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methods and data comparability board

Field Sensors

A Manufacturer's Perspective

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Specifications

- Protocols for field sensors are defined by the vendors
  - Ambient monitoring is non-regulated; not standardized except for safety standards (UL, CE, FCC)
- Challenge for manufacturers:
  - How to demonstrate advantages over competition
  - How to define specifications so that they are repeatable and defendable
  - How to mimic sample and environmental conditions
- Specifications often incorporate features and functions

What Does This All Mean?

- Specifications tell the vendor that:
  - The product is ready for “prime time”
  - Which applications suit the technology best
  - Which applications to avoid
    - Reduces post-sale warranty claims, customer complaints
    - What are the interferences?
- Specifications tell the customer:
  - That the instrument will perform competitively
  - That the instrument will suit the desired application
  - The general conditions under which a technology is expected to perform without failure or excessive maintenance
    - E.g., ambient and sample temperature ranges

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Testing Environment

- Testing is performed in a “perfect” world
  - Controlled conditions where test variables can be separated out and evaluated one at a time
  - Validation of sensor performance is performed in a purified environment using standards/ surrogates
    - Interferences are minimized or eliminated
  - Testing must be repeatable in so it can be redone when the product incurs changes
    - Component changes, material changes, manufacturing changes, etc.

The same conditions exist for the test of laboratory or bench methods




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The Test Location

- Most testing is performed in a lab setting
  - Control water quality and its composition
  - Control both ambient and water temperatures
  - Control flow rates
- Environmental testing chambers
  - Determine operational ranges with respect to temperature, humidity (condensing and non-condensing)
  - Sample temperature
  - Life testing through accelerated test protocols (involving elevated temperatures)
  - Test conditions must be controlled to the extent that they can be repeated when deemed necessary

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Field Testing

- Involves the Installation of the measurement system at a given site that is deemed “typical”
  - Long-term
  - Customer feedback
  - Typically find failures that are missed in the laboratory
  - Expensive!

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Manufacturer's Expectations

- Calibration standards meet the accuracy requirements desired by the customer (Instrument error + matrix error = total error)
- Suitable site selection criteria to determine desired results within the instrument's capability
- Understanding of interferences within the matrix being tested

Testing Environment

- Why not test everything in a real world environment?
  - The environment is not controlled / Difficult to determine cause of either failure or excellence
  - Cost associated with natural testing
  - Manufacturer cannot cover all sample types or applications

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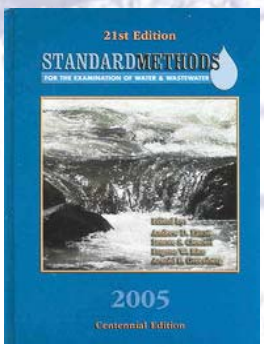
Example: Temperature

- Validation
  - Accuracy: Side-by-side testing with a NIST-calibrated thermometer. Reference instrument must be at least 3x as accurate as the sensor being validated.
  - Precision: How often do repeated measurements agree under identical conditions?
  - Range: What range does it meet accuracy? What is the operating range?
  - Response time: How long does it take to stabilize?
  - Accelerated life: Does the sensor drift? After how long? Does it meet the test of time?
  - No interferences to this type of parameter when measured in-situ

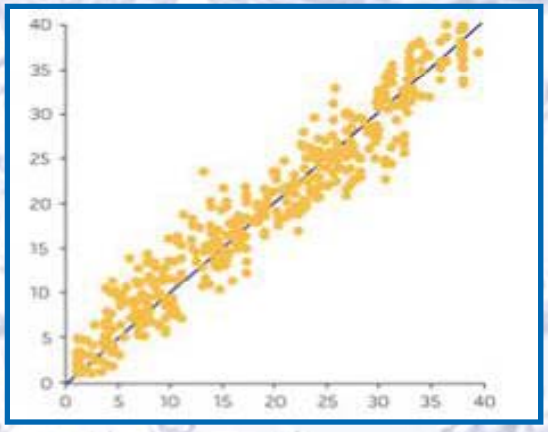
Specifications and Application

- The purpose is to prove that the technology performs to a certain level of performance
  - Examples: Stated Accuracy, response time, detection limit
  - There are few consensus methods or procedures that define or determine many of the most common specifications
  - Specifications do not guarantee how an instrument will perform in the real world
- Specifications provide a means of proving that the instrument is capable of analytical measurement using a given method.



Example: Dissolved Oxygen

- Validation
  - Accuracy: Across DO concentration and temperature as compared with an established method.
  - Precision: How often does it measure within that accuracy?
  - Range: What range does it meet accuracy? What is the operating range?
  - Response time: How long does it take to stabilize?
  - Accelerated life: Does the sensor drift? After how long? Does it meet long-term test criteria?
  - Applications: abrasion, response time



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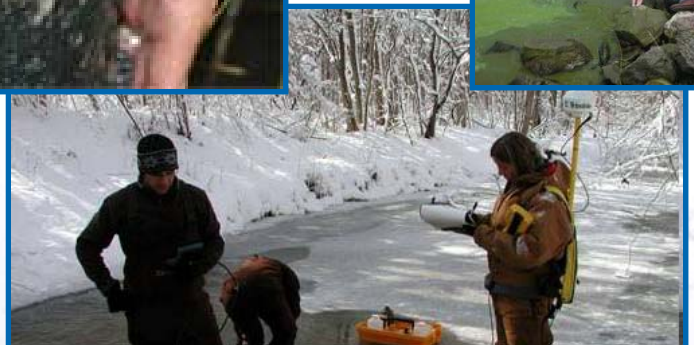
What should the user do?

- Understand your sample
- Question the manufacturer on measurement of your “type” of sample.
- Ask the manufacturer to define the specifications and provide the means (method) used for their determination
- Question these specs to meet your monitoring goals (ambient range, robustness, cost of ownership (operation and maintenance)






What will the manufacturer do?

- Create consistency in reporting specifications
- Follow the guidelines established by the Aquatic Sensors Workgroup
- Guide customers to a consistent data collection format

Data of Known Quality and Documentation-- the Goal of Everyone!