LECETURE 3

Application Considerations of Sensors

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Sensor Systems

- Sensors do not operate by themselves.
- Generally part of a larger system.
- Composition:
  - signal conditioners,
  - various analog or digital signal processing circuits.
Sensor Systems

The system could be a measurement system, data acquisition system, or process control system, et cetera.
Application Considerations

The highest quality, most up-to-date, most accurately calibrated and most carefully selected sensor can still give totally erroneous data if it is not correctly applied.
What is the most difficult tasks facing an instrumentation engineer?
The selection of the proper measuring system.
Why do we need to select the proper measuring system?
obtain accurate, reliable data on each and every measurement.
The instrumentation engineer must carefully analyze every aspect of the test to be performed,

- Test article,
- Environmental conditions
- Analytical predictions (if available).

In most cases, this process will indicate a clear choice of acceptable system components.
Our aim is to assist in the process of selecting an acceptable measuring system.
• For all measurement systems, it is not adequate to consider only that which we wish to measure.

• In fact, every physical and electrical phenomenon that is present needs to be considered lest it contaminate our data.
User must remember that every measurement system responds to its total environment.
Sensor Characteristics
System Characteristics
Instrument Selection
Sensor Characteristics

- The prospective user is generally forced to make a selection based on the characteristics available on the product data sheet.
- Many performance characteristics are shown on a typical data sheet.
- Many manufacturers feel that the data sheet should provide as much information as possible.
● The instrumentation engineer must be sure he or she understands the characteristics and how they will affect the measurement.

● If there is any doubt, the manufacturer should be contacted for clarification.
Sensor and signal conditioners must be selected to work together as a system.

Overall system accuracy is usually affected most by sensor characteristics.
Selecting a sensor/signal conditioner system for *highly* accurate measurements requires very *skillful* and *careful* measurement engineering.
Must be considered:

- All environmental,
- mechanical, and
- measurement conditions.
- Installation must be carefully planned and carried out.
SOME GUIDELINES
The following guidelines are offered as an aid to selecting and installing measurement systems for the best possible accuracy.
Sensor

The most important element in a measurement system is the sensor. If the data is distorted or corrupted by the sensor, there is often little that can be done to correct it.
Will the sensor operate satisfactorily in the measurement environment?

- **Check:**
  - Temperature Range
  - Maximum Shock and Vibration
  - Humidity
  - Pressure
  - Acoustic Level
  - Corrosive Gases

- Magnetic and RF Fields
- Nuclear Radiation
- Salt Spray
- Transient Temperatures
- Strain in the Mounting Surface
Will the sensor characteristics provide the desired data accuracy?

- **Check:**
  - Sensitivity
  - Frequency Response
  - Resonance Frequency
  - Minor Resonances
  - Internal Capacitance
  - Transverse Sensitivity
  - Amplitude Linearity and Hysteresis
  - Temperature Deviation
  - Weight and size

- **Internal Resistance at Maximum Temperature**
- **Calibration Accuracy**
- **Strain Sensitivity**
- **Damping at Temperature Extremes**
- **Zero Measurand Output**
- **Thermal Zero Shift**
- **Thermal Transient Response**
Is the proper mounting being used for this application?

- Check:
  - Is Insulating Stud Required?
  - Ground Loops
  - Calibration Simulation
  - Is Adhesive Mounting Required?
- Thread Size, Depth and Class
Reminder

Cable

- Will the cable operate satisfactorily in the measurement environment?
- Will the cable characteristics provide the desired data accuracy?
power supply

- Will the power supply operate satisfactorily in the measurement environment?
- Is this the proper power supply for the application?
- Will the power supply characteristics provide the desired data accuracy?
Amplifier

- Will the amplifier operate satisfactorily in the measurement environment?
- Is this the proper amplifier for the application?
- Will the amplifier characteristics provide the desired data accuracy?
Data Acquisition and Readout

Does the remainder of the system, including any additional amplifiers, filters, data acquisition and readout devices, introduce any limitation that will tend to degrade the sensor-amplifier characteristics?

Check: ALL of previous check items, plus Adequate Resolution.
Installation

Even the most carefully and thoughtfully selected and calibrated system can produce bad data if carelessly or ignorantly installed.
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Application Considerations

https://endeveco.com/
When the above questions have been answered to the user’s satisfaction, the measurement system has a high probability of providing accurate data.
Homework  （Materials for the Seminar course）

• Please discuss the application considerations of the sensor and the measurement system you chosen at the last time with a example.

• You need to report them in the seminar course.
THANK YOU!