INTRODUCTION TO METROLOGY

Course : Metrology and Measurements

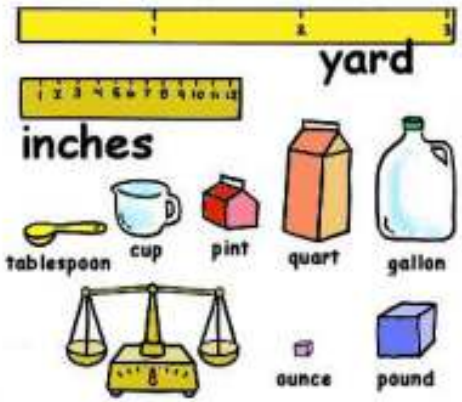
HOW WILL YOU PURCHASE ?

Metrology

- Derived form Greek words Such as ***Metro – Measurement & Logy - Science.***
- BIMP (Bureau of Weights and Measures) ***– " The Science of Measurement, embracing both experimental & theoretical determinations at any level of uncertainty in any field of science & technology"***

Functions of Metrology

- Establishing units of measurement
- Reproducing these units as standards
- Ensuring the uniformity of measurement
- Development of method of measurement
- Analysis of accuracy of methods related to errors.

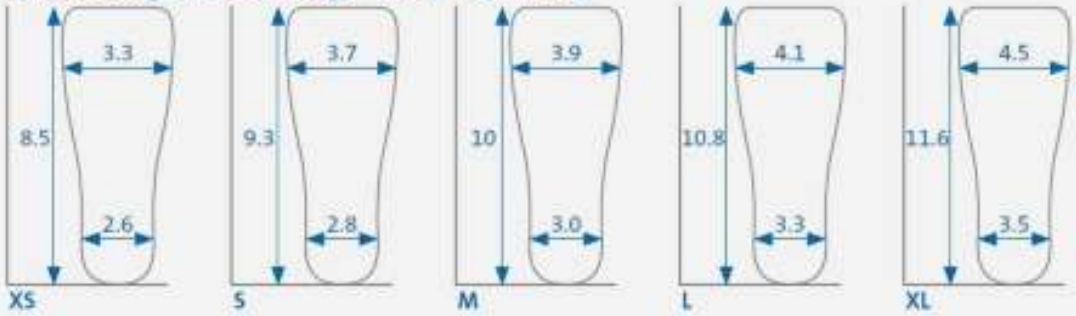


1. Units of Measurement

2. Standards of Measurement

Sizes and Measurements

OrthoWedge®, HeelWedge®, APB®, SlimLine®



Uniformity of Measurement

1000 millimetres = 1 metre

250 millimetres = $\frac{1}{4}$ metre

10 millimetres = 1 centimetre

100 centimetres = 1 metre

50 centimetres = $\frac{1}{2}$ metre

Methods of Measurement

Accuracy

Objectives of Metrology

- Used for selection of proper measuring instrument.
- Used for deciding the proper measuring standards.
- Used for minimizing cost of inspection.
- Determining process capabilities.
- Decide/find tolerances.
- Achieve standardization.
- Maintain accuracy and precision at the time of inspection.

Types of Metrology

- Legal Metrology or Scientific Metrology
- Deterministic metrology or Industrial metrology.

Legal Metrology or Scientific Metrology

- Scientific or fundamental metrology concerns with the **establishment** of quantity system, unit of measurement, the development of new methods etc.
- Applications
  - Commercial Transactions related with net quantity.
  - Industrial measurements, accuracy, interchangeability.
  - Measurement of health.
  - Measurement of human safety.

Industrial Metrology

- It concerns with application of measurement science to **manufacturing and other processes and their use in society**.

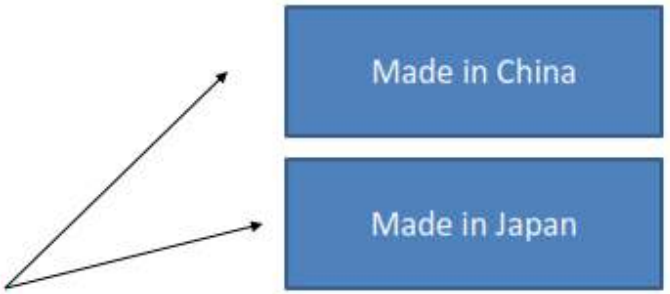
Inspection

- In engineering activities **inspection** involves the measurements, tests, and gauges applied to certain characteristics in regard to an object or activity.

Careful observation

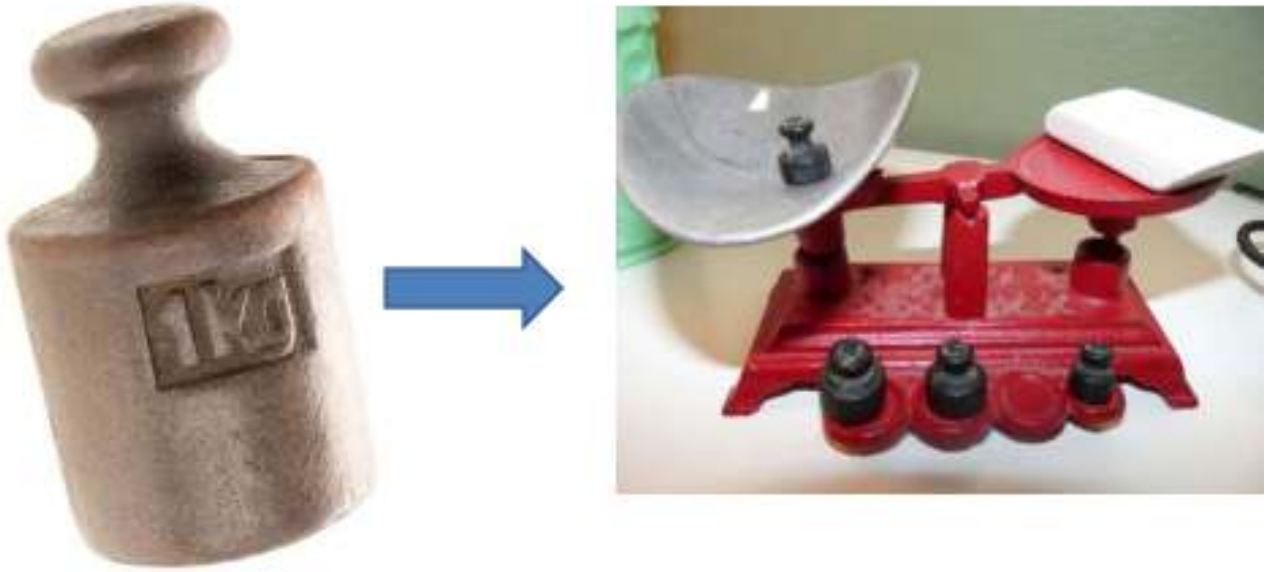
Need of Inspection

- Quality output
- Change in technology
- Mass production
- Save money
- Interchangeability
- To develop reputation



Standards of Measurement

- A ***standard*** is an exact quantity that people agree to use for comparison.



Types of Standards

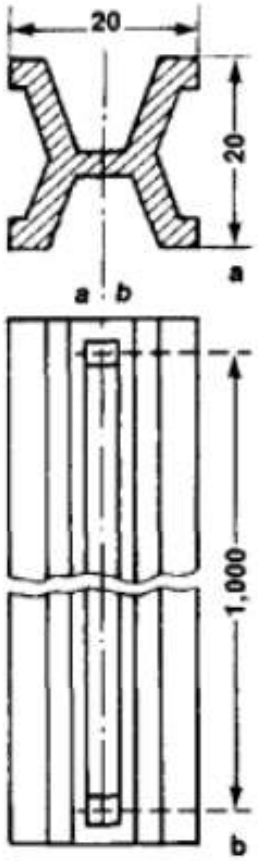
- Primary Standard
- Secondary Standard
- Tertiary Standard
- Working Standard

Primary Standard

- They are material standard preserved under most careful conditions.
- These are not used for directly for measurements but are ***used once in 10 or 20 years for calibrating secondary standards***.
- ***Ex:*** International Prototype meter, Imperial Standard yard.

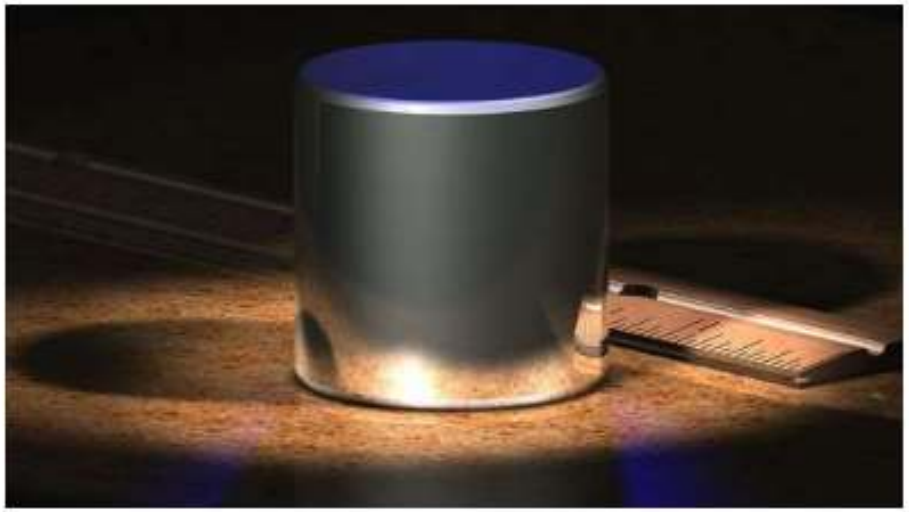
Example : International Prototype Meter

The bars were to be made of a special alloy, **90% platinum and 10% iridium,** which is significantly harder than pure platinum, and have a special X-shaped cross section (a "Tresca section", named after French engineer Henri Tresca) to minimise the effects of torsional strain during length comparisons.



International Prototype Weight

- The IPK is made of a platinum alloy known as "Pt-10Ir", which is 90% platinum and 10% iridium (by mass) and is machined into a right-circular cylinder (height = diameter) of 39.17 millimeters to minimize its surface area.



Secondary Standard

- The value of the secondary standard quantity is **less accurate than primary standard** one. It is obtained by comparing with primary standard.
- These are close copies of primary standards w.r.t design, material & length.

Tertiary Standard

- Maintained in National Physics Laboratories (NPL).
- The primary or secondary standards exist as the ultimate controls for reference at rare intervals.
- They are made as close copies of secondary standards & are kept as reference for comparison with working standards.

Working Standards

- These standards are similar in design to primary, secondary & tertiary standards.
- But being less in cost and are made of low grade materials, they are used for general applications in metrology laboratories

Line Standard

- The standard in which the distance is measured between two straight and parallel lines.
- Example :- ***Steel Rule***
- Advantages
  - Quick and easy
  - Cheaper
- Disadvantages
  - Parallax error can be generated
  - Accuracy Less

End Standard

- When the distance is measured between two flat and parallel surfaces it is called as end standard.
- Example : ***Vernier Caliper, Micrometer***
- Advantages
  - Accuracy of 0.005mm is measureable
  - Minimum possibility of parallax error
- Disadvantages
  - They are costly and difficult to use
  - The measuring surfaces are to be protected.

Wavelength Standard

- Material Standards are subjected to errors due to continuous use because of this wavelength standards are used.
- Light sources like Cadmium 114, Krypton 86 etc. in hot cathode discharge lamp at 68 K.
- According to this
  - 1m = 16507623.73 x Wavelength of Kr 86

Difference between line, end and wavelength standard

Sr. No	Parameter	Line Standard	End Standard	Wavelength Standard
1	Accuracy	Limted ± 0.2 mm	Good ±0.001	Highest
2	Time of Measurement	Quick	Sligthly more than line	Time consuming
3	Effect of Use	Diffecult to assume zero	Ends are harden	Depends on wavelength
4	Errors	Parallax	Wringing errors, environmental error, wear and tear	No error
5	Process	Easy	Slightly difficult	Highly difficult
6	Cost	Low	Medium	High
7	Example	Steel rule	Vernier, Slip gauges	Monochromatic light source
8	Care	Engraved lines must be protected	Measuring ends must be protected	Not affected


thank
you