

BFF3302 SENSOR AND INSTRUMENTATION SYSTEM

Standards and calibration

By

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Chapter Description

- **Aims**
 - Obtain basic knowledge about electronic, measurement, sensors, and instrumentation
 - Able to analyse particular sensor, instrument, and measurement situation.
- **Expected Outcomes**
 - Determine general treatment of instrument elements and their characteristic
 - Analyse transducer elements, intermediate elements, and data acquisition system (DAQ)
 - Determine principles of the work and derive mathematical model of sensors for measuring motion and vibration, dimensional metrology, force, torque and power, pressure, temperature, flow and acoustics
- **References**
 - B.C.Nakra and K.K. Chaudhry, 2012. Instrumentation measurement and analysis, 3rd ed., Tata-McGraw-Hill.
 - Introduction to signal processing, instrumentation, and control : an integrative approach / Joseph Bentsman Hackensack, NJ : World Scientific Pub., 2016
 - Transducers for instrumentation / M. G. Joshi, New Delhi, India : Infinity, 2017
 - Instrumentation and measurement in electrical engineering / editor : Harinirina Randrianarisoa, New York : Arcler Press, 2017



Standards and calibration

- Calibration —demonstrates relationship between physical measurement variable (input) & signal variable (output).
- When calibration is used? → **manufacturer tolerances and tolerances of the interface (signal conditioning) circuit are broader/bigger than the required system accuracy** → required to minimize errors.

Standards and calibration

- **Measurement → act of a quantitative comparison between a predefined standard and the unknown magnitude of a physical quantity.**
- **Requirements:**
 1. **The standard that for comparison must well-established, highly accurate and reproducible.**
 2. **The measurement devices & calibration procedures adopted in the act of measurement must have proven reliability.**

Standards of measurements

- Defined as → physical representation of the unit of measurements.
- Classification of measurements standard based on function and type of applications:
 1. **International standards:** are devices designed and constructed to the specifications of an international forum.
 2. **Primary standards:** are devices maintained by standards organisation/national laboratories in different country.
 3. **Secondary standards:** are basic reference standards employed by industrial measurement laboratories.
 4. **Working standards:** are high-accuracy devices that are commercially available and are duly checked and certified against either the primary or secondary standards.

B.C.Nakra and K.K. Chaudhry, 2012. Instrumentation measurement and analysis, 3rd ed., Tata-McGraw-Hill.

Calibration

- → act or result of quantitative **comparison between a known standard and the output of the measuring system** measuring the same quantity.
- The process of calibration is in effect the **procedure** for determining the scale of the measuring system.
- **Estimation** → uncertainty between the **values indicated by the measuring instrument** and **true value** of the input.
- Calibration → process of checking the inferior instrument against a superior instrument of known traceability certified by a reputed standards organisation/national laboratories.
- ‘traceability’ of a calibrating device → certified accuracy when compared with superior standard of highest possible accuracy.

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Calibration

- Routine calibration → periodically checking the accuracy & proper functioning of instrument with standards that are known to be accurately reproducible.
- The usual steps taken in the calibration procedure:
 1. **Visual inspection** → obvious physical defects.
 2. Proper **installation** → accordance with the **manufacturer's specifications**
 3. **Zero setting** of indicators.
 4. Levelling → which require this precaution.
 5. **Operational tests** to detect major defects.
 6. The instrument → **calibrated in the ascending & descending order** of the input values to ensure that errors due to friction/stiction are accounted for.
 7. The calibration device should have superior level of traceability of standard as compared to the calibrated device.

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Conclusion

- Understanding and describe the standards and calibration of the instruments.
- Carried out the right procedure of calibration.