IPE 381
Chapter: 02, 08 & 09
Linear and Angular Measurement

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Measuring the diameter of small bore by Pivoted Stylus and Autocollimator
\[
\frac{D - d}{2} = R \sin \left( \theta + \frac{\beta}{2} \right)
\]
\[
\frac{S - d}{2} = R \sin \left( \theta + \frac{\alpha}{2} \right)
\]
\[
\frac{D - S}{2} = R \sin \left( \theta + \frac{\beta}{2} \right) - R \sin \left( \theta + \frac{\alpha}{2} \right)
\]
\[
D - S = 2R \left[ \sin \left( \theta + \frac{\beta}{2} \right) - R \sin \left( \theta + \frac{\alpha}{2} \right) \right]
\]
Short Notes

2.13: V-Block, Slip Gauge
2.28: Errors in Measurement with Vernier caliper
2.55.1: Telescopic Gauge for Large bore
2.55.2: Hemispherical Gauge for Small Bore
2.56: Pin Gauge for Large bores
2.57: Two Ball method for measuring bore dia
Angular Measurement-Sin Bar

• The sine principle uses the ratio of the length of two sides of a right triangle in deriving a given angle. The measurement is usually limited to 45° from loss of accuracy point of view.
Constructional Features of sin bar on which accuracy depends

(i) The two rollers must have equal diameter and be true cylinders.

(ii) The rollers must be set parallel to each other and to the upper face.

(iii) The precise centre distance between the rollers must be known.

(iv) The upper face must have a high degree of flatness.
Use of Sine Bar

(1) Measuring known angles or locating any work to a given angle.

(2) Checking of unknown angles.

(3) Checking of unknown angles of heavy component.
Limitations of Sine Bars

The sine bars inherently become increasingly impractical and inaccurate as the angle exceeds 45° because of following reasons:

- The sine bar is physically clumsy to hold in position.
- The body of the sine bar obstructs the gauge block stack, even if relieved.
- Slight errors of the sine bar cause large angular errors.
- Long gauge stacks are not nearly as accurate as shorter gauge blocks.
- Temperature variation becomes more critical.
- A difference in deformation occurs at the point of roller contact to the support surface and to the gauge blocks
- The size of gauges, instruments or parts that a sine bar can inspect is limited, since it is not designed to support large or heavy objects.
8.10: Principle of Autocollimator
Angle Measurement

![Diagram of angle measurement setup with labels for illumination, object reticle, beam splitter, objective lens, and mirror surface with angles α and 2α. The focal length f is indicated.]
Miscellaneous Measurement

• Worked Examples
  – Problem 9.2
  – Problem 9.3
  – Problem 9.12