

# ERRORS IN MEASUREMENT

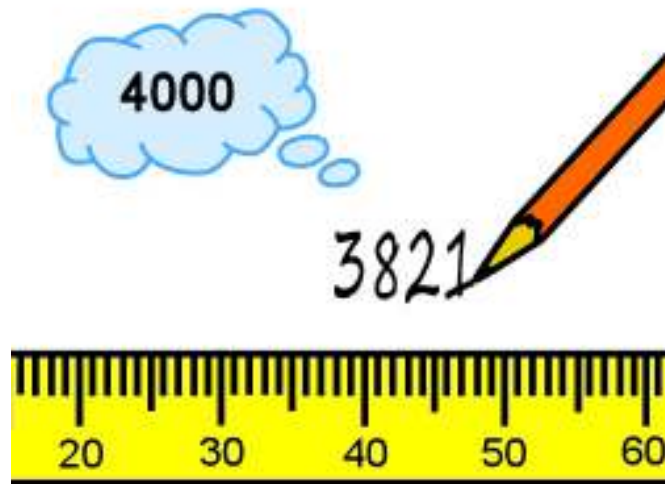
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Course : Metrology and Measurements



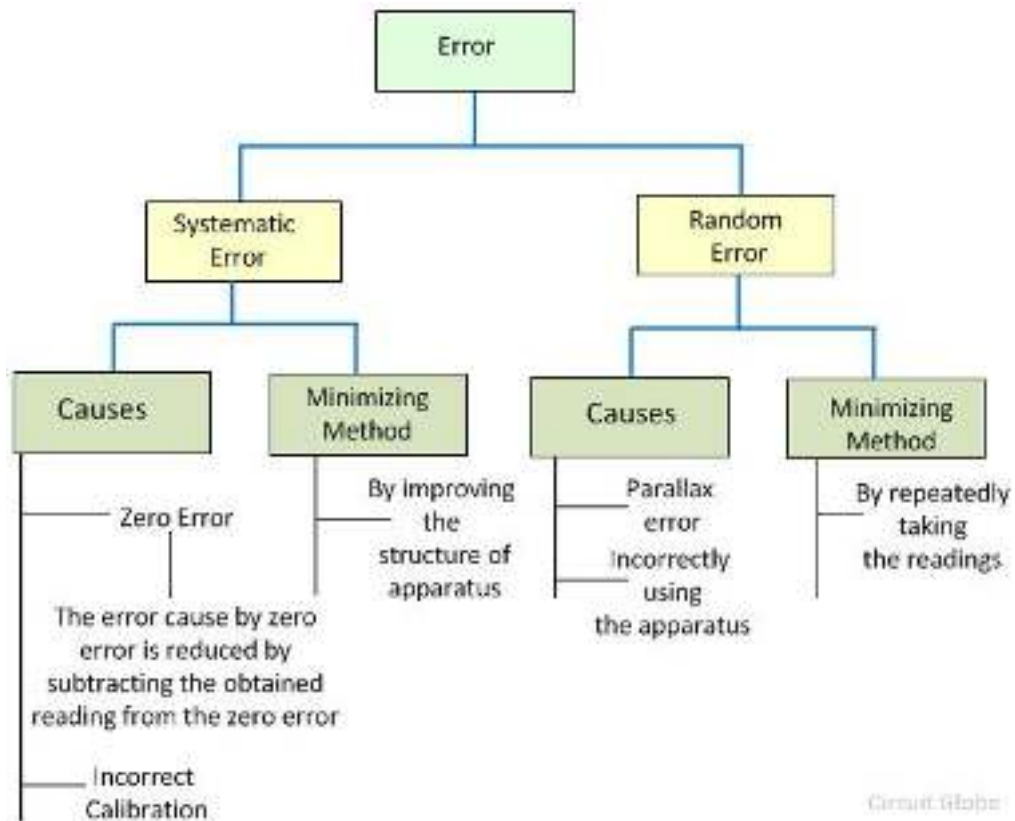
# ERROR

- ✓ The measurement error is defined as the difference between the true or actual value and the measured value.
- ✓ The true value is the average of the infinite number of measurements, and the measured value is the precise value.





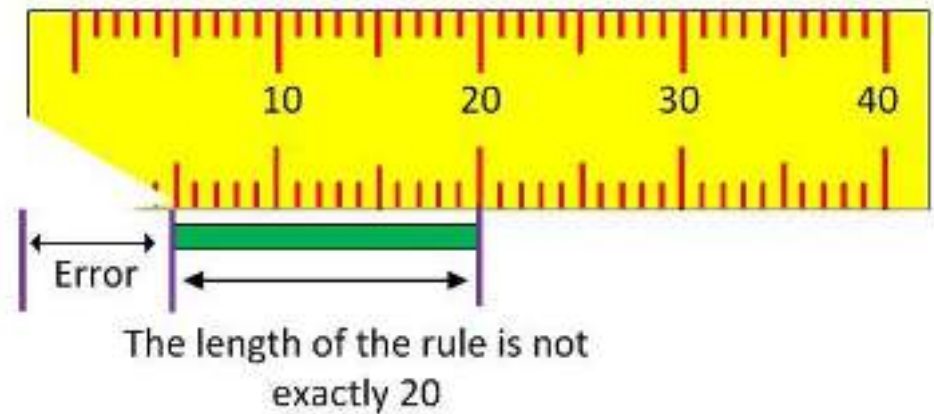
# TYPES OF ERROR





# CONTROLLABLE OR SYSTEMATIC ERRORS

- Calibration errors
- Ambient conditions
- Stylus pressure
- Avoidable errors
- Experimental arrangement





# CALIBRATION ERRORS

- ✓ Actual length of standards as slip gauges – vary from nominal value by small amount
- ✓ Instrument inertia, hysteresis effect
- ✓ Signal transmission error between transducer and electric motor



1. Take away the amount given on the scale (0.5kg)
  - If 2.5kg measured, **true value** is 2.0kg
2. **Swap** for a new device
3. **Recalibrate** the device



# AMBIENT CONDITIONS

- Temperature
- Pressure
  
- Internationally agreed standard value of 20°C
- Pressure -760mm of mercury

# STYLUS PRESSURE

- Definite stylus pressure – both the deformation of workpiece surface and deflection of the workpiece shape will occur

## Contact Pressure Error





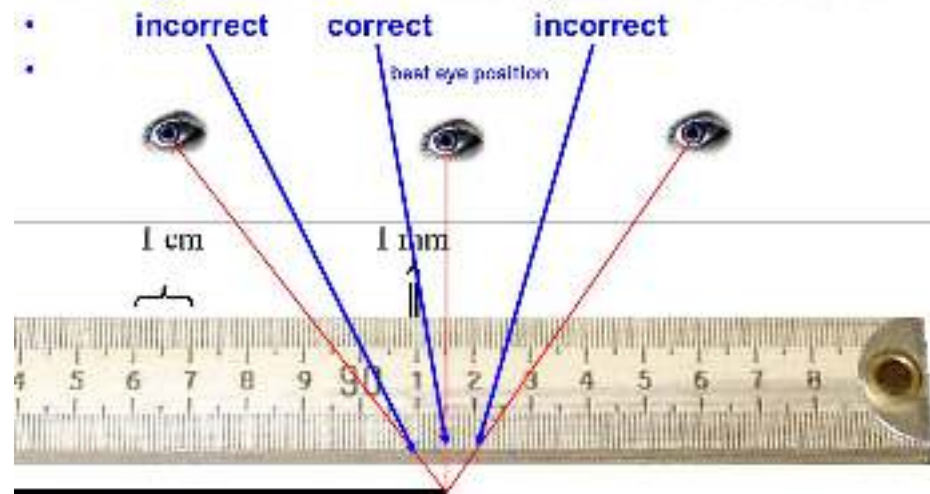
# AVOIDABLE ERRORS

- Parallax errors
- Instrument location



## Parallax When Measuring

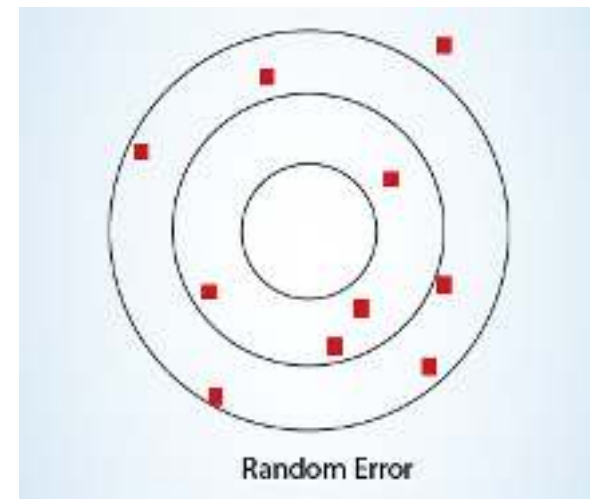
- If the **eye** is **not directly across** from what is being measured, the measuring scale will give an **inaccurate reading**. The line is 91.50 cm long, not 92.10 or 90.90 cm.





# RANDOM ERRORS

- ❖ The error which is caused by the sudden change in the atmospheric condition, such type of error is called random error.
- ❖ These types of error remain even after the removal of the systematic error. Hence such type of error is also called residual error.







# SOURCES OF RANDOM ERROR

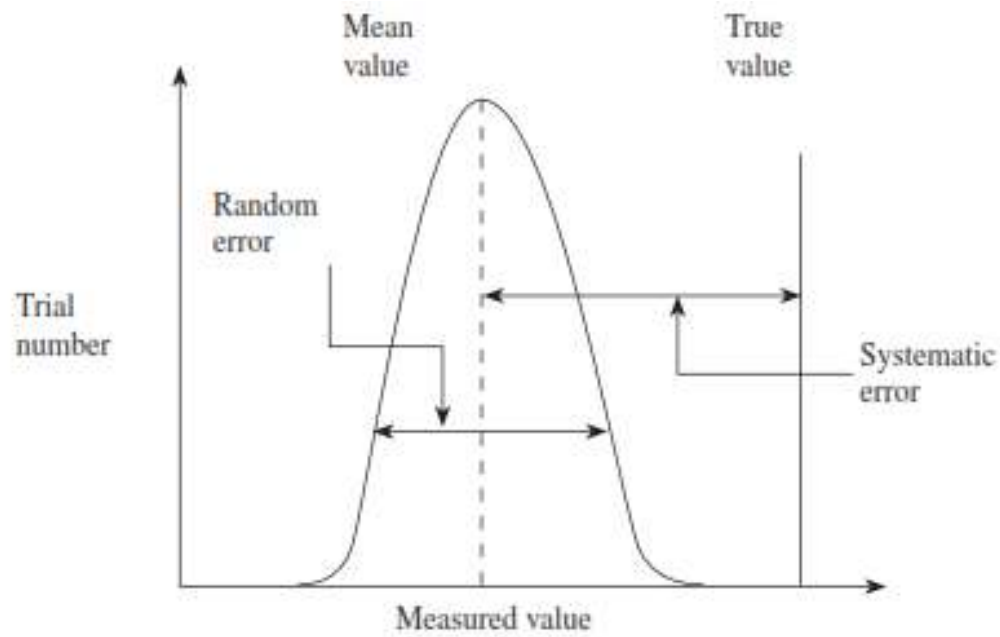
The following are the likely sources of random errors:

- Presence of transient fluctuations in friction in the measuring instrument
- Play in the linkages of the measuring instruments
- Error in operator's judgment in reading the fractional part of engraved scale divisions
- Operator's inability to note the readings because of fluctuations during measurement





# RELATIONSHIP





# DIFFERENCE

Systematic error	Random error
Not easy to detect	Easy to detect
Cannot be eliminated by repeated measurements	Can be minimized by repeated measurements
Can be assessed easily	Statistical analysis required
Minimization of systematic errors increases the accuracy of measurement	Minimization of random errors increases repeatability and hence precision of the measurement
Calibration helps reduce systematic errors	Calibration has no effect on random errors
Characterization not necessary	Characterized by mean, standard deviation, and variance
Reproducible inaccuracies that are consistently in the same direction	Random in nature and can be both positive and negative

