Lesson 3

Measuring Instruments – Types and Characteristics

Measuring Instruments …

"The device used for comparing the unknown quantity with the unit of measurement or standard quantity is called a Measuring Instrument."

OR

"An instrument may be defined as a machine or system which is designed to maintain functional relationship between prescribed properties of physical variables & could include means of communication to human observer."

Measuring Instruments …

- Micrometers
- Vernier Calipers
- Dial Indicators
- Telescopic Gauges
- Small Hole Gauges
- Thickness Gauges
- Straight Edge

Measuring Instruments ... (Micrometers)

- Instrument for making precise linear measurements of dimensions such as diameters, thicknesses, and lengths of solid bodies.
- It consists of a C-shaped frame with a movable jaw operated by a screw.
- The accuracy of the measurements depends on the accuracy of the screw-nut combination.

Outside Micrometer

Inside Micrometer

Depth Micrometer

Measuring Instruments …

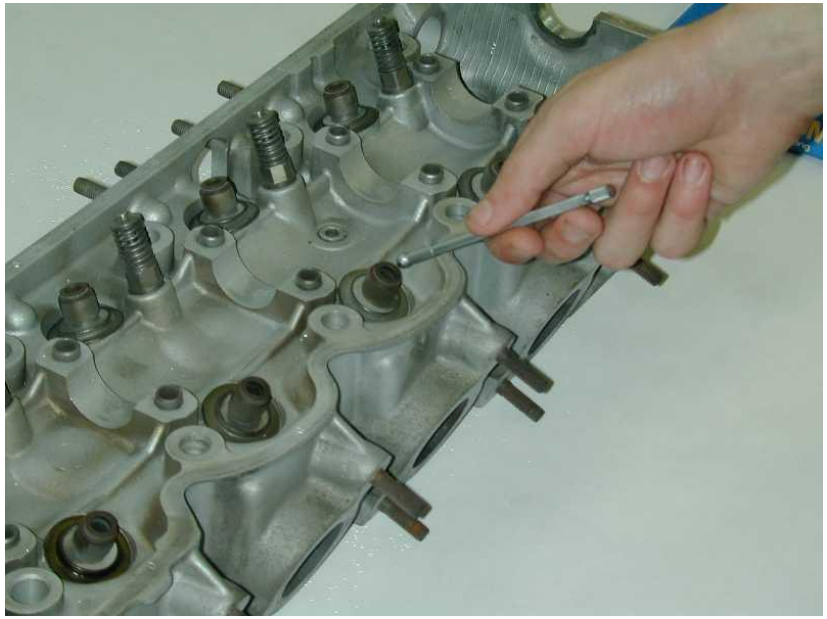
- Combination (**Metric or Imperial at the push of a Button)** Digital Micrometer

- Digital Micrometer

Measuring Instruments …

Telescopic Gauges

- Spring loaded
- Measure large inside dia.



Measuring Instruments …

Dividers or Caliper

- Instrument that consists of two adjustable legs or jaws for measuring the dimensions of material parts.
- Outside calipers measure thicknesses and outside diameters of objects;
- Inside calipers measure hole diameters and distances between surfaces.

Measuring Instruments …

Standard Vernier Caliper

- Instrument for making very accurate linear or angular measurements.
- Introduced in 1631 by Pierre Vernier (*c.* 1580–1637), it uses two graduated scales: a main scale similar to that on a ruler, and a specially graduated scale, the vernier, that slides parallel to the main scale and enables readings to be made to a fraction of a division on the main scale.

Measuring Instruments …

Digital Vernier Caliper

Dial Vernier Caliper

Measuring Instruments …

Dial Indicators

- Any of a number of deviation-type gauges that indicate the amount by which an object being gauged deviates from the standard.
- This deviation is shown in units of measurement, in which movement of a gauging spindle deflects a pointer on a graduated dial

Measuring Instruments …

- Very useful instrument for checking Steering and Suspension components

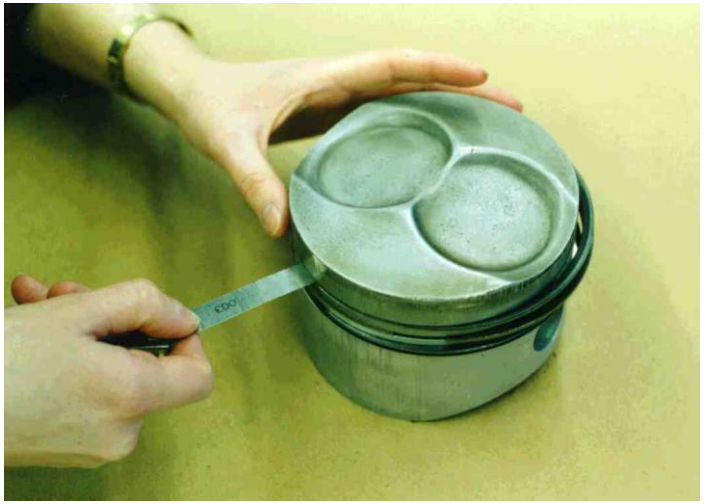
Digital Micrometer

Measuring Instruments …

Thickness Gauges

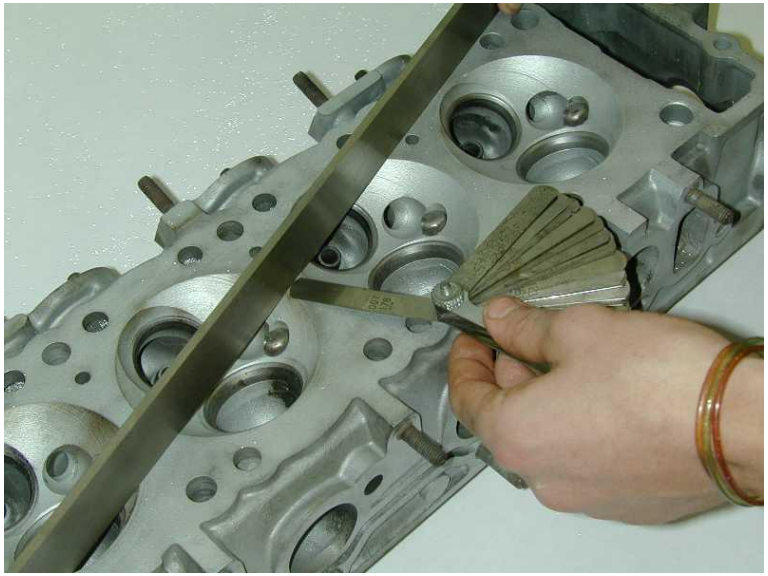
- Consists of thin blades of metal of various thicknesses
- Feeler gages are principally used in determining clearances between various parts of machinery.
  - Various blades are inserted between mating surfaces until a blade of the feeler gage is found that will just slide between the two surfaces without too much friction or sticking.
  - The thickness of the blade then determines the clearance.

- Metric Feeler Gauges



Measuring Instruments …

Straight Edge



- Used in automotive service and machining industry to check straightness of machined mating surfaces

- Straight edge tool

Measuring Instruments …

Measuring Instruments Types…

- **Length measuring Instruments:** ex: Steel rule; Caliper; Micrometer; and comparators.
- **Angle measuring Instruments:** e.g. Angle gauges; Divided scales; Sine bar with slip gauges; Autocollimator; and Tool Maker Microscope.
- **Instruments for surface finish:** surface roughness measurements.
- **Instruments for deviations:** Coordinate Measuring Machine (CMM).

- **Measurement Applications**
  - ✓ **The layout and inspection** performed from a surface plate. The primary purpose of a surface plate is to provide a reference plane.
  - ✓ **Coordinate Measurement**
  - ✓ **Statistical Quality Control**
  - ✓ **Inspection:** Verification of conformity to a standard.

Measuring Instruments …

Measurement Methods …

- **Direct method. compare the quantity directly with the primary or secondary standard.**

- **Indirect method.**

- **Comparison method:** the comparison of an unknown quantity to a known quantity called a standard using Dial Indicator.

Measuring Instruments …

Basic Steps in Development of Instruments …

- Analysis: Incl. e.g. development of mathematical model for identification of parameters to be measured.
- Identification of characteristic features to be possessed by a general Instruments/requirements specification.
- Qualitative and Quantitative models for determination of Instrument design details (ideation & conceptual design).
- Selection of geometrical and physical parameters (detail design).

Measuring Instruments …

Dimensional Metrology Needs

- Linear measurements
- Angular measurements
- Geometric form measurements
  - Roundness
  - Straightness
  - Cylindricity
  - Flatness, etc

- Geometric relationships
  - Parallel, perpendicular, etc.
  - Concentric, runout, etc.
- Controlled surface texture

- **Measurement** is the process of determining or finding the size, quantity or degree of something .
- The principle dimensional measurement is **length**; secondary measurement is **angle and curvature**. *You can describe shape without describing size, but not the reverse.*

Measuring Instruments …

Desirable characteristics of measurement systems…

- To choose the instrument, most suited to a particular measurement application, we must know the system characteristics.
- The performance characteristics may be broadly divided into two groups, namely '***static***' and '***dynamic***' characteristics.

Static characteristics

- the performance criteria for the measurement of quantities that remain constant, or vary only quite slowly.

Dynamic characteristics

- the performance characteristics (e.g., relationship between the system input and output when measuring quantities (measurands)) vary rapidly.

End...