CHAPTER-1

INSPECTION- Inspection is the art of applying tests preferably by the aid of measuring instruments to observe whether a given item or product is within the specified limits of variability.

Planning of Inspection- Inspection planning is the process of creating a plan to inspect materials or systems to ensure they meet quality standards and safety requirements. Inspection plans can be used for a variety of purposes, including quality control, maintenance, and safety.

> Selecting the type of inspection for different stages in production flow.

> Selecting the operation to be performed during inspection.

> Selecting the time for inspection.

> Selecting the quality to be inspected.

> selecting the place where to be performed during inspection.

W5H Principle- The W5HH principle outlines a series of questions that can help project managers more efficiently manage software projects. Each letter in W5H stands for a question in the series of questions to help a project manager lead.

These are involves following steps:-

1. Why to inspect? In this step, we find out the necessity of doing inspection. The purpose for which the inspection is to be done should be clearly laid down.

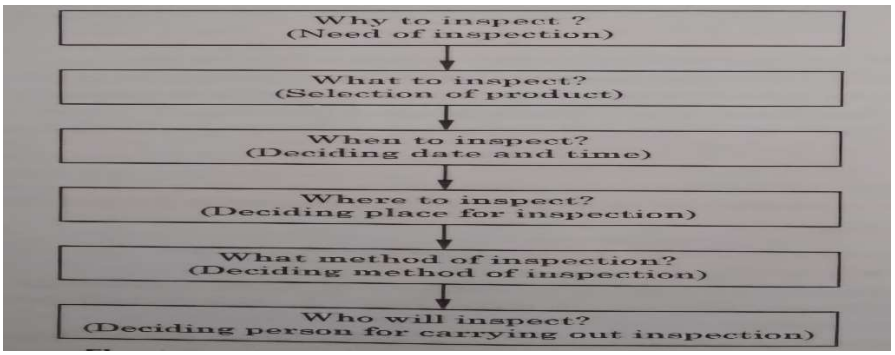
2. What to inspect? In this step, the product, tool, raw material or finished product is selected upon which the inspection is to be done. In other words, in this step, the article is selected which is to be inspected.

3. When to inspect? In this step, the date and time ane decided to carry out the inspection after selecting the article upon which inspection is to be done.

4. Where to inspect? After selecting the product are deciding the time of inspection, the next step is to decide the place or venue where the is to be done (i.e. in factory or outside the factory or in inspection room etc.).

5. What method of inspection? In this step, the decision is taken about the method of inspection whether the inspection is to be done manually or by machines or with some special purpose equipments.

6. Who will inspect? Finally, the name of person who will do the inspection is decided upon.



***TYPES OF INSPECTION :-**

A - Based upon the method of inspection:-

1. Remedial inspection.
2. Preventive inspection.
3. Incoming inspection.
4. In-process inspection.
5. Operation inspection.
6. Final inspection.

1. Remedial Inspection : In this type of inspection, the tools, jigs, fixtures and machines are checked in advance, according to specifications, before the commencement of operations. A trial is attempted with a single piece and if this piece conforms with the specifications, then the production is allowed to be carried out otherwise remedial steps are taken.
2. Preventive Inspection: This inspection has many aspect

(i) This is done upon the incoming raw material to prevent the wrong purchasing of material.

(ii) After some time, there occurs wear and tear of machine parts and tools which affects the quality of product. By preventive inspection, all these things can be avoided to happen.

(iii) After completion of product and before it is sent to the market, again inspection is done to prevent the bad products entering the market.

3. Incoming Inspection: Materials inspection is concerned with the control of the quality of the raw material and purchased parts. It is also known as incoming inspection. It examines everything coming into the plant eg. materials, parts, assemblies, equipments etc. The received material is generally checked for:

   (a) Requirement laid down in purchase order
   (b) Damages, corrosion, cracks etc.
   (c) Test reports in case of raw-materials. production.
   In case of necessity, the persons of the inspection department inspect the materials at the supplier's plant, before its delivery or even when it is in the process of production.

4. In-Process Inspection: This is also known as working inspection and in this inspection, products are inspected while they are in process, to see, whether they are being produced according to specifications.
5. Operation Inspection: This inspection is carried out after the completion of an operation before the component passes to next operation/machine or department.

6. Final Inspection: This type of inspection is employed when the manufacturing process is complete and the article is to be sent to store.

➢ **STANDARDS OF MEASUREMENTS**:-

1. Primary standards,
2. Secondary standards,
3. Teritiary standards,
4. Working standards.

1. Primary standards: A "primary standard" in the context of measurement standards is the most accurate and definitive standard used to calibrate other, less precise standards, essentially acting as the top level of reference in a measurement hierarchy; it is not calibrated against any other standard and is used to set the basis for measuring a specific quantity like length, mass, or time.

➢ Key points about primary standards:

- **Highest accuracy:** They are designed to have the lowest possible measurement uncertainty.
- **Directly traceable to SI units:** Their values are directly linked to the International System of Units (SI).
- **Calibration of other standards:** Primary standards are used to calibrate secondary and working standards which are then used for routine measurements.

2. Secondary standards :-A "secondary standard" in the context of measurement standards is a reference material whose value is determined by comparison to a primary standard, meaning it is calibrated against a highly accurate primary standard and used for routine measurements in a laboratory setting, typically when a high level of precision is not required for the specific analysis at hand; essentially acting as a "working standard" derived from the primary standard.

➢ Key points about secondary standards:

- **Calibration against primary standard:**
  The key feature of a secondary standard is that its value is established by comparing it to a primary standard, which is considered the most accurate reference point.
- **Used for routine analysis:**
  Secondary standards are generally used for everyday laboratory measurements and quality control checks, as they are more readily accessible and easier to handle than primary standards.
- **Less stringent purity requirements:**
  Compared to primary standards, secondary standards may have slightly lower purity levels, as their accuracy is derived from the primary standard they are calibrated against.

3. Tertiary standards:- A "tertiary standard" in the context of measurement standards refers to a reference standard used in laboratories and workshops, essentially a copy of a

secondary standard, which is used to compare and calibrate "working standards" used for everyday measurements; it acts as the first point of reference for routine testing within a facility, sitting between the highly precise secondary standard and the working standards used for regular operations.

➢ Key points about tertiary standards:

- **Function:**
  They are used to verify the accuracy of working standards by comparing them to the tertiary standard, which is itself calibrated against a secondary standard.
- **Hierarchy:**
  In the standard hierarchy, primary standards are the most accurate and are used to calibrate secondary standards, which then calibrate tertiary standards, which finally calibrate working standards.
- **Application:**
  Tertiary standards are typically used in industrial settings where high precision is needed but not as frequently as with working standards.

4. Working standards:- A "working standard" in the context of measurement standards is a secondary standard used for routine calibration and checking of measuring instruments, which is periodically compared against a higher-level standard (like a primary or secondary standard) to ensure its accuracy; essentially, it's a practical tool used to verify

the consistency of measurements in day-to-day operations within a laboratory or manufacturing setting.

➢ Key points about working standards:

- **Function:**
  Used to calibrate instruments and verify the accuracy of measurement methods within a laboratory or facility.
- **Calibration:**
  Regularly calibrated against a higher-level standard (like a primary or secondary standard) to maintain traceability.
- **Hierarchy:**
  Considered a secondary standard, meaning it is derived from a more accurate primary standard.
  Example: A set of gauge blocks used to check the calibration of a micrometer would be considered a working standard.

➢ 1.12:-INTERNATIONAL,NATIONAL AND COMPANY STANDARDS.

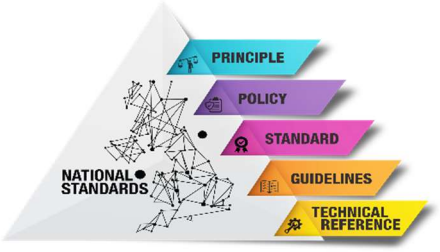
1.**International standard**:- International standards (IS) are documents that establish guidelines, rules, and processes for products and services. They are developed

by experts from multiple countries and approved by a globally recognized body.

1. Purpose
2. International standards ensure that products and services are safe, reliable, and high quality
3. They help businesses adopt sustainable and ethical practices
4. They help researchers understand the value of innovation
5. They help manufacturers produce products of consistent quality
6. Examples
7. **International System of Units (SI)**: The international standard for measurement, also known as the metric system
8. **Health and safety standards**: Help reduce accidents in the workplace
9. **Energy management standards**: Help reduce energy consumption
10. **Food safety standards**: Help prevent food from being contaminated
11. **IT security standards**: Help keep sensitive information secure.

- **2.National standards**:- National standards are guidelines for the design, use, and performance of products, services, and systems. They are developed by national standards bodies, which are organizations that are members of the

International Organization for Standardization (ISO).



Examples of national standards

- **Standards of Weights and Measures Act**: This act establishes units of measurement for mass, length, area, and capacity.
- **NIST standards**: The National Institute of Standards and Technology (NIST) develops standards for a variety of areas, including school bus colors, ionizing radiation, and radioactivity.
- **American National Standards Institute**: This organization develops standards for the United States.
- How national standards are developed
- Subject matter experts develop standards through a consensus.
- A recognized body approves the standards.
- Standards can be developed by businesses, government departments, or consortia of businesses.
- Benefits of national standards National standards help ensure the quality of products and services, They help protect consumers, and They help support regulations.

3. **company standard**:- Company standards are guidelines that define how a company operates, and can include quality, safety, performance, and more. They help build trust in a brand.

Why are company standards important?

- They help ensure consistent and high-quality service delivery
- They help ensure compliance with corporate policies
- They help protect consumers by ensuring safety, durability, and market equity
- They help make interoperability of components made by different companies possible
- They help provide a common language to measure and evaluate performance

How are company standards created?

- They are based on the company's objectives, values, and industry best practices
- They are created by committees or working groups that discuss, research, and test new ideas to determine best practices

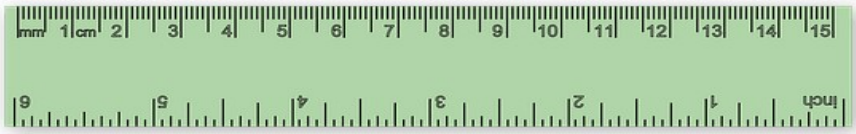
Examples of company standards

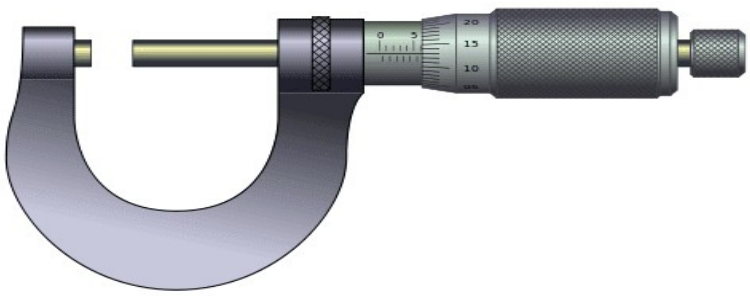
- Quality standards
- Performance standards
- Safety standards

- Terminology standards
- Testing standards
- Management system standards
- Software code and design standards
- Quality assurance and testing standards

➢ What is line standard and end standard?

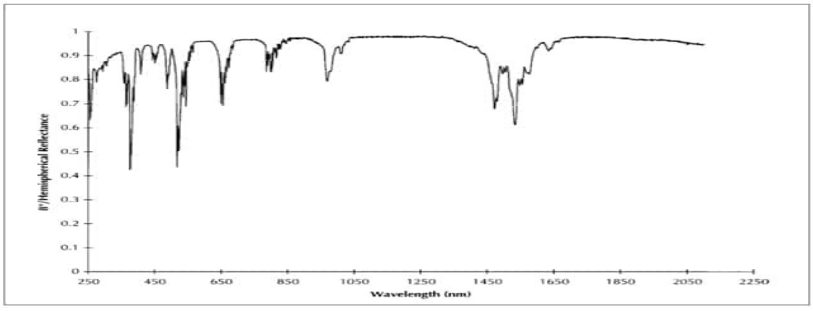
For accurate measurement, it is crucial to choose a suitable measuring device that suits the particular situation. There are mainly two methods for the measurement of distance. When the distance between two engraved lines is used for the measurement of length then it is called line standard or line measurement. They are used for direct length comparison, and they have no auxiliary devices. The most common line standard is the division marked meter rule.





- When the distance between two parallel surfaces is used as the standard for measuring length, it is known as end standard or end measurement. The end standard is primarily used in the workshop for precision measurement. The common examples are end bars, micrometer anvil, slip gauge etc. The end parallel surface of these tools is hardened to resist wear to ensure the accuracy of measurement. Comparator is used to transfer line standard correctly to the end standard. In comparison to line standard, the end standard provides high accuracy results.

- **A wavelength standard** is a known wavelength of spectral radiation that is used to measure the wavelengths of other spectra. Wavelength standards are used in spectroscopy, which is the study of the production, measurement, and interpretation of electromagnetic spectra.



- How are wavelength standards used?
- **Calibration**: Wavelength standards are used to calibrate instruments.

- **Comparison**: Wavelength standards are used to compare the wavelengths of different spectra.
- **Measurement**: Wavelength standards are used to measure the wavelengths of other spectra.
- What are some examples of wavelength standards?
- **Frequency-stabilized lasers**: These lasers are used in length metrology and precision laser spectroscopy.
- **Holmium oxide glass**: This material is used as a wavelength standard.
- **Spectralon**: This material is used as a wavelength calibration standard.
- The standard unit of wavelength is the meter (m).

- **A study of factors influencing the quality of manufacture:-** would examine various elements within a production process, including raw material quality, equipment condition, employee skill level, process controls, production planning, environmental factors, quality management systems, and organizational culture, all of which can significantly impact the final quality of a manufactured product.

Key factors to consider:

Input factors (Raw materials):

- **Consistency:** Variations in the quality of raw materials (e.g., impurities, dimensions) can directly affect product quality.
- **Source reliability:** Consistent supply from reliable vendors is crucial.
- **Testing and inspection:** Thorough quality checks on incoming raw materials.

Process factors:

- **Equipment maintenance:** Proper upkeep of machinery to ensure optimal performance and prevent defects.
- **Process parameters:** Precise control of temperature, pressure, time, etc., within specified ranges.
- **Automation level:** Automation can minimize human error and improve consistency.
- **Work instructions:** Clear and detailed procedures for each manufacturing step.

Human factors:

- **Employee training:** Adequate training on quality standards and proper operating procedures.
- **Skill level:** Matching employee skills to required tasks.
- **Motivation and engagement:** A positive work environment can contribute to quality focus.

Quality management factors:

- **Quality control methods:** Statistical process control (SPC), in-process inspection, final product testing.
- **Quality standards:** Adherence to established industry standards (e.g., ISO)
- **Feedback loop:** Continuous monitoring and improvement based on quality data

Organizational factors:

- **Leadership commitment:** Top management support for quality initiatives
- **Communication:** Clear communication of quality goals and expectations throughout the organization
- **Continuous improvement culture:** Emphasis on identifying and addressing quality issues

Environmental factors:

- **Temperature and humidity control:** Maintaining stable environmental conditions for sensitive production processes.
- **Cleanliness:** Proper cleaning practices to prevent contamination

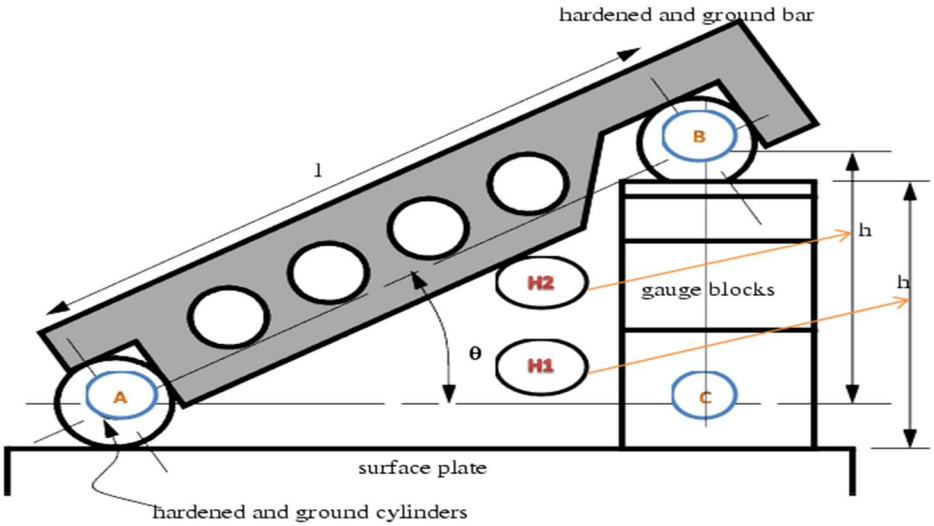
Study approach:

- **Data collection:** Analyze production data, quality reports, employee feedback, and process monitoring metrics.

- **Root cause analysis:** Identify underlying causes of quality issues.
- **Process mapping:** Visualize the manufacturing steps to identify potential bottlenecks.
- **Benchmarking:** Compare performance against industry best practices.

CHAPTER- 2

➢ **Sine bar :-** A sine bar is a precision measuring tool used to measure and set angles. It's made of hardened steel and has two cylinders at its ends. The bar's top surface is parallel to a line that runs through the centers of the cylinders.

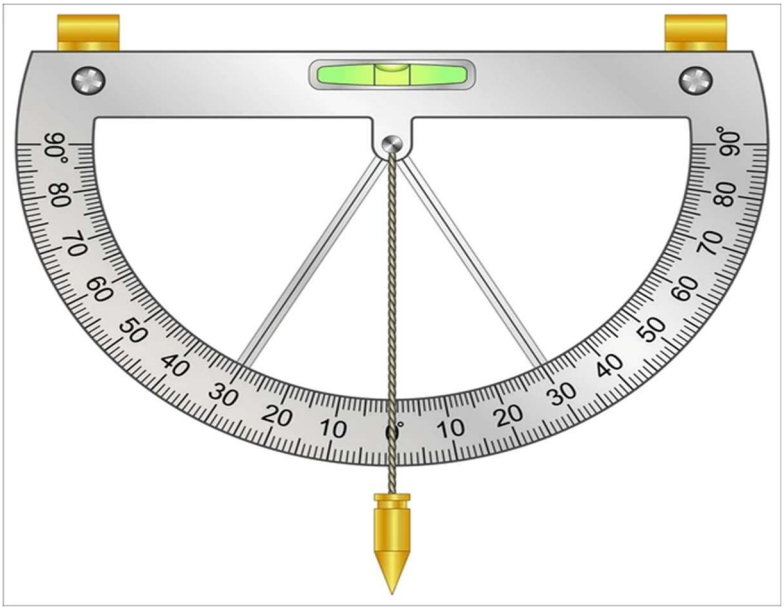


l = distance between centres of ground cylinders (typically 5" or 10")
h = height of the gauge blocks
θ = the angle of the plate

$$\theta = \operatorname{asin}\left(\frac{h}{l}\right)$$

- How it works
- The sine bar forms the hypotenuse of a right triangle.
- The cylinders at the ends of the bar are called rollers.
- One roller is placed on a flat surface.
- The other roller is raised to set the desired angle.
- The difference in height between the two rollers is equal to the sine of the angle multiplied by the distance between the rollers.

2.19:-CLINOMETER:-



A clinometer is a tool that is used to measure the angle of elevation, or angle from the ground, in a right - angled triangle. You can use a clinometer to measure the height of tall things that you can't possibly reach to the top of, flag poles, buildings, trees**.**

- **Comparator**:-A comparator is a device that compares two inputs and outputs a signal that indicates which is larger. Comparators are used in many applications, including chemical analysis, medical diagnosis, and electronics.

- Types of comparators
- **Mechanical comparator**: Compares inputs using mechanical means.
- **Electrical-electronic comparator**: Compares inputs using electrical and electronic means
- **Pneumatic comparator**:

- **Optical comparator**:

- How comparators work
- A comparator compares two voltages or currents
- It outputs a digital signal that indicates which input is larger
- The output signal is usually a 1 or a 0
- The output signal is high if the non-inverting input is greater than the inverting input
- The output signal is low if the inverting input is greater than the non-inverting input

- **CHARACTERISTICS OF A COMPARATOR**:- A comparator should have the following characteristics:

- 1. It should be able to record variations of 0.0025 mm.

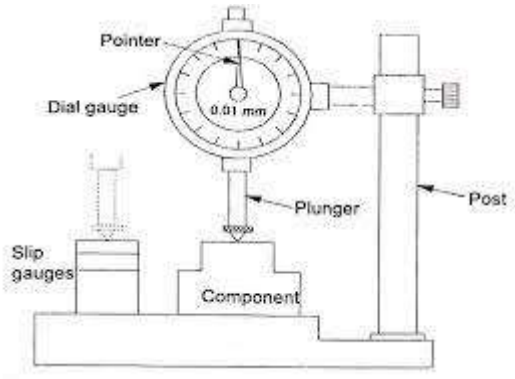
- 2. It should has linear scale

- 3. It should be highly rigid.

- 4. There should be neither lag nor backlash in the movement of the plunger and recording mechanism.

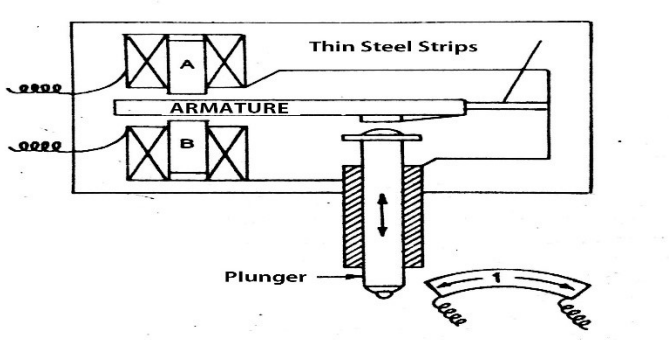
- 5. It should be capable of a wide measuring range.

*__Mechanical comparator:-__



A mechanical comparator is a measuring instrument that utilises mechanical components such as gears, levers, pinions, and racks to achieve magnification, thereby enhancing measurement precision.

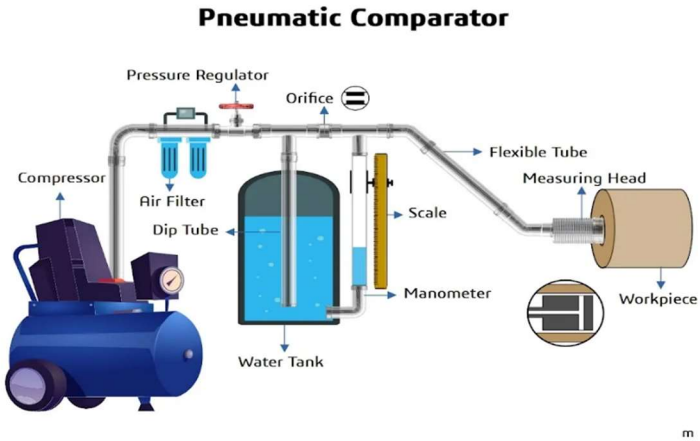
- **Electrical comparator:-** is an electronic circuit that compares two input voltages or currents and outputs a binary signal to indicate which is larger.



How it works

- The comparator compares the two input voltages
- The output is high if the non-inverting input is greater than the inverting input
- The output is low if the inverting input is greater than the non-inverting input .

- **Pneumatic comparator**:- is a precision device operated using a pneumatic system or compressed air. Like other mechanical, optical, and electrical comparators, pneumatic comparators are also used to analyze the dimensional difference between the workpiece to be measured and the standard workpiece



- .
- **Working principle** :-

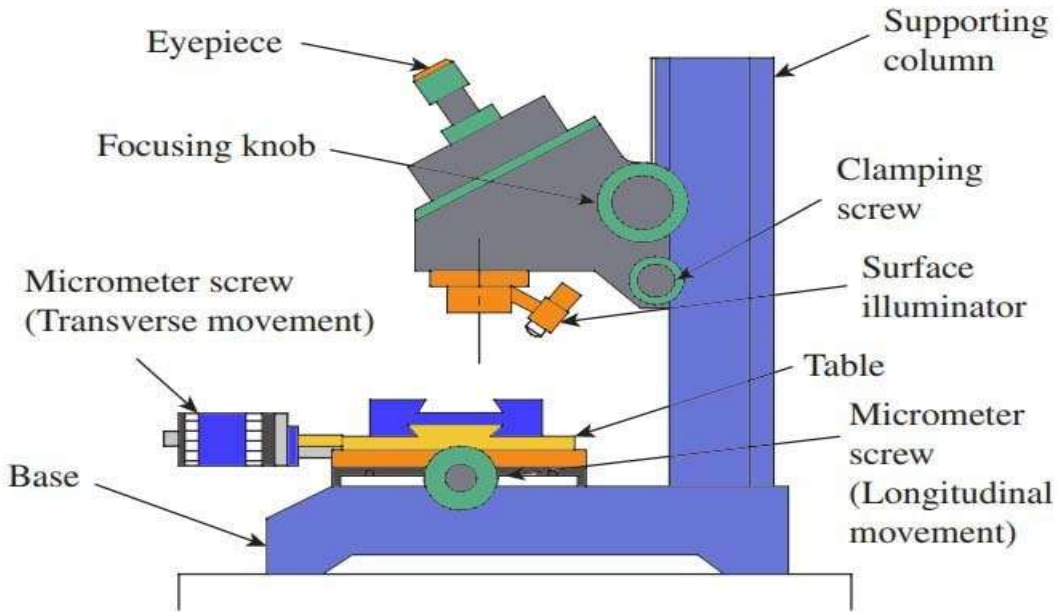
1.A compressed air source supplies air at a constant pressure to the comparator .

2. The air passes through an orifice into an intermediate chamber.
3. The air then passes through a second orifice into the atmosphere .
4. The pressure in the intermediate chamber depends on the size of the two orifices .
5. The difference in pressure is measured.
6. The difference in pressure is represented as a liquid height in an analog comparator, or as a graphical representation in a digital comparator.

- **Slip gauges**:- Slip gauges are precision measuring tools used in metrology to measure length, calibrate instruments, and ensure quality control. They are also known as gauge blocks or Jo blocks.
- How are slip gauges used?
- **Calibrate instruments**: Slip gauges are used to calibrate other measuring instruments, such as micrometers, vernier calipers, and dial indicators.
- **Check accuracy**: Slip gauges are used to check the accuracy of other measuring instruments.
- **Set up sizes**: Slip gauges are used to set up sizes for other measuring instruments.
- **Measure tolerances**: Slip gauges are used to measure tolerances between 0.001 and 0.0005 mm.

2.25:- **TOOL ROOM MICROSCOPE:-** A tool room microscope is a versatile instrument which measures by optical means with no pressure involved. A tool room microscope is designed for the following measurements:

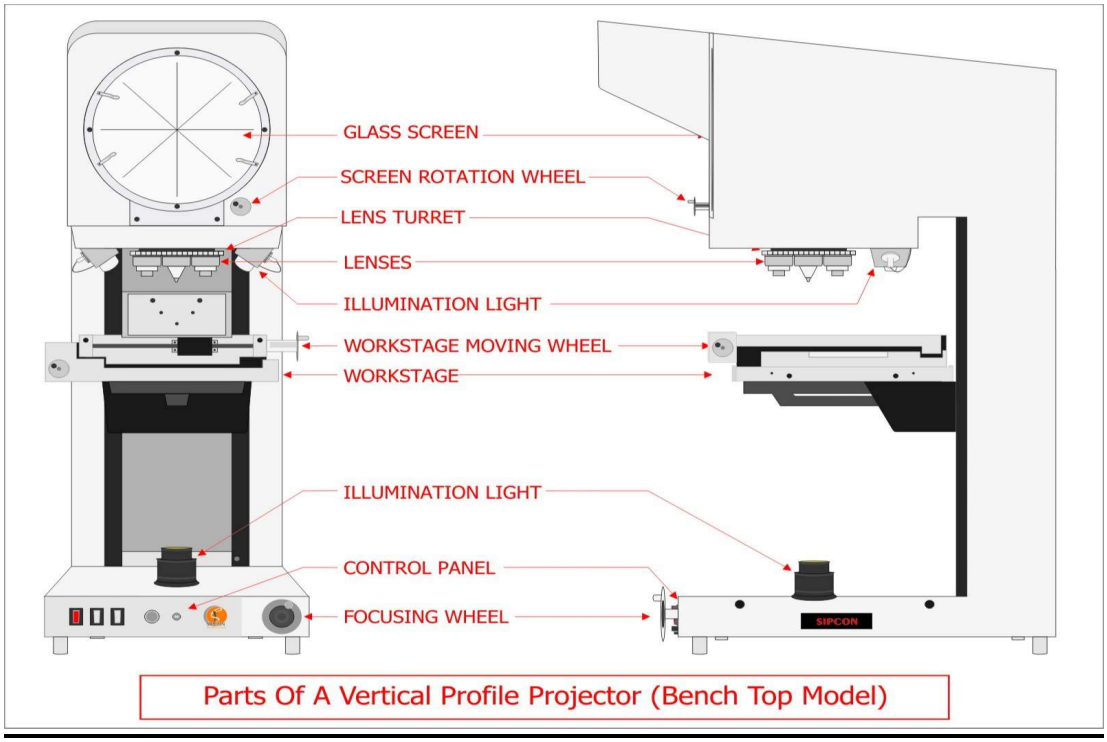
- **Principle of Tool room Microscope** When the light falls on the object, it casts a shadow, as light cannot pass through the object. However, this shadow closely resembles the object's features, allowing for precise measurements to be taken.



- 2.26:-**Profile projector**:- Profile projectors (optical comparators) are a type of optical measuring instrument. The measurement principle is similar to that of optical microscopes. The target is placed on the stage, and a light is shined on the target from underneath. This causes the target's profile, or shadow, to be projected on the screen.

- **How it works**
- Place the object on a surface with a light source
- The light illuminates the object and casts a shadow onto the screen
- The optical system magnifies the shadow
- The magnified shadow is projected onto the screen
- The user uses measuring tools or a digital scale to assess the object's dimensions
- What it's used for

- Profile projectors are used in quality control, reverse engineering, and other industries. They can help identify irregularities or defects in an object's design.



Parts Of A Vertical Profile Projector (Bench Top Model)

CHAPTER -3

- GAUGE :-A gauge is an important measuring device in the field of design engineering. It is a device used to provide

certain dimensional information, according to a specified standard or system. Some gauges are meant to measure the size of the object.

- TYPES OF GAUGE:-

1. According to there type:
   - A).Standard Gauge :-These indicate the accuracy or inaccuracy of a single dimension only . These gauges

     Are made to the nominal size of the parts to be tested and have the measuring member equal in size to the mean permissible dimension of the part to be checked .
   - B).Limit Gauge :- Limit gauges are used to check the dimensions of a manufactured component. As gauges are without scale, we are unable to use it to determine the actual size of dimensions of parts. They are different from conventional measuring tool.

2.According to there purpose:

A).Workshop or working gauge

B).Inspection gauge

B).Reference gauge

3.3. **PLUG GAUGES**: A plug gauge is a tool used to measure the size and shape of a hole. It's a cylinder-shaped

gauge with a "go" section on one end and a "no-go" section on the other.

3.4 RING GAUGE: A **ring gauge**, also known as a **ring gage**, is a cylindrical ring made of a thermally stable material, often steel. Its inside diameter is finished to gauge tolerance and is used for **checking the external diameter of a cylindrical object**. It can have either the maximum or minimum allowable diameter.

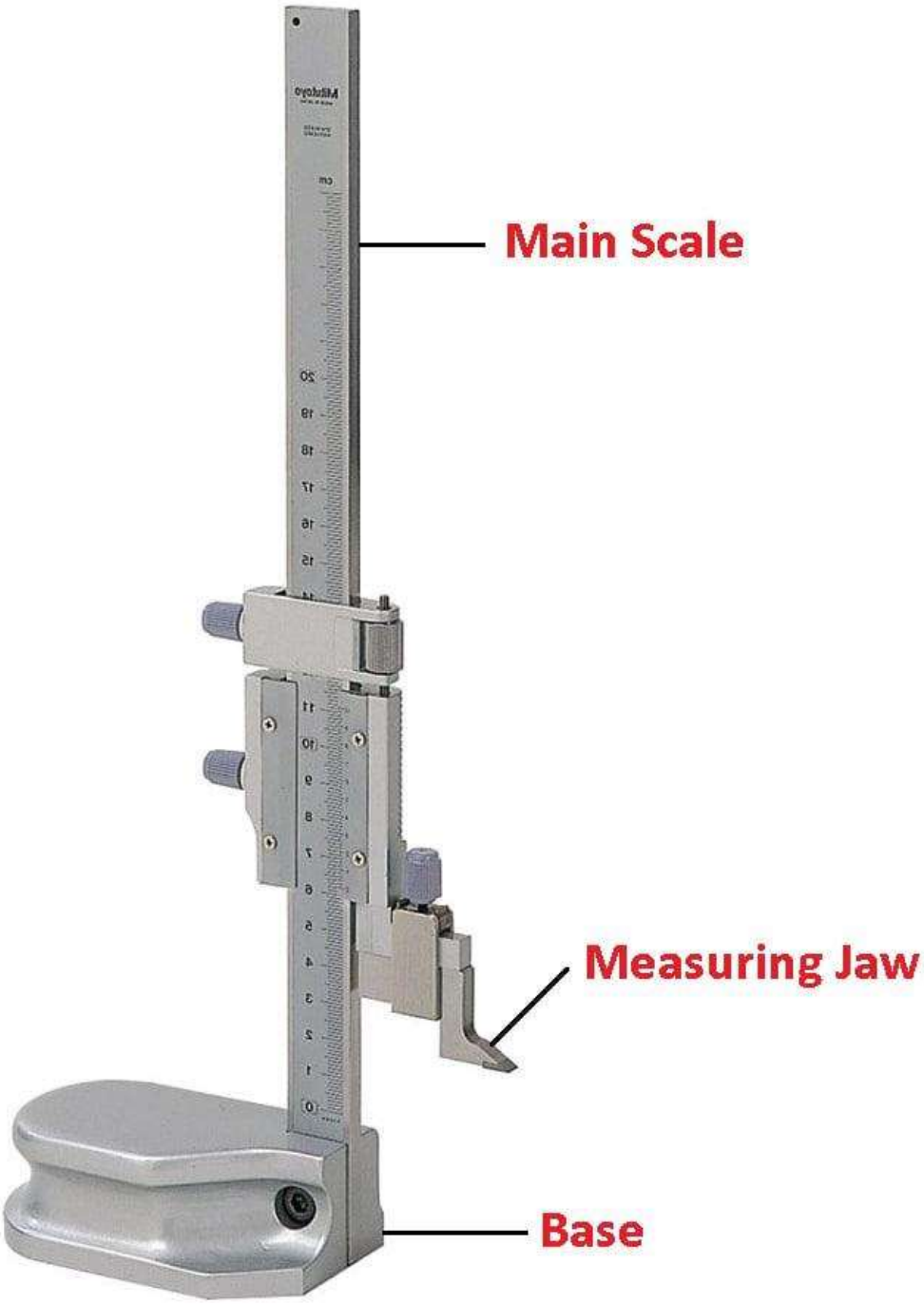
W

3.5 **TAPER GAUGE:-** A taper gauge is a measuring tool used to determine the taper or angle of bores, slots, and gaps. It typically comes in the form of a metal strip that gradually narrows from one end to the other, allowing for the measurement of sizes such as the width of gaps, grooves, and hole diameters. Taper gauges can be made from various materials, including carbon tool steel, stainless steel, and plastic. They are commonly used in fields like flooring technology to assess unevenness and gap dimensions.

3.6 SNAP GAUGE:- Snap gauge are used to checked external dimension .Shafts are generally checked by snap gauge.

3.7 THREAD GAUGE :- A thread gauge, also known as a screw gauge or pitch gauge, is a tool used to **measure the pitch or lead of a screw thread**.

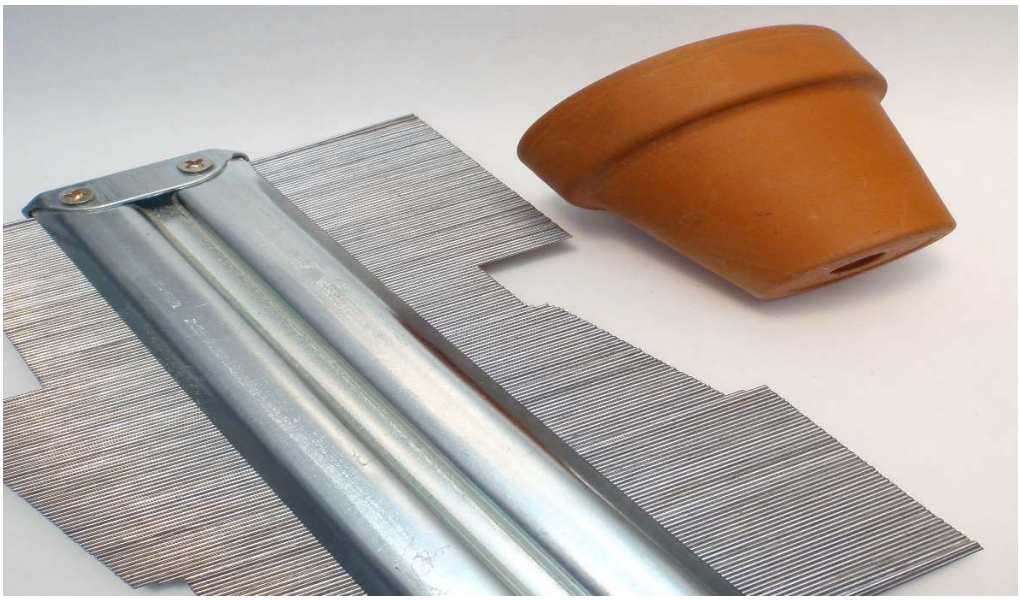
3.8 VERNIER HEIGHT GAUGE :- The vernier height gauge has a vernier caliper, equipped with a special base block, measuring jaw, and other attachments which make the instrument suitable for height measurements. In addition to sliding jaw assembly, provision is provided to carry a removable clamp. The upper and lower surfaces of the measuring jaws are parallel to the base so that they can be used for measurements over or under a surface.



Vernier Height Gauge

3.9 FORM GAUGE:- A profile or form gauge

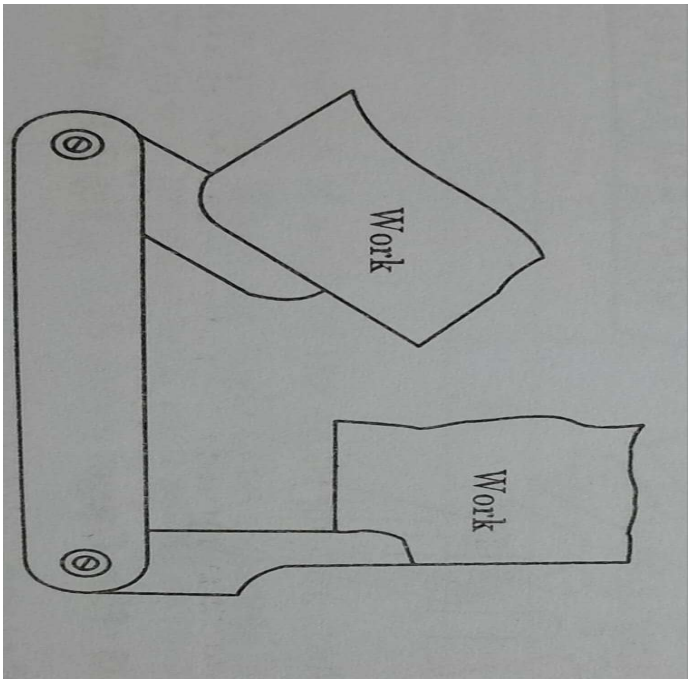
gauge or contour gauge is a tool for recording the cross-sectional shape of a surface. Contour gauges consist of a set of steel or plastic pins that are set tightly against one another in a frame which keeps them in the same plane and parallel while allowing them to move independently, perpendicularly to the frame. When pressed against an object, the pins conform to the object. The gauge can then be used to draw the profile or to copy it on to another surface.



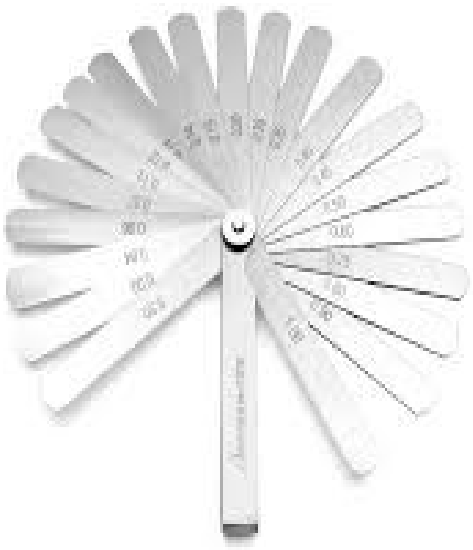
3.11 SCREW PITCH GAUGE :- A screw pitch gauge,

also known as a thread gauge, is a tool used to measure the pitch of a screw thread. It's a useful tool for mechanics to quickly determine the pitch of various threads.

3.12 RADIUS AND FILLET GAUGE:- A radius gauge, also known as a fillet gauge, is a tool used to measure the radius of an object. It's a precision tool used in many industries, including machining, metalworking, tool making and die-making .

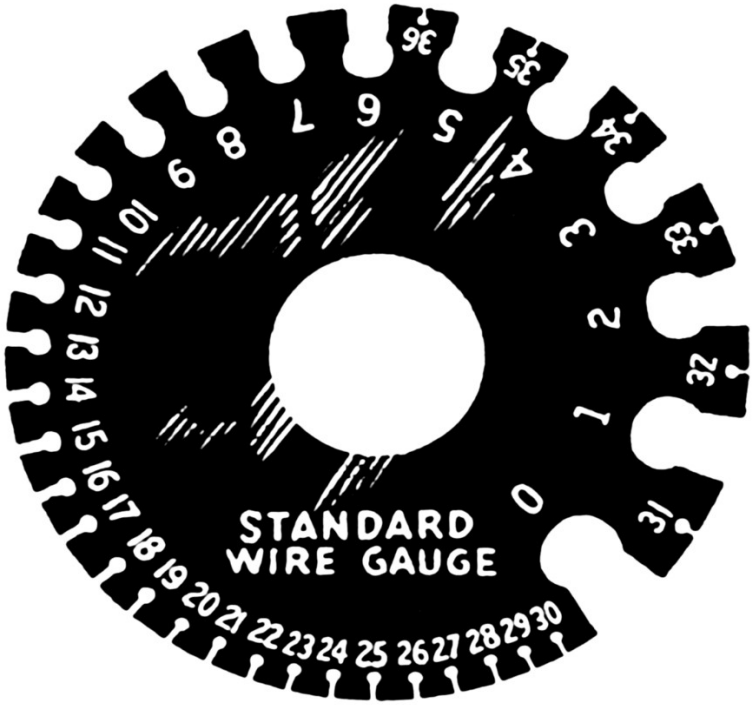


3.13 FEELER GAUGE:- A feeler gauge is a tool used to measure the gap between two objects that are close together. It's a set of thin metal blades of different thicknesses, with each blade marked with its thickness.

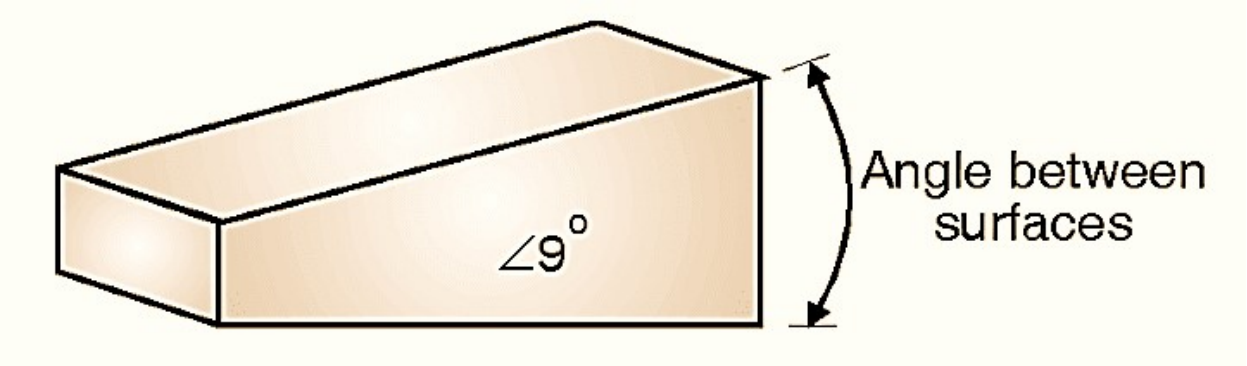


3.14 PLATE GAUGE AND WIRE GAUGE :-

A wire gauge is a tool used to measure the diameter of a wire or the thickness of a sheet of metal. It's also known as a wire diameter gauge or wire thickness gauge.



3.15 ANGULAR GAUGE:- An angle gauge is a tool used to measure and inspect angles. It is used in a variety of industries, including engineering, woodworking and forestry.



3.16 SURFACE GAUGE:- A surface gauge is a tool used to measure and mark distances on a surface. It can also be called a height gauge or height comparator .

3.17 GAUGE TOLERANCE:-the maximum amount that a measurement can deviate from a specified value. It's also known as the gauge's resolution or discrimination.

3.18 Thread measurement:-