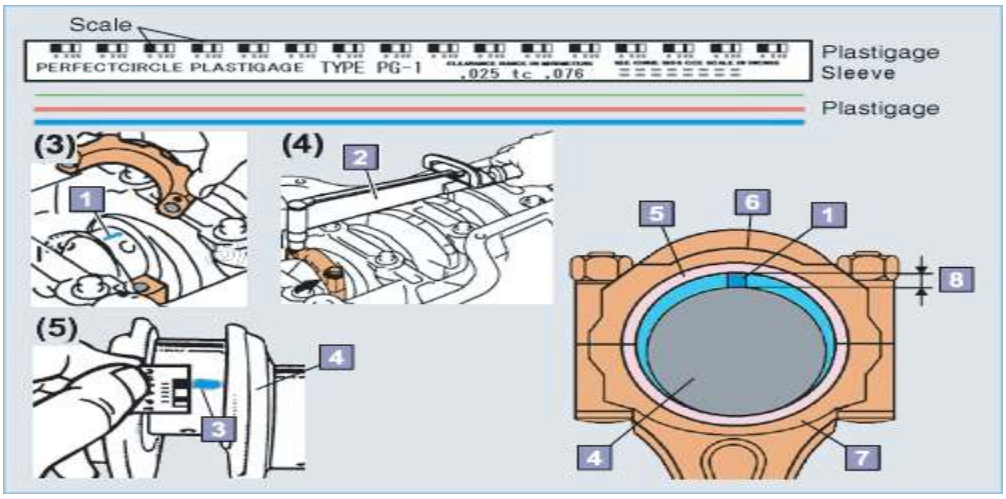
(1) Clean the crankshaft pin and the bearing.

(2) Cut the plastic gage sleeve with plastic gage to match the width of the bearing.

(3) Place the plastic gage on the crankshaft pin as shown.

(4) Place the bearing cap over the crankshaft pin and tighten it at the specified torque. Do not turn the crankshaft.

(5) Remove the bearing cap and use the scale on the plastic gage sleeve to determine the thickness of the flattened plastic gage. Measure the thickness at the widest portion of the plastic gage



Proper handling of tool and equipment

- The proper care and storage of tools and equipment are not only the concern of the management but of the workers who use the equipment.
- Good organization of stored materials is essential for overcoming material storage problems whether on a temporary or permanent basis. There will also be fewer strain injuries if the amount of handling is reduced, especially if less manual materials handling is required. The location of the stockpiles should not interfere with work but they should still be readily available when required. Stored materials should allow at least one meter (or about three feet) of clear space under sprinkler heads.

Equipment &material safety

- Make sure it is used properly
- properly handle measuring instruments which designed for without damage
- It should be properly maintained (frayed electrical cords or loose mountings) and periodically inspected for unsafe conditions.
- Check all equipment with rotating parts should be equipped with safety guards
- Check it before you use it! If it is unsafe, put a sign on it warning others not to use it

1.3 Tagging unsafe tools and equipment

Make red-tags each company has specific needs for documenting and reporting the movement, use, and value of materials, equipment, tools, inventory and products. The company's red tags should be designed to support this documentation process.

Various types of information on a red tag may include:

- Category: provides a general idea of the type of item (e.g., a warehouse item or machine). Categories include raw materials, in-process inventory, products, equipment, jigs, tools and dies.
- Item name and manufacturing number
- Quantity: indicates the number of items included under this red tag.
- Reason: describes why a red tag has been attached to this item.

Self-Check -1	**Written Test**

Directions: say true or false all the questions listed below

3 and above correct answered points passed mark

1 Accidents are not a result of being un lucky.(2)
2. Example of common causes of accidents are Improper use of tools and equipment.(2)
3. Safety means protect our self from any injury and danger.(2)

OPERATION SHIT 1

OPERATION TITLE:- Cleaning work shop area

PURPOSE:- For safety and health as well as good business.

CONDITIONS OR SITUATIONS FOR THE OPERATIONS:-

- ✓ properly sorted working area
- ✓ Properly operated tools and equipment's
- ✓ Appropriate working cloths fit with the body.

EQUIPMENT TOOLS AND MATERIALJJKLK

- ✓ Hand tools -brush / a scopa etc.
- ✓ Equipment's - air compressor etc.
- ✓ water, solvent, etc

PROCEDURE:-

1. Clean up every time whenever you leave an area, including sweeping the floor.
2. Clean and return all tools to where you got them.
3. Use compressed air sparingly; never aim it at another person or use it to clean hair or clothes.
4. Shut off and unplug machines when cleaning, repairing, or oiling.
5. Never use a rag near moving machinery.
6. Use a brush, hook, or a special tool to remove chips, shavings, etc. from the work area. Never use the hands.
7. Keep fingers clear of the point of operation of machines by using special tools or devices, such as, push sticks, hooks, pliers, etc.
8. Keep the floor around machines clean, dry, and free from trip hazards. Do not allow chips to accumulate.

9. clean up and dry spills immediately and put a chair or cone over them if they are wet enough to cause someone to slip.

PRECAUTIONS:-

- Wear working cloths which properly fit with your body
- Make working area hazard free
- Read and interpret manual which guide you how to use tools and equipments

QUALITY CRITERIA: Assured performing of the activities correctly accordance with the given procedure mentioned above.

LAP Test -1	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates/guides, workshop, tools and materials you are required to perform the following tasks within 2:30 hours.

Task 1: use the proper tool and equipment the proper place.
Task 2: Using the given template measure and test

Task 3: Using the given template - observe at all times and appropriate personal protective equipment (PPE)

Task 4: Using a given template, Tools and equipment are handled

UNIT TWO: Measurement

This unit to provide you the necessary information regarding the following content coverage and topics:

- measuring/testing devices
- method of conducting measurements
- measuring instruments
- Comparing and documenting the measurement results

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Measuring tools are selected in line with job requirements
- Measuring/testing devices are checked and adjusted as needed in accordance with work requirements
- Appropriate method of conducting measurements is implemented in accordance with workplace procedures and manufacturer specifications.
- Measuring instruments are handled without damage and according to procedures
- Measurement results are compared with manufacturer specifications to indicate compliance or non-compliance.
- Results are documented with evidence and supporting information and recommendation(s).

2.1. Measuring/Testing Devices

Measurement is a systematic, replicable process by which objects or events are **quantified** and/or **classified** with respect to a particular dimension this is usually achieved by the assignment of numerical values

Encarta dictionary defines measurement as the size, length, quantity, or rate of something that has been measured. In automotive service, the first job is to make – measurement. Sometimes, this means measuring engine vacuum or compression, or alternator output. Most often, it means measuring length or diameter.

Kinds of Measurements

Linear Measurement; Angular Measurement; Weight Measurement; Temperature; Volume; or Area

Performance measurement is the selection and use of quantitative measures of capacities, processes, and outcomes to develop information about critical aspects of activities, including their effect on the public.

Reliability of a Measure

The degree to which a measurement technique can be depended upon to secure consistent results upon repeated application "The rubber ruler issue"

Validity of a Measure

The degree to which any measurement approach or instrument succeeds in describing or quantifying what it is designed to measure "The 35-inch yardstick issue"

MEASURING TOOLS

An automotive measuring device is suitable for professionals in the automotive sector. Which is used to check the ignition of the car or to search for leaks in the air conditioning, and also to check the high pressure from diesel vehicles? For further analysis etc

Some service work, such as engine repair, requires very exact measurements, often in ten-thousandths (0.0001) of an inch or thousandths (0.001) of a millimeter. Accurate measurements with this kind of precision can only be made by using precise measuring devices.

Measuring tools are precise and delicate instruments. In fact, the more precise they are, the more delicate they are. They should be handled with great care. Never pry, strike, drop, or force these instruments. They may be permanently damaged.

Precision measuring instruments, especially micrometers, are extremely sensitive to rough handling.

Clean them before and after every use. All measuring should be performed on parts that are at room temperature to eliminate the chance of measuring something that has contracted because it was cold or has expanded because it was hot.

S h o p ta l k

Check measuring instruments regularly against known good equipment to ensure that they are operating properly and are capable of accurate measurement. Always refer to the appropriate material for the correct specifications before performing any service or diagnostic procedures. The close tolerances required for the proper operation of some automotive parts make using the correct specifications and taking accurate measurements very important. Even the slightest error in measurement can be critical to the durability and operation of an engine and other systems.

Different types of tools/equipment's and instruments

Machinist's Rule

The **machinist's rule**looks very much like an ordinary ruler. Each edge of this basic measuring tool is divided into increments based on a different scale. As shown in **Figure 1**, a typical machinist's rule based on the Imperial system of measurement may have scales based on 1⁄8-, 1⁄16-, 1⁄32-, and 1⁄64-inch intervals. Of course, metric machinist rules are also available. Metric rules are usually divided into 0.5 mm and 1 mm increments.

Some machinist's rules may be based on decimal intervals. These are typically divided into 1⁄10-, 1⁄50-, and 1⁄1,000-inch increments. Decimal machinist's rules are very helpful when measuring dimensions specified in decimals; they make such measurements much easier.

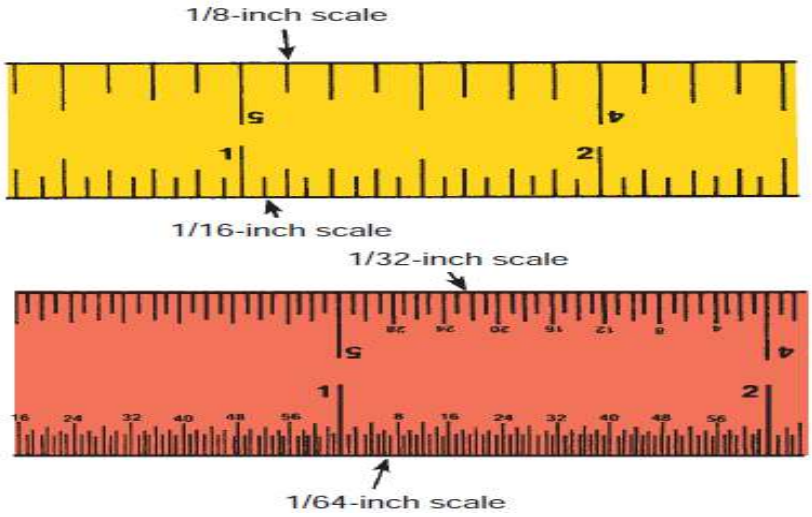


Figure 2.1 Graduations on a typical machinist's rule.

Vernier Caliper

A Vernier caliper is a measuring tool that can make inside, outside, or depth measurements. It is marked in both British Imperial and metric divisions called a Vernier scale. A Vernier scale consists of a stationary scale and a movable scale, in this case the Vernier bar to the Vernier plate. The length is read from the Vernier scale.

A Vernier caliper has a movable scale that is parallel to a fixed scale **(Figure 2)**. These precision measuring instruments are capable of measuring outside and inside diameters and most will even measure

depth. Vernier calipers are available in both Imperial and metric scales. The main scale of the caliper is divided into inches; most measure up to 6 inches.

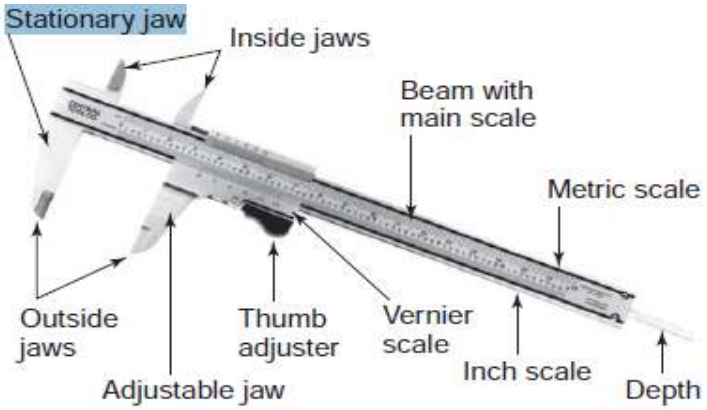


Figure2. 2 A Vernier caliper.

Each inch is divided into 10 parts, each equal to 0.100 inch. The area between the 0.100 marks is divided into four. Each of these divisions is equal to 0.025 inch **(Figure 3)**.

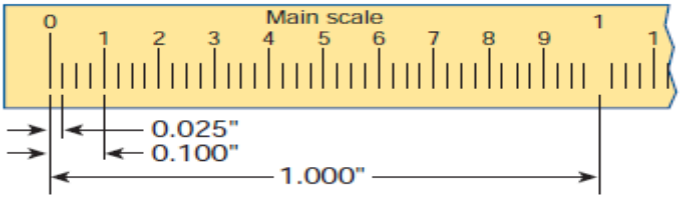


Figure 3 Each line of the main scale equals 0.025 inch.

The Vernier scale has 25 divisions, each one representing 0.001 inch. Measurement readings are taken by combining the main and Vernier scales. At all times, only one division line on the main scale will line up with a line on the Vernier scale **(Figure 4)**. This is the basis for accurate measurements.

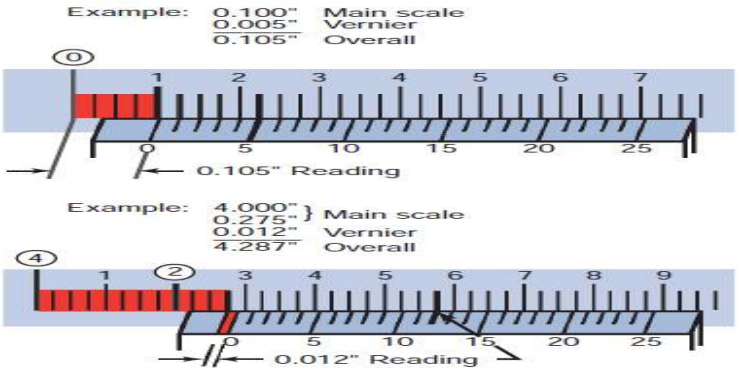


Figure 2.3 To get a final measurement, line up the Vernier scale line that is exactly aligned with any line on the main scale.

To read the caliper, locate the line on the main scale that lines up with the zero (0) on the Vernier scale. If the zero lined up with the 1 on the main scale, the reading would be 0.100 inch. If the zero on the Vernier scale does not line up exactly with a line on the main scale, then look for a line on the Vernier scale that does line up with a line on the main scale.

The basic steps are as follows:

1. Preparation to take the measurement:
    a. Loosen the locking screw and move the slider to check if the Vernier scale works properly.
    b. Before measuring, do make sure the caliper reads 0 when fully closed. If the reading is not 0, adjust the caliper's jaws until you get a 0 reading. If you can't adjust the caliper, you will have to remember to add to subtract the correct offset from your final reading.
    c. Clean the measuring surfaces of both the vernier caliper and the object, then you can take the measurement.
2. Take the measurement:
    a. Be careful not to pull on the jaws. Using the screw, close the jaws lightly on the item which you want to measure.
    b. If you are measuring something round, be sure the axis of the part is perpendicular to the caliper. Namely, make sure you are measuring the full diameter.
3. How to read the measured value:
    a. Read the centimeter mark on the fixed scale to the left of the 0-mark on the Vernier scale. (10mm on the fixed caliper)

b. Find the millimeter mark on the fixed scale that is just to the left of the 0-mark on the Vernier scale. (6mm on the fixed caliper

. Look along the ten marks on the Vernier scale and the millimeter marks on the adjacent fixed scale, until you find the two that most nearly line up. (0.25mm on the Vernier scale)

a. To get the correct reading, simply add this found digit to your previous reading. (10mm + 6mm + 0.25mm= 16.25 mm)

Dial Caliper

The **dial caliper (Figure 2.4)**is an easier-to-use version of the vernier caliper. Imperial calipers commonly measure dimensions from 0 to 6 inches (0 to 150 mm). Metric dial calipers typically measure from 0 to 150 mm in increments of 0.02 mm. The dial caliper features a depth scale, bar scale, dial indicator, inside measurement jaws, and outside measurement jaws.

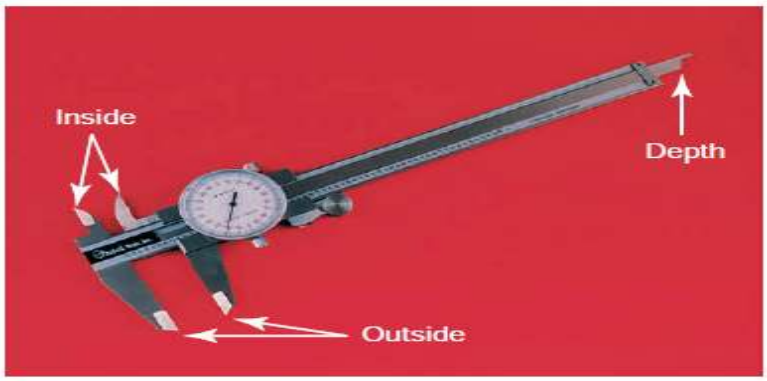


Figure2. 5 A dial Vernier caliper

The main scale of a British Imperial dial caliper is divided into one-tenth (0.1) inch graduations. The dial indicator is divided into one-thousandth (0.001) inch graduations. Therefore, one revolution of thedial indicator needle equals one-tenth inch on thebar scale.

A metric dial caliper is similar in appearance; however, the bar scale is divided into 2 mm increments. Additionally, on a metric dial caliper, one revolution of the dial indicator needle equals 2 mm.

Both English and metric dial calipers use a thumb operated roll knob for fine adjustment. When you use a dial caliper, always move the measuring jaws backward and forward to center the jaws on the objectbeing measured. Make sure the caliper jaws lay flat onor around the object. If the jaws are tilted in any way,you will not obtain an accurate measurement.

Although dial calipers are precision measuring instruments, they are only accurate to plus or minus two-thousandths (±0.002) of an inch. Micrometers are preferred when extremely precise measurements are desired.

Micrometers

The **micrometer** is used to measure linear outside and inside dimensions. Both outside and inside micrometers are calibrated and read in the same manner. Measurements on both are taken with the measuring points in contact with the surfaces being measured.

The major components and markings of a micrometer include the frame, anvil, spindle, locknut, sleeve, sleeve numbers, sleeve long line, thimble marks, thimble, and ratchet **(Figure 6)**.

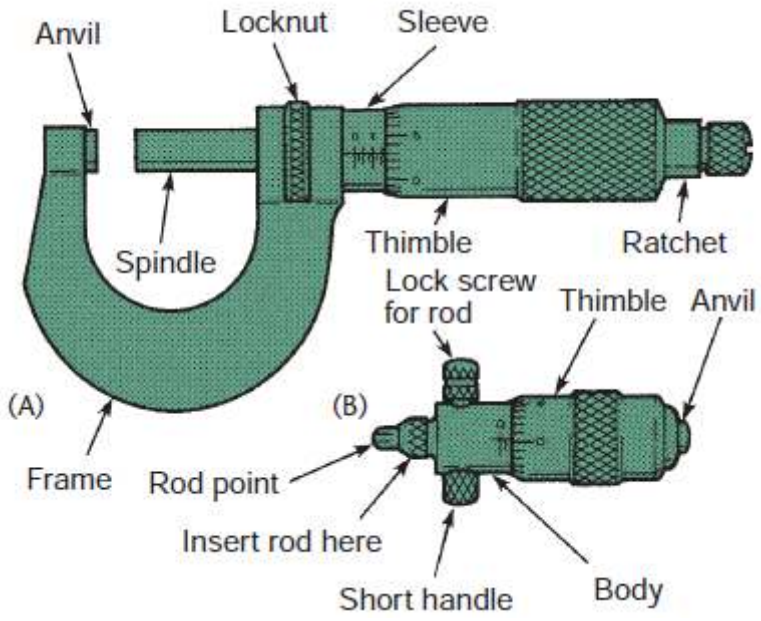


Figure2. 6 Major components of (A) an outside and (B) an inside micrometer.

Micrometers are calibrated in either inch or metric graduations and are available in a range of sizes. The proper procedure for measuring with an inch-graduated outside micrometer is outlined in Photo Sequence 2.

Most micrometers are designed to measure objects with accuracy to 0.001 (one-thousandth) inch.

Micrometers are also available to measure in 0.0001 (ten-thousandths) of an inch. This type of micrometer should be used when the specifications call for this much accuracy.

PHOTO SEQUENCE 2 Using a Micrometer

P2-1 Micrometers can be used to measure the diameter of many different objects. By measuring the diameter of a valve stem in two places, the wear of the stem can be determined.

P2-2 Because the diameter of a valve stem is less than 1 inch, a 0-to-1-inch outside micrometer is used.

P2-3 The graduations on the sleeve each represent 0.025 inch. To read a measurement on a micrometer, begin by counting the visible lines on the sleeve and multiplying them by 0.025.

P2-4 The graduations on the thimble assembly define the area between the lines on the sleeve. The number indicated on the thimble is added to the measurement shown on the sleeve.

P2-5 A micrometer reading of 0.500 inch.

P2-6 A micrometer reading of 0.375 inch.

P2-7 *Normally, little stem wear is evident directly below the keeper grooves. To measure the diameter of the stem at that point, close the micrometer around the stem.*

P2-8 *To get an accurate reading, slowly close the micrometer until a slight drag is felt while passing the valve in and out of the micrometer.*

P2-9 *To prevent the reading from changing while you move the micrometer away from the stem, use your thumb to activate the lock lever.*

P2-10 *This reading (0.311 inch) represents the diameter of the valve stem at the top of the wear area.*

P2-11 *Some micrometers are able to measure in 0.0001 (ten-thousandths) of an inch. Use this type of micrometer if the specifications call for this much accuracy. Note that the exact diameter of the valve stem is 0.3112 inch.*

P2-12 *Most valve stem wear occurs above the valve head. The diameter here should also be measured. The difference between the diameter of the valve stem just below the keepers and just above the valve head represents the amount of valve stem wear.*

Digital micrometers are also available **(Figure2. 7)**. These eliminate the need to do math and still receive a precise measurement.

Figure2. 7 A digital micrometers eliminates the need to do math.

Reading a Metric outside Micrometer

The metric micrometer is read in the same manner as the inch graduated micrometer, except the graduations are expressed in the metric system of measurement.

Readings are obtained as follows:

- Each number on the sleeve of the micrometer represents 5 millimeters (mm) or 0.005 meter (m)
- Each of the 10 equal spaces between each number, with index lines alternating above and below the horizontal line, represents 0.5 mm or five tenths of a mm. One revolution of the thimble changes the reading one space on the sleeve scale or 0.5 mm
- The beveled edge of the thimble is divided into 50 equal divisions with every fifth line numbered: 0, 5, 10, . . . 45. Since one complete revolution of the thimble advances the spindle 0.5 mm, each graduation on the thimble is equal to one hundredth of a millimeter **(Figure 10 C)**.

As with the inch-graduated micrometer, the three separate readings are added together to obtain the total reading **(Figure 11)**.

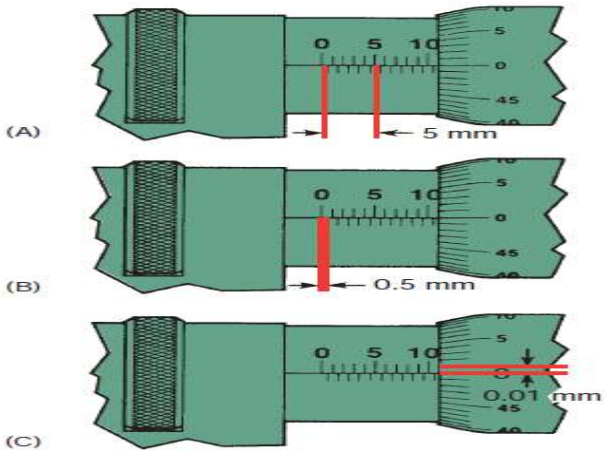


Figure 2.8 Reading a metric micrometer: (A) 10 mm plus (B) 0.5 mm plus (C) 0.01 mm equals 10.51 mm.

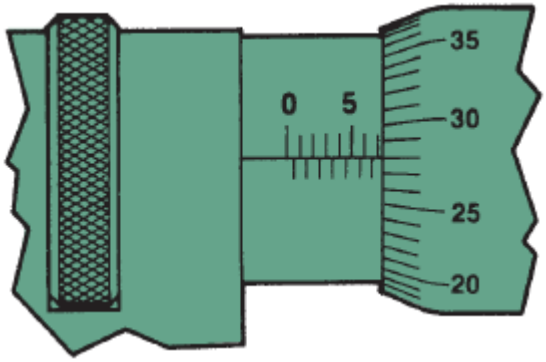


Figure 2.9 The total reading on this micrometer is 7.28 mm.

To measure small objects with an outside micrometer, open the tool and slip the object between the spindle and anvil. While holding the object against the anvil, turn the thimble with your thumb and forefinger until the spindle contacts the object. Use only enough pressure on the thimble to allow the object to just fit between the anvil and spindle. Slip the micrometer back and forth over the object until you feel a very light

Resistance while at the same time rocking the tool from side to side to make certain the spindle cannot be closed any further **(Figure 12)**. After your final adjustment, lock the micrometer and read the measurement.

Micrometers are available in different sizes. The size is dictated by the smallest to the largest measurement it can make. Examples of these sizes are the 0-to-1-inch, 1-to-2-inch, 2-to-3-inch, and 3-to-4-inch micrometers.

Reading an Inside Micrometer

Inside micrometers are used to measure the inside diameter of a bore or hole. The tool is placed into the bore and extended until each end touches the bore's surface. If the bore is large, it might be necessary to use an extension rod to increase the micrometer's range. These extension rods come in various lengths.

To get a precise measurement, keep the anvil firmly against one side of the bore and rock the micrometer back and forth and side to side. This centers the micrometer in the bore. Make sure there is correct resistance on both ends of the tool before taking a reading.

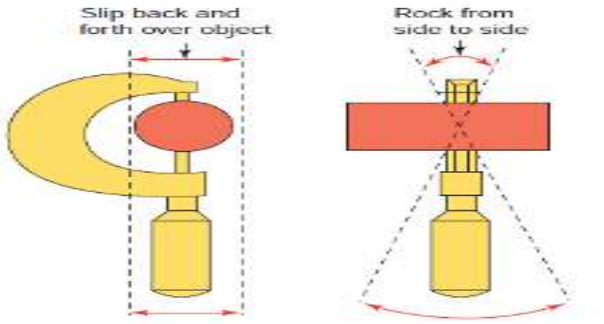


Figure 2.10 Slip the micrometer over the object and rock it from side to side.

Reading a Depth Micrometer

A depth micrometer **(Figure 2.11)** is used to measure the distance between two parallel surfaces. It operates and is read in the same way as other micrometers. If a depth micrometer is used with a gauge bar, it is important to keep both the bar and the micrometer from rocking. Any movement of either part will result in an inaccurate measurement.

Figure 2.12 A depth micromete

S H O P TA L K

Measurements with any micrometer will be reliable only if the micrometer is calibrated correctly. To calibrate a micrometer, close the micrometer over a micrometer standard. If the

reading differs from that of the standard, the micrometer should be adjusted according to the instructions provided by the tool manufacturer. Proper care of a micrometer is also important to ensure accurate measurements. This care includes:

- Always clean the micrometer before using it.
- Do not touch the measuring surfaces.
- Store the tool properly. The spindle face should not touch the anvil face; a change in temperature might spring the micrometer.
- Clean the micrometer after use. Wipe it clean of any oil, dirt, or dust using a lint-free cloth.
- Never use the tool as a clamp or tighten the jaws too tightly around an object.
- Do not drop the tool.
- Check the calibration weekly.

Telescoping Gauge

Telescoping gauges (Figure2. 13) are used for measuring bore diameters and other clearances. They may also be called snap gauges. They are available in sizes ranging from fractions of an inch through 6 inches (150 mm). Each gauge consists of two telescoping plungers, a handle, and a lock screw. Snap gauges are normally used with an outside micrometer. To use the telescoping gauge, insert it into the bore and loosen the lock screw. This will allow the plungers to snap against the bore. Once the plungers have expanded, tighten the lock screw. Then, remove the gauge and measure the expanse with a micrometer.

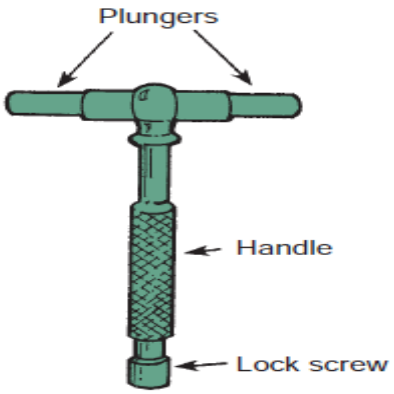


Figure 14 Parts of a telescoping gauge.

Small Whole Gauge

A small hole or ball gauge works just like a telescoping gauge. However, it is designed to be used on small bores. After it is placed into the bore and expanded, it is removed and measured with a micrometer (Figure 15). Like the telescoping gauge, the small hole gauge consists of a lock, a handle, and an expandingend. The end expands or retracts by turning the gauge handle.

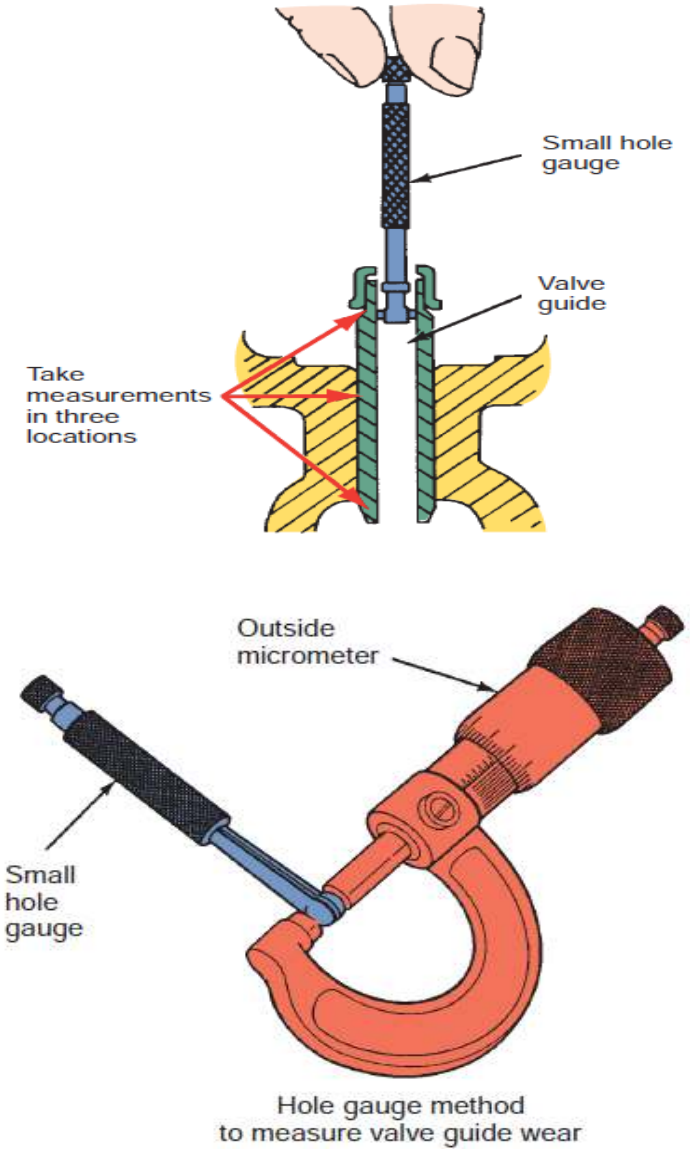


Figure 2.14 Insert the ball gauge into the bore to be measured. Then expand it, lock it, and remove it. Now measure it with an outside micrometer.

Feeler Gauge

A feeler gauge is a thin strip of metal or plastic of known and closely controlled thickness. Several of these metal strips are often assembled together as a feeler gauge set that looks like a pocket knife

(Figure 2.15) The desired thickness gauge can be pivoted away from others for convenient use. A steel feeler gauge pack usually contains strips or leaves of 0.002- to 0.010-inch thickness (in steps of 0.001 inch) and leaves of 0.012- to 0.024-inch thickness (in steps of 0.002 inch). Metric feeler gauges are also available. A feeler gauge can be used by itself to measure piston ring side clearance, piston ring end gap, connecting rod side clearance, crankshaft end play, and other distances. Round wire feeler gauges are often used to measure spark plug gap. The round gauges are designed to give a better feel for the fit of the gauge in the gap.

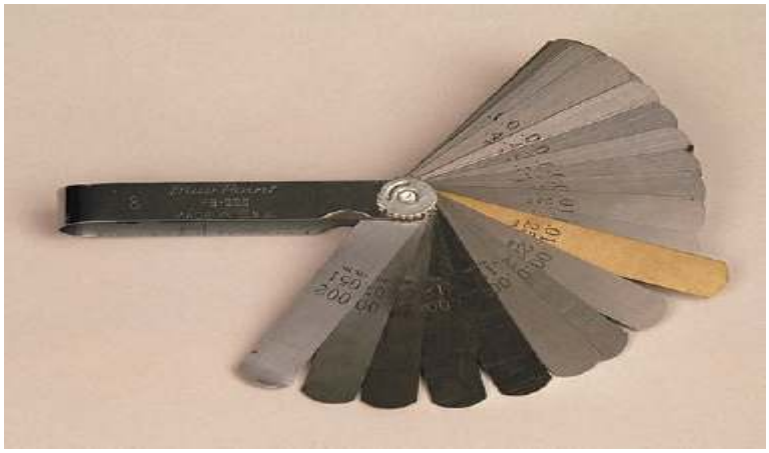


Figure 2.16 Typical feeler gauge set.

Straightedge

A straightedge is no more than a flat bar machined to be totally flat and straight, and to be effective it must be flat and straight. Any surface that should be flat can be checked with a straightedge and feeler gauge set. The straightedge is placed across and at angles on the surface. At any low points on the surface, a feeler gauge can be placed between the straightedge and the surface **(Figure 16)**. The size gauge that fills in the gap indicates the amount of warpage or distortion.

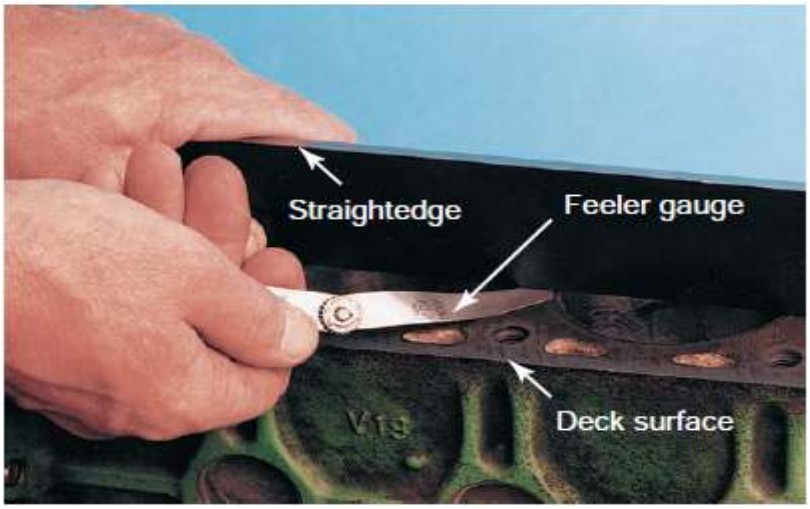


Figure 2.17 Using a feeler gauge and precision straightedge to check for warpage.

Dial Indicator

The dial indicator **(Figure 18)** is calibrated in 0.001-inch (one-thousandth inch) increments. Metric dial indicators are also available. Both types are used to measure movement. Common uses of the dial indicator include measuring valve lift, journal concentricity, flywheel or brake rotor run out, gear backlash, and crankshaft end play. Dial indicators are available with various face markings and measurement ranges to accommodate many measuring tasks.

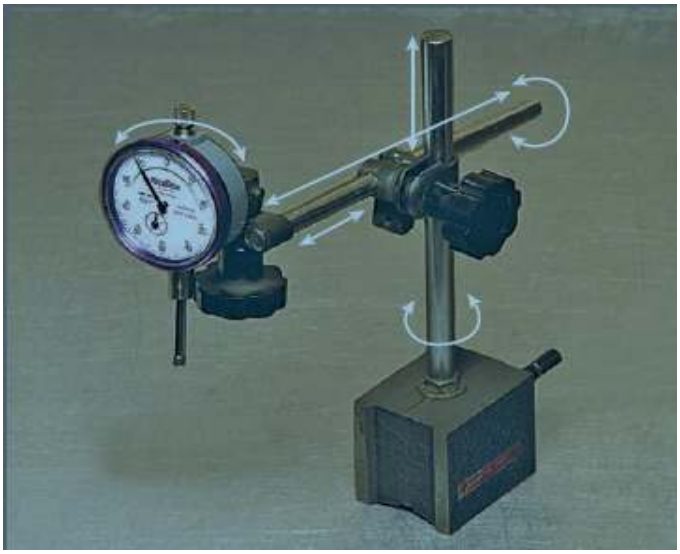


Figure2. 18 A dial indicators with a highly adaptive holding fixture.

To use a dial indicator, position the indicator rod against the object to be measured. Then, push the indicator toward the work until the indicator needle travels far enough around the gauge face to permit movement to be read in either direction **(Figure 18)**. Zero the indicator needle on the gauge.

Always be sure the range of the dial indicator is sufficient to allow the amount of movement required by the measuring procedure. For example, never use a 1-inch indicator on a component that will move 2 inches.

Figure2. 19 This dial indicator setup will measure the amount this axle can move in and out.

General procedures for measurements

- visual inspection before sampling
- know the problem to be measured
- select tools/equipment's the purpose designed for
- check safe operation of selected tools/equipment's
- connect/attach measuring tools /equipment's with the parts to be measured
- carryout measurement
- record the measured value in a specified format
- compare the measured values with the standard/manufacturers specification and take an action

2.2. Method of Conducting Measurements

An automotive measuring device is suitable for professionals in the automotive sector. Which is used to check the ignition of the car or to search for leaks in the air conditioning, and also to check the high pressure from diesel vehicles? For further analysis etc

Some service work, such as engine repair, requires very exact measurements, often in ten-thousandths (0.0001) of an inch or thousandths (0.001) of a millimeter. Accurate measurements with this kind of precision can only be made by using precise measuring devices.

Measuring tools are precise and delicate instruments. In fact, the more precise they are, the more delicate they are. They should be handled with great care. Never pry, strike, drop, or force these instruments. They may be permanently damaged.

Precision measuring instruments, especially micrometers, are extremely sensitive to rough handling.

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S H O P TA L K

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Different types of tools/equipment’s and instruments

2.1 MEASURING TOOLS

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2.3. Comparing and documenting the measurement results

Parts:-

1. Fixed jaw	2. Movable jaw	3. Beam/ Main scale
4. Vernier scale	5. Fine adjusting unit	6. Nibs
7. Depth bar	8. Locking screws	

There are two basic parts of a Vernier caliper.

- The main scale, Which is similar to a steel rule with a fixed jaw
- A "sliding jaw" with a Vernier scale.

The Vernier scale slides parallel to the main scale and provides more precision

• Smallest whole unit	1.000
• Tenths of an inch	0.200
• Twenty five thousands	0.000
• Vernier scale	0.011
Sum (measurement)	**1.211**

Example

Set the Vernier Caliper to read 0.532 inch

Solution

On the Main Scale $(0 \times 1") + (5 \times 0.1") + (1 \times 0.025") = 0.525"$

On the Vernier Scale

Observe which Vernier scale graduation most closely coincides with a main scale graduation

The 7^{th} Vernier scale graduation coincides. $(7 \times 0.001")$

Total =0.525“ + 0.007") = 0.532")

For Metric Vernier Caliper

- Record the position of zero of Vernier scale on the Main scale
- Notice the reading of VS which coincides with MS reading

Example1

On Main Scale

(3 × 1cm) + (2 × 0.1cm) = 3.2 cm

On vernier scale

(3 × 0.01cm) ± = 0.03cm

Total= 3.2 cm+0.03 cm= 3.23 cm

Example 2

Set the Vernier Caliper to read 22.82 mm: with L.C of 0.02 mm

Solution

On the Main Scale

(22 × 1 mm) + (1 × 0.5 mm) = 32.5 mm

On Vernier Scale

Using telescoping gauge

Observe which Vernier scale graduation most closely coincides with a main scale graduation

The 16th scale graduation coincides

16 × 0.02 mm = 0.32 mm

Total= 32.5 mm + 0.32 mm = 32.82 mm

Self-Check -2 Written Test

I. Directions: Answer all the questions listed below

8 and above correct answered points passed mark

1, ---------- is a systematic, replicable process by which objects or events are quantified and/or classified. (2)

2, List down Kinds of Measurements. (2)

3---------- Are used to measure the inside diameter of a bore or hole(2)

4, ----------is a measuring tool that can make inside, outside, or depth measurements. (1)

5, ----------is a thin strip of metal or plastic of known and closely controlled thickness (2)

6, ----------are used for measuring bore diameters and other clearances (2)

7---------- is used to measure linear outside and inside dimensions .(2)

8---------- is used to measure the distance between two parallel surfaces.(2)

II say true or flues

1, Each inch is divided into 10 parts, each equal to 0.100 inch.(1)

2, micrometers are used to measure the inside diameter of a bore or hole.(1)

OPERATION TITLE:- Tasting valve steam diameter by micrometer

PURPOSE: To check optimum diameter of valve steam

CONDITIONS OR SITUATIONS FOR THE OPERATIONS:-

- Wear appropriate clothes, shoe ...

- Ensure the work shop hazard free
- prepare measuring tool
- The area must be clean

EQUIPMENT TOOLS AND MATERIALS :-

Valves, outside micrometer

PROCEDURE:-

- ❖ Always clean the micrometer before using it.
- ❖ Do not touch the measuring surfaces.
- ❖ Hold the object in your left hand and place it against the anvil
- ❖ Hold the micrometer with your right hand
- ❖ Spin the ratchet counter clockwise
- ❖ Twist until the spindle is against the object
- ❖ Slide out the object carefully.
- ❖ Write down the measurements before unlocking the spindle
- ❖ Read the whole number on the sleeve first.
- ❖ Find the number and corresponding marking on the thimble scale closest to but
- ❖ Check the calibration
- ❖ Store the tool properly. The spindle face should not touch the anvil face; a change in temperature might spring the micrometer..

PRECAUTIONS:-

- ➢ ensure work area hazard free.
- ➢ know and implement the correct procedures
- ➢ apply wearing of protective cloths

QUALITY CRITERIA:

Assured Performing of the activities for measuring valve steam diameter according to the given guide and manuals.

LAP Test -2

LAP Test	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates/guides, workshop, tools and materials you are required to perform the following tasks within 2:30 hours.

Task 1: use the proper tool and equipment the proper place .
Task 2: Using the given template measure and test .

Task 3: Using the given template - observe at all times and appropriate personal protective equipment (PPE)

Task 4: Using a given template , Tools and equipment are handled

UNIT THREE: Tools and Equipment

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Using and handling tools and equipment
  - ✓ Hand tools
  - ✓ Power tools
  - ✓ Special tools
  - ✓ Equipment
  - ✓ Electrical measurement/device
- Reporting malfunctions

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Tools and equipment are used according to tasks undertaken
- All safety procedures in using tools and equipment are observed at all times and appropriate Personal Protective Equipment (PPE) are used
- Tools and equipment are handled without damage and according to procedures
- Malfunctions, unplanned or unusual events are reported to the supervisor

3.1. Using and handling tools and equipment

All tools and equipment's be kept in good condition with regular mentainance The right tool is used for the job. Each tool and equipment be examined before use and d.amaged or defective tools and equipment's not to be used Tools and equipment's be operated according to manufacturer's instruction. The right protective equipment's for the tool and activity be used.

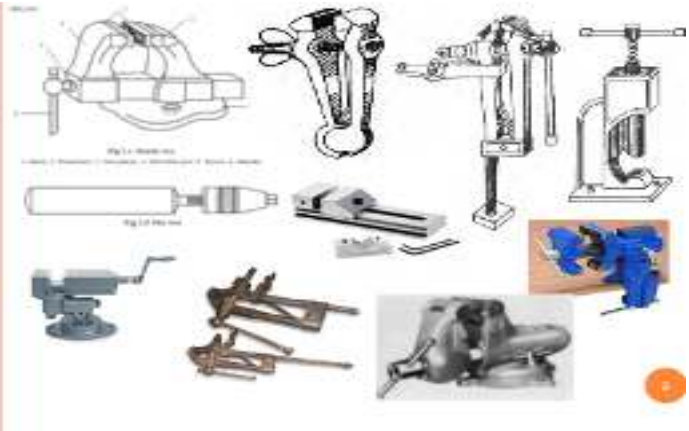
3.1.1 Hand tools

Vises

- **a vise** is a clamping device, usually consisting of two jaws that close with a screw or a lever, that is commonly attachable to a workbench;
- Vises are used to hold a piece work firmly for filing, sawing, chiseling, and bending light metal.
- The top of the vise jaws should be at elbow height. Poor work is produced when the vise is mounted too high or too low.

The types of vises are

1. Bench vise
2. Hand vise
3. Leg vise
4. Pipe vise
5. Pin vise
6. Tool maker's vise
7. Swivel vise
8. Universal vise
9. Blacksmith
10. Machine vis



Maintenance of vise

1. Vises should be maintained properly. Care should be taken that the screw of the vise is free from dirt or metal burrs.
2. The screw of the vise should be lubricated with grease for proper sliding of the movable jaws.
3. The top of the vise should not be used as an anvil.

Care of Vices

a) Do not direct impact the vice body by the hammer.
b) **Light hammering** can be done on and only on the anvil of the vice.
c) To avoid over clamping, the handle of the vice should be tightened by hand only

Clamps

C-Clamp

- C-clamps are used to hold work pieces on machines such as drill presses, as well as to clamp parts together.
- The size of the clamp is determined by the largest opening of its jaws.
- Heavy-duty C-clamps are used by machinists to hold heavy parts such as steel plates together for drilling or other machining operations.

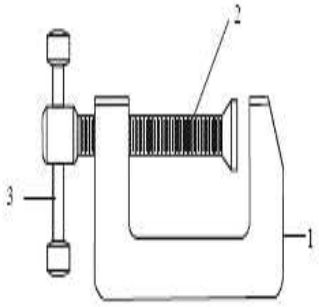


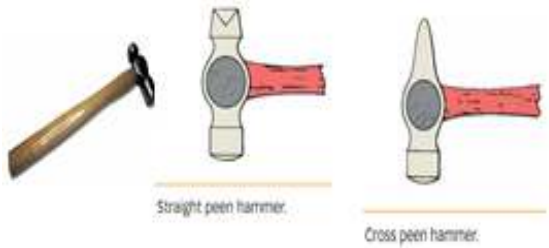
Fig 2.6 'C' clamp
1. Frame
2. Screw 3. Handle

Parallel – Clamp (tool maker's clamp)

- Parallel clamps are used to hold small parts (nonferrous metals).
- Since they do not have as much holding power as C-clamps, this usually limits the use of parallel clamps to delicate work.
- Precision measuring setups are usually held in place with parallel clamps.

Hammers

- Hammers are classified as either hard or soft. Hard hammers have steel heads such as blacksmith types made for heavy hammering.
- The ball peen hammer is the one most frequently used by machinists.
- It has a rounded surface on one end of the head, which is used for upsetting or riveting metal, and a hardened striking surface on the other.
- Two hammers should never be struck together on the face, as pieces could break off.
- Hammers are specified according to the weight of the head.
- Ball peen hammers range from 2 or to 3. Those under 10. are used for layout work.
- Two other shop hammers are the straight peen and the cross peen.



The types of hammers are

1. Hand hammer
2. Sledge hammer
3. Claw hammer
4.Softhammer

Hand hammers are of different types and they are

1. Ball peen hammers
2. Cross peen hammer
3. Straight peen hammers
4. Double face hammer

Wrenches

- A large variety of wrenches are made for different uses such as turning cap screws, bolts, and nuts.
- The adjustable wrench, commonly called a crescent wrench, is a general purpose tool and will not suit every job, especially those requiring work in close quarters.
- The wrench should be rotated toward the movable jaw and should fit the nut or bolt tightly.
- The size of the wrench is determined by its overall length in inches.

- Open end wrenches are best suited to square headed bolts, and usually fit two sizes, one on each end.
- Box wrenches are also double ended and offset to clear the user's hand.
- Socket wrenches are similar to box wrenches in that they also surround the bolt or nut and usually are made with 12 points contacting the six-sided nut.
- Sockets are made to be detached from various types of drive handles.
- Pipe wrenches, as the name implies, are used for holding and turning pipe. These wrenches have sharp serrated teeth and will damage any finished part on which they are used.

5. Screwdrivers

- The two types of screwdrivers that are most used are the standard and Phillips.
- Both types are made in various sizes and in several styles: straight shank and offset.
- It is important to use the right width blade when installing or removing screws.
- The shape of the tip is also important. If the tip is badly worn or incorrectly ground, it will tend to jump out of the slot.
- Never use a screwdriver as a chisel or pry bar.
- Keep a screwdriver in proper shape by using it only on the screws for which it was meant.

Pliers

- Pliers are made in many styles and are used to perform as many different operations. They are used for holding and gripping small articles in situations where it may be inconvenient or unsafe to use hands.
- It is not a good practice to use pliers in place of a wrench.

Side cutting pliers

- Side - cutting pliers are made with cutting blades on one side of the jaws. They are used mostly for gripping and cutting wires.

Nose pliers

- Nose pliers are made with a thin nose or jaws.
- This tool can be used for placing and removing small items in narrow spaces.
- It is also preferred for electrical and radio repair work.

Bench work tools and their operation

Hacksaw

- A hacksaw is generally used for cutting a metal into pieces. (Also to produce grooves and slits.)
- It consists of a frame, handle and a saw blade as shown below.
- The frame may be of fixed type to take only one length of blade, or adjustable to take different blade lengths. It has a wing nut to adjust the tension of the blade.
- Hand hacksaw blades are generally ½ in. wide and .025 in thick.
- The kerf, or cut, produced by the hacksaw is wider than the .025-in thickness of the blade because of the set of the teeth.
- The set refers to the bending of teeth outward from the blade itself.
- Two kinds of sets are found on hand hacksaw blades.
- The first is the straight or alternate set, in which one tooth is bent to the right and the next tooth to the left for the length of the blade.
- The second kind of set is the wavy set, in which a number of teeth are gradually bent to the right and then to the left.
- A wavy set is found on most fine-tooth hacksaw blades.
- The spacing of the teeth on a hand hacksaw blade is called the pitch and is expressed in teeth per inch of length.
- Standard pitches are 14, 18, 24, and 32 teeth per inch, with the 18-pitch blade used as a general-purpose blade.

Hardening - Usually the saw blade is supplied with all hard or flexible grades.

- The all hard is very brittle, and it is suitable for the skillful user only.
- The flexible grade is tough, so it can twist an angle. It is suitable for cutting a curve or for the beginner to use.

- The hardness and thickness of a workpiece determine to a great extent which pitch blade to use.
- As a rule, you should use a coarse-tooth blade on soft materials, to have sufficient clearance for the chips, and a fine-tooth blade on harder materials. But you should also have at least three teeth cutting at any time, which may require a fine-tooth blade on soft materials with thin cross sections.
- The blades are mounted in the frame with the teeth pointing away from the handle so that the hacksaw cuts only on the forward stroke.
- No cutting pressure should be applied to the blade on the return stroke as this tends to dull the teeth.
- The sawing speed with the hacksaw should be from 40 to 60 strokes per minute.
- To get the maximum performance from a blade, make long, slow, steady strokes using the full length of the blade.
- Sufficient pressure should be maintained on the forward stroke to keep the teeth cutting.
- Teeth on a saw blade will dull rapidly if too little or too much pressure is put on the saw.
- The teeth will dull also if too fast a cutting stroke is used; a speed in excess of 60 strokes a minute will dull the blade because friction will overheat the teeth.

Reasons for the breakage of hacksaw blades

1. The cutting action may not be of uniform speed and thrust
2. Improper fitting of blades (undue tightness or looseness)
3. Putting into use new blades in old cuts
4. Not selecting blades of suitable pitch
5. Poor workmanship

Reasons for the blunting of hacksaw blades

1. The material being cut is harder than the blades
2. Improper selection of blades
3. Application of high thrust and speed
4. applying thrust during return stroke also
5. Not applying a coolant

Safety and Care of Hacksaw

- The cutting action is carried on the forward action only. So the blade must be mounted with its teeth pointing forward.
- Suitable tension should be applied on the blade to avoid breakage or loosen.
- Change the blade if some teeth are broken.
- Avoid rapid and erratic strokes of cut.
- Avoid too much pressure.
- Work piece must be hold firmly.
- Starting a cut for sawing
- In order to achieve a perfect cut, To start a hacksaw cut, it is a good practice to guide the blade until the cut is well established.
- To start an accurate cut, use the file with a triangular file a small notch beside the marking line to get a good start, using the thumb can also be a guide and saw slowly with short strokes.
- Place the saw with an angle of tilt and start with sawing.
- Approximate body position when doing hand hacksaw process.

II. File and filling

- A file is a hand cutting tool made of high-carbon steel, having a series of teeth cut on the body by parallel chisel cuts.
- Files are used to remove surplus metal and to produce finished surfaces.
- Files are often used to put the finishing touches on a machined work piece, either to remove burrs or sharp edges or as a final fitting operation.
- Intricate parts or shapes are often produced entirely by skilled workers using files.

Main parts of File:-

- Files are categorized as follows:-
- Length - measured from the shoulder to the tip.
- Shape - the cross-sectional profile.

- Grade - the spacing and pitch of the teeth.
- Cut - the patterns of cutting edge.
- File Length: - the length of a file is measured from the shoulder above the tang to the point. Needle files are the exception to this rule, the total length being measured.(100-350mm)
- Files are manufactured in many different shapes and are used for many specific purposes.
- Hand files - These are parallel in width and tapered in thickness. They have one safe edge (smooth edge) which permits filing in corners and on other work where a safe edge is required. It has double cut teeth on two faces, single cut teeth on one edge, and one save edge. Used principally for finishing flat surfaces and similar work.
- Flat files: - are slightly tapered toward the point in both width and thickness. They cut on both edges as well as on the sides. They are the most common files in use. Flat files are double cut on both sides and single cut on both edges.
- Half-round File - The section is a chord of a circle with its taper towards the tip. It is used for forming radii, grooves, etc. and the flat side is used for finishing flat surfaces.
- Round File - This is of round section tapering toward the end. It is used for enlarging holes, producing internal round corners. Usually double cut in the larger sizes, and single cut for the smaller sizes.
- Square File - This is square in section, with tapered towards the tip, and usually double cut on all four faces. It is used for filing rectangular slots or grooves.
- Three Square File - It is also known as triangular file. This is a triangular in section, with tapered towards the tip with double cut on both faces. It is used for filing corners or angles less than 90°
- Needle Files - Needle files are a set of small files with their shapes made in a way similar to the large ones. They are generally used for small and delicate works such as the repair of small instruments.

- Grade: - the pitch (spacing) of the teeth that spread throughout the whole length of the file. Files with a rougher grade of cut give a faster metal removal rate but a poorer surface finish or the vice versa. It is designated by the number of rows of teeth per inch.
- There are five types of files according to its grade. They are

1. Rough file (R) – 20 to 25 teeth / inch
2. Bastard file (B) – 25 to 30 teeth / inch

    - Medium teeth for general purposes, especially suitable for mild steel.

3. Second cut file (SC) – 35 to 40 teeth / inch

    - Finer teeth for cutting hard metals.

4. Smooth file (S) – 40 to 60 teeth / inch

    - Fine teeth for finishing.

5. Deed smooth file (DS) – 80 to 100 teeth / inch

- Cut Pattern: -
- Single Cut - There is only one set of cutting teeth to one edge. It gives a less efficient cutting but a better finish.
- It is suitable for the soft metal.
- Double Cut - A double cut file has one set of teeth cut at 60 degrees to one edge, and another set of grooves cut at 80 degrees to the other edge. It is thus more efficient in cutting. It is easy to clog the teeth when it is work on the soft metal.
- Rasp - Very coarse teeth, like the nail, it is commonly used for the cutting off soft materials such as rubber, PVC, or wood etc.

File Handling

- Clamp the workpiece as close as possible to the jaws of the vise.
- Use protective jaws (Aluminum) to protect the workpiece.
- Start with a rough file for removing more material then take a smooth file to reach a good surface.

File Handling

- Forward stroke with pressure; Return stroke without pressure.

- Move with the file crosswise to control the area of filing.
- Clean the file from time to time (especially smooth files) with a wire brush to prevent messy finishes.
- Never work with a file without a file grip.
- Make sure that the file grip is properly attached, that it has the right dimension and that it is not splatted.

Care of Files

- Choose the right file for the material and work to be performed.
- Keep all files racked and separated so they do not bear against each other.
- Keep the files in a dry place—rust will corrode the teeth points, dulling the file.
- Keep files clean. Tap the end of the file against the bench after every few strokes, to loosen and clear the filings. Use the file card to keep files clean—a dirty file is a dull file. A dirty file can also contaminate different metals when the same file is used on multiple metal surfaces.

File Card

- When filing the soft metals, the small pieces of metal will tend to clog the teeth. If the file is not cleaned, this small piece of metal will scratch on the surface of the work. We call it pinning. This case is frequently appeared when applying a new smooth file on the soft metals.
- The pinning can be removed with a File Card as shown , which is a wire brush mounted on a block of wood.
- Sweep the file card along the grooves on the file until the pinning is removed.

III. Chisels and chiseling

- A chisel is a hard steel cutting tool that can be used for cutting and chipping any metal softer than the chisel itself. It can be used in restricted areas and for such work as shearing rivets, or splitting seized or damaged nuts from bolts.
- These are sometimes referred to as cold chisels because they are used to cut cold metals.
- They are made of cast steel or alloy steel, with a hardened and tempered cutting edge.

The common types of chisel include:

1. The flat chisel: used for general-purpose chiseling.
2. The cross-cut chisel: used for cutting grooves such as keyways, and for chipping. (Cape)
3. The half-round-nosed chisel: used for cutting grooves (which are either curved or half-round).
4. The diamond-pointed chisel: used for working into corners and cutting small grooves.

Chiseling is one of the methods of cutting material. Though is it inaccurate it is still widely used. The chisel is held in one hand and hammered to chop out, shear and chip material.When it becomes difficult to use shears or a saw, you can use the chisel in cutting metal plate or sheet. This process is called chopping out. When chopping out slots and holes, drill holes in the waste to help prevent distortion of the material and to make cutting easier. When you are cutting strips from material (about 1.5 mm to 4.5 mm thick), you can use the shearing process.Now a day the grinder, shaper and miller are widely used for this purpose, but if these machines are not available, chipping is still an economical process.Chiseling is the art of shaping metals using chisels. Hammers are used to strike the heads of the chisel so that they can cut while the work piece is held stationery. Chiseling can take one of the two forms : chipping or shearingChipping is a chiseling operation in which small metals pieces are removed and the work is shaped.Shearing is a process of separating metals in to pieces using chisel. hipping produces chip, whereas shearing is a chip less process.Grind off the mushroom head caused by hammering. If it is not removed, pieces may snap off, and this can be dangerous.

Chisel Safety

Wear safety goggles and erect a shield around the work when cutting material with a chisel.
Hold the chisel properly against the work.
Do not use a chisel with a mushroomed head.
Remove sharp edges from the work after making a cut

3.1.2 Power tools

- Impact wrenches
- Air ratchets Grinding wheel Wire wheel
- Trouble lights
- Incandescent or fluorescent Lifting Tools
- Hydraulic floor jack
- Drills
- Blow guns
- Grinders
- Cutting tools
- Drill press

Is used to raise vehicle off the ground Is used with safety stands.

• Pneumatic jack Uses air to raise vehicle. is used with safety stands.

• **Safety stand:** - is used to support a vehicle when raised

• Hydraulic **lift :- is safest lifting tool Is also called a hoist.**

• **Engine** hoist

Is sometimes called a cherry picker Uses hydraulic pressure to lift an engine from a vehicle

• Repairing the modern automobile requires the use of many different hand and power tools.

• Carelessness or mishandling of power tools can cause serious injury.

The high-speed mighty mite with super-efficient silencer and rear exhaust system. Wonder works on all metals, wood, and plastics, even extremely hard and exotic materials. And now that efficiency is upgraded with the addition of an air silencer and new rear exhaust system for grinding dust-it's all the more the perfect tool for tool rooms and model shops. The super efficiency of the silencer makes it possible for all craftsmen to work longer with less irritation due to noise. For precision grinding, debarring machines parts, grinding small castings, removing welding slags, shaping and finishing wood, glass and plastics this is the compact, easy handing air tool for all tasks.

Sand and polish metal, wood, plastic to a super fine swirl-free finish. Light weight, compact, powerful, whisper quiet, and adjustable speed regulator. Productivity and efficiency increase with the orbital sander. The lightweight unit delivers the performance of heavy duty unit with less vibration and reduced operator fatigue.

3.1.3 Special tools

Definitions The following definitions are used in this Procedure:

(i) Special Tooling has the meaning defined in the Eaton purchase order for the items to be supplied. Appendix A contains a non-exclusive list of examples of Special Tooling.

(ii) Generic Tooling is general-purpose items and equipment, even if dedicated to the production of items for Eaton.

(iii) Consumable Tooling is tooling that will be consumed within less than 12 months based on Eaton's forecasted usage and the cost is to be recovered in the piece price.

3.1.4 Equipment

Jack Stands

After raising a vehicle with a jack, always support it with jack stands placed under the frame, axle housing, or suspension arm

• Cylinder head stands, transmission fixtures, rear axle holding stands, and others all make your work safer and easier

Holds the head in position during valve and seat work

Engine Stand

- Used to hold an engine once it is removed from the vehicle
- The engine bolts to the stand
- The engine can usually be rotated and held in different positions, making it easy to work on

3.1.5 Electrical measurement/device

Multi-meter

- It is a 3 in 1 instrument, which can measure the resistance, voltage, and amperage of the current.

Digital Type

Ohmmeters

Ohmmeters are used to test the resistance in components and they must be disconnected from any other power source.

Ohmmeters are self-powered

Most common scales • 200 • 2K

20K

- 200K
- 2M
- 20M

Manual Ranging Auto Ranging

Out of range indication if the resistance is higher than the scale you are on.

The Meter will round off the reading if you are on too high of a scale. This can make your readings

Somewhat inaccurate Ohmmeters are used to:

- Test continuity in switches
- Test continuity in fuses
- Test continuity in mercury switches
- Test the continuity and or resistance of relay

3.2. Reporting malfunctions:

When you find an issue in the field, you may wish to report to the client or to your supervisor. In doing so, you can communicate information such as the location and the

results of a sensory inspection or measurement, and ask for instructions. You may also wish to send message to more effectively communicate conditions at the site. Damaged or malfunctioning equipment report this form is to report any broken or malfunctioning equipment. Return this form immediately to a Cage operator or the Media Asset Coordinator Please clearly explain the problem and when/how it occurred. NAME:_____ DATE:_____ MALFUNCTIONING ITEM:_____ ITEM'S CMU #_____ DATE PROBLEM OCCURRED:_____ DESCRIPTION OF MALFUNCTION:

_____

_____

_____

_____

_____

_____

_____ (signature)

Self-Check -3 Written Test

I. Directions: Answer all the questions listed below

1. ---------- is a 3 in 1 instrument, which can measure the resistance (2)
2. List down Kinds of tools .(2)
3. ---------- are used to testing the volt of a storage device (2)
4. ----------are slightly tapered toward the point in both width and thickness (1)
5. ----------is classified as either hard or soft (2)

Unit Four: Maintain Tools and Equipment

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Undertaking routine maintenance
- Cleaning the equipment and tools
- Re-storing tools and equipment

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Select appropriate calculation method
- Estimate material quantities for canal
- Estimate division box material quantity
- Confirm and record results
- Perform scale and grade calculation

4.1 Undertaking routine maintenance

All tools, equipment and vehicles must be properly maintained so that workers are not endangered. Construction regulations require inspections of vehicles, tools, machines and equipment before use.

Components of maintenance program

A maintenance strategy includes procedures as well as corrective and preventive maintenance

- Inspections ensure that tools and equipment are operating correctly. Safety inspections ensure the tools/equipment is safe for both patients and operators.
- Corrective maintenance (cm) restores the function of a failed device and allows it to be put back in to service.
- Preventive maintenance (pm) aims to extend the life of the tools/equipment and reduce failure rates.

Preventive maintenance is the systematic care and protection of tools, equipment, machines and vehicles in order to keep them in a safe, usable condition limit downtime and extend productivity. We must always be aware that maintenance tasks themselves are potentially hazardous and can result in injury. The successful maintenance program is:

- well organized and scheduled,
- controls hazards,
- defines operational procedures, and
- Trains key personnel.

General requirements for tools/equipment maintenance include:

- Obtaining a copy of the maintenance schedule recommended by the manufacturer.
- Ensuring that maintenance is performed as required.
- Ensuring that the person(s) performing the maintenance are competent (e.g. licensed mechanic).
- Retaining records of maintenance/service conducted.
- Specifying who is responsible for overseeing tools/equipment maintenance and where the records are kept.
- Set up a system for removal and tagging of damaged or defective tools and equipment

Routing maintenance

Drained waste fluids such as waste oil, antifreeze, and solvents are stored in separate drums or tanks.

Waste oil is removed by a licensed transporter or burned on-site in an approved heater.

Oil filters are punctured and hot drained over waste oil drum for the required amount of time, and then recycled or disposed properly.

Oily shop rags are placed in sealed, labeled metal containers and are managed properly.

Oily absorbents are disposed according to state regulations.

apply 5S as work regulation.

Solvent Degreasing/cleaning

Solvent degreasing (or solvent cleaning) is the physical process of using organic solvents to remove grease, fats, oils, wax or soil from various metal, glass, or plastic items. The types of equipment used in this method are categorized as cold cleaners, open top vapor degreasers, or conveyor zed degreasers. non aqueous solvents such as petroleum distillates, chlorinated hydrocarbons, ketenes, and alcohols are used. Solvent selection is based on the solubility of the substance to be removed and on the toxicity, flammability, flash point, evaporation rate, boiling point, cost, and several other properties of the solvent.

The metalworking industries are the major users of solvent degreasing, i. e., automotive, electronics, plumbing, aircraft, refrigeration, and business machine industries. Solvent cleaning is also used in industries such as printing, chemicals, plastics, rubber, textiles, glass, paper, and electric power. Most repair stations for transportation vehicles and electric tools use solvent cleaning at least part of the time

4.2 Cleaning the equipment and tools

- Clean up every time whenever you leave an area, including sweeping the floor.
- Clean and return all tools to where you got them.

- Use compressed air sparingly; never aim it at another person or use it to clean hair or clothes.
- Shut off and unplug machines when cleaning, repairing, or oiling.
- Never use a rag near moving machinery.
- Use a brush, hook, or a special tool to remove chips, shavings, scraps etc. from the work area. Never use the hands.
- Keep fingers clear of the point of operation of machines by using special tools or devices, such as, push sticks, hooks, pliers, etc.
- Keep the floor around machines clean, dry, and free from trip hazards. Do not allow chips to accumulate.
- Mop up spills immediately and put a chair or cone over them if they are wet enough to cause someone to slip.

After cleaning the work area, store tools and equipment's on its proper place/storage shelf.

Which have the following procedures?

- Store reused materials, tools and equipment's in a proper place.
- Design place for each kind of tools.
- Label the storage cabinet or place correctly.
- Store them near the point of use.
- Wash and dry properly before storing.
- Store sharp edge materials properly when not in use with sharp edge down.
- Put frequently used items in conveniently accessible conditions.
- Gather and secure electrical chord to prevent entanglement or snagging.
- Cutting boards should be stored vertically to avoid moisture collection
- Metal equipment's can be stacked on one another after drying.
- Make sure the areas where you are storing the equipment are clean, dry and not overcrowded.

Importance of proper storage of tools and equipment's

- It is important factor for safety and health as well as good business.

- Improves appearance of general-shop and construction areas.
- Reduce overall tool cost through maintenance.
- This also ensures that tools are in good repair at hand.
- Teaches workers principles of tool accountability.

4.3 Re-storing tools and equipment

Toolbox stores and protects a technician's tools when not in use

Toolbox Parts lower roll-around cabinet holds bulky, heavy tools o upper tool chest holds commonly used tools in easy reach small carrying tray is placed in the upper tool chest and allows tools to be taken to the vehicle more easily

Toolbox

Never open more than one drawer at a time

Toolbox Organization

4 Related tools are usually kept in the same drawer various types of hammers may be stored in one drawer and all screwdrivers in another

5 Small or delicate tools should not be kept with large, heavy tools to prevent damage

6 Tool holders help organize small tools

Self-Check 4 Written Test

Directions: Answer all the questions listed below

5 and above correct answered points passed mark

1. Good organization of stored materials is essential for overcoming material storage problems whether on a temporary or permanent basis.(2)

A. True B. False

2. Stored materials should not obstruct (2)

A. walkway, stairs, exits, B. Fire equipment, emergency eyewash fountains,

C. emergency showers, or first aid stations D. all

3. the following is correct about maintaining of tools and equipments except?(2)

A. They should be stored in a separate secure place

B. They should be stored in a safe and easy to find

C. They should be Stored on/near walkway, stairs, exits

D. All storage areas should be clearly marked

4. List down Importance of proper storage of tools and equipments. (4)

Operation sheet 4

OPERATION TITLE:-proper storing tools and equipment's

PURPOSE:- For safety and health as well as good business. And for Reducing overall tool cost through maintenance.

CONDITIONS OR SITUATIONS FOR THE OPERATIONS:-

- Safe working area
- Properly operated tools and equipment's
- Appropriate working cloths fit with the body.

EQUIPMENT TOOLS AND MATERIALS :

- Hand tools -screw driver, wrenches, hammers etc.
- Equipment - floor jack, hydraulic crane etc.
- Special tools - torque wrench etc.

PROCEDURE:-

- Design place for each kind of tools.
- Label the storage cabinet or place correctly.
- Store them near the point of use.
- Wash and dry properly before storing.
- Store sharp edge materials properly when not in use with sharp edge down.
- Put frequently used items in conveniently accessible conditions.
- Gather and secure electrical chord to prevent entanglement or snagging.
- Cutting boards should be stored vertically to avoid moisture collection
- Metal equipment can be stacked on one another after drying.
- Make sure the areas where you are storing the equipment are clean, dry and not overcrowded.

PRECAUTIONS:-

- Wear working cloths which properly fit with your body
- Make working area hazard free
- Read and interpret manual which guide you how to use tools and equipment

QUALITY CRITERIA:

Assured performing of the activities correctly accordance with the given procedure given above.

LAP Test 4

Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates/guides, workshop, tools and materials you are required to perform the following tasks within 2:30 hours.

Task 1: By Using the given template undertaking routine maintenance of tools and equipment

Task 2: By using the given template cleaning equipment and tools

Task 3:By Using the given template store tools and equipment safely in appropriate with work place procedure

Task 4: By using the given guide apply 5S activities