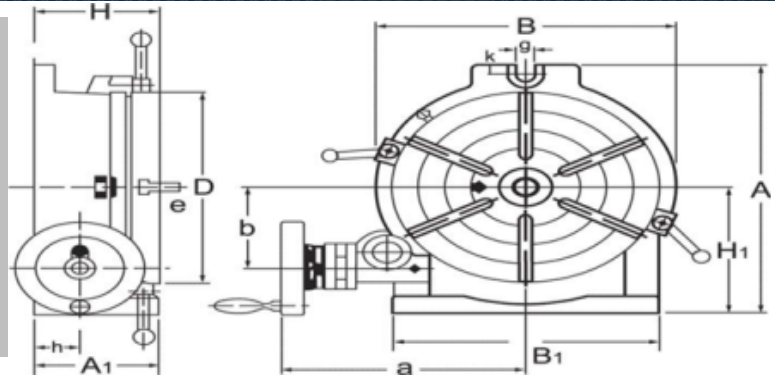
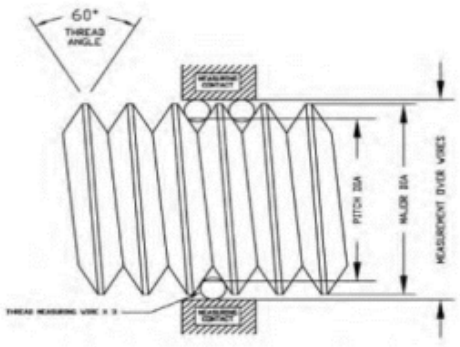
SAND2022-13293C

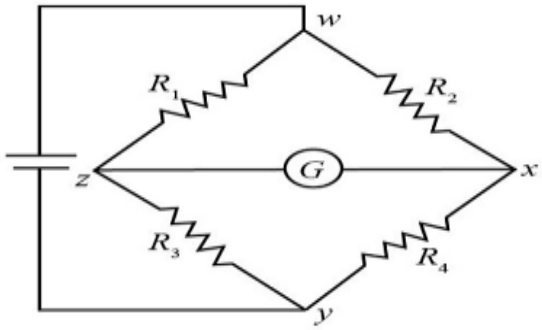
Primary Standards Laboratory

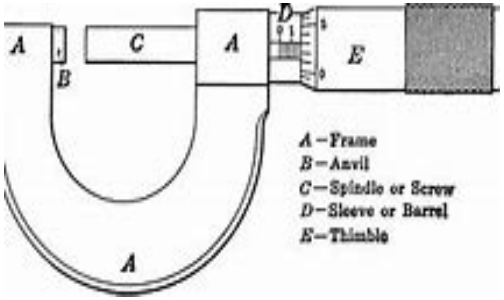
Exceptional service in the national interest

Sandia National Laboratories









Developing Calibration Methods that Work

A PSL R&D Summit Presentation

by Barry Roberts

U.S. DEPARTMENT OF ENERGY

NNSA

Sandia National Laboratories is a multimission laboratory managed and operated by National Technology and Engineering Solutions of Sandia, LLC, a wholly owned subsidiary of Honeywell International, Inc., for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-NA0003525.

Sandia National Laboratories is a multimission laboratory managed and operated by National Technology & Engineering Solutions of Sandia, LLC, a wholly owned subsidiary of Honeywell International Inc., for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-NA0003525.

What is this about?

- *Goal*: Develop calibration methods for the Mechanical Calibration Laboratory that produce consistent, correct, and credible results.

ISO/IEC 17025

General requirements for the competence of testing and calibration laboratories

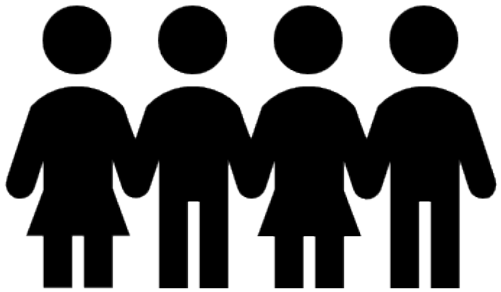
- *Problem*: To support high volumes of calibration work across a variety of measurement disciplines, the Mechanical Calibration Laboratory needs to replace legacy methods with new high, integrity calibration methods.

- *Solution*: Apply a systematic approach to replace all of the legacy calibration methods with methods that foster confidence and produce reproducible, defendable results.

Primary Standards Laboratory

What are Successful Calibration Methods?

- Methods that can be readily implemented.
- Methods that produce consistent results.
- Methods that are inherently defendable.
- Methods that are developed in collaboration with end users (metrologists).
- Methods that meet or exceed ISO/IEC 17025 quality requirements.



Primary Standards Laboratory

Aspects of Successful Calibration Methods

- Align the order of data entry in software with the procedural steps.
- Use consistent terminology in software and procedure.
- Keep the software transparent.
- Use prompts, explanatory notes, and diagrams.

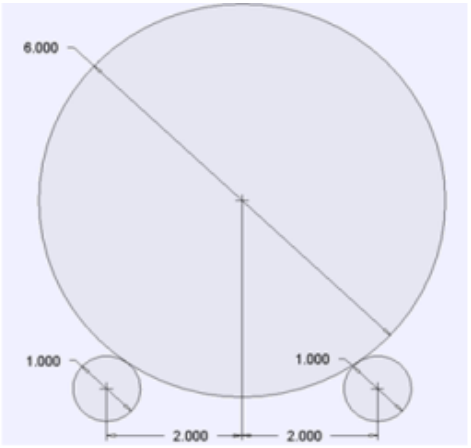
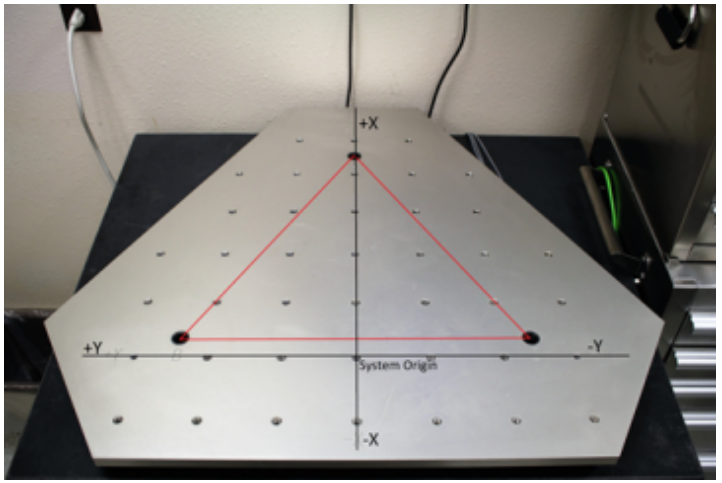


Figure 2. Weight position. The weight schedule prescribes pin locations and which side of the pins where the weight must rest.



Primary Standards Laboratory

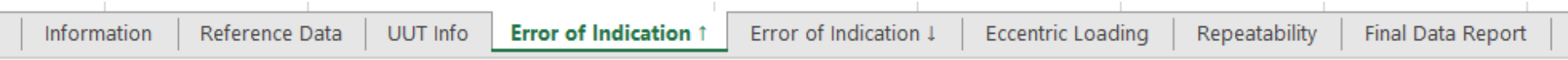
Calibration Software for Success

- Align the order of data entry with the steps in the procedure.
- Use consistent prompts and style.
- Use conditional statements to:
  - Keep calculations from reporting nuisance errors (e.g. division by zero) when the data entry is incomplete.
  - Flag entries that are problematic.
- Conduct trials and solicit feedback during software development.
- Innovate!
  - Consider adding photographs or drawings to your spreadsheet.
  - Data plots tell the story better than an entire army of data points.

Primary Standards Laboratory

Spreadsheet Features in Mechanical Calibration

- Information Sheet, example: SS-MCP-1011
  - Log changes
  - Instructions
  - Technical or Theory Information
- Reference Sheet, example: SS-MCP-1011
  - Tabulated Data / Standard Reference Data / Certification Data for Specific Standards
- Familiar appearance
  - Fields that require input are color shaded
  - Significant results are shown in bold type
  - Drop-down lists are frequently used
  - Conditional formatting alerts the metrologist of problematic results



Primary Standards Laboratory

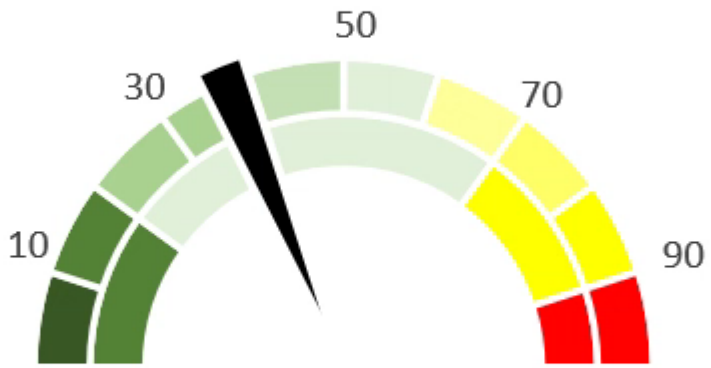
Example: Flexible Units

Unit Under Test Information				
Asset No.	Example		Date	9/14/2022
Serial No.	123		Work Order No.	abc
Visual Inspection				
General State of Unit				
Temperature		°C		
Display Resolution of Balance				
Balance Tolerance, Percent of Reading		%		
Balance Tolerance, Fixed				
Eccentricity Tolerance				
Repeatability Tolerance				

Primary Standards Laboratory

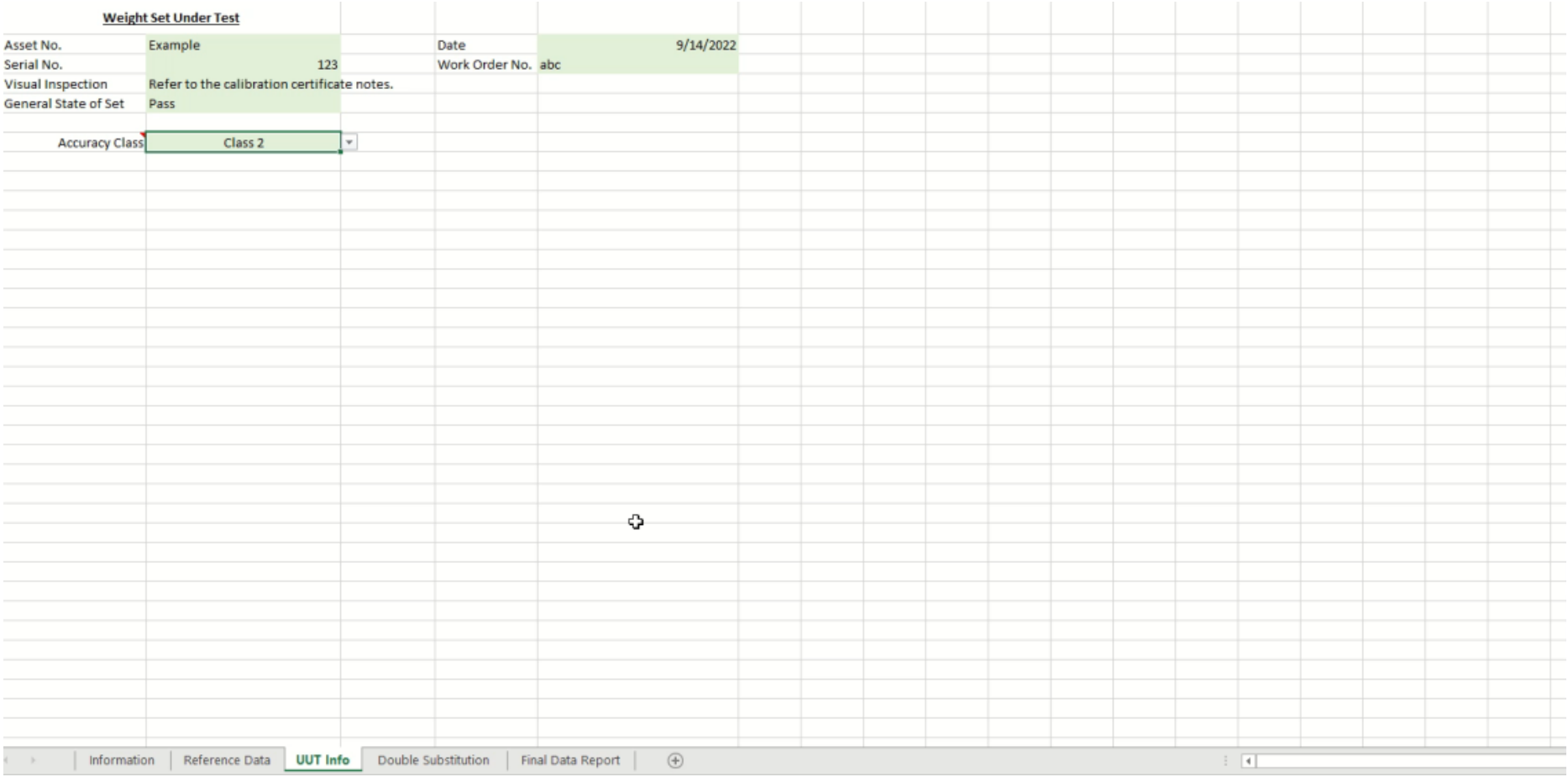
Example: Percent of Tolerance Gauge

Label	Value			
Percent of Tolerance	35	%		
Uncertainty	5			
Rest	160			



Primary Standards Laboratory

Example: Preloaded Accuracy Class



Weight Set Under Test

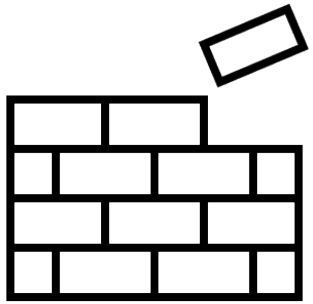
Asset No.	Example	Date	9/14/2022
Serial No.	123	Work Order No.	abc
Visual Inspection	Refer to the calibration certificate notes.		
General State of Set	Pass		
Accuracy Class	Class 2		

Information | Reference Data | UUT Info | Double Substitution | Final Data Report

Primary Standards Laboratory

Implementation Status

- Legacy methods still dominate. The newest of the legacy procedures are at least 6 years old and the bulk are well over 10 years old.
- Several calibration methods have been brought into service over the last year that meet the level of rigor that is now required. Each new method requires a significant time investment.
- Mechanical Calibration is shifting to a second stage of method development with the creation of a calibration method team.
  - Increased rate of method development
  - Peer review practices
  - Greater distribution of expertise



Primary Standards Laboratory

Conclusion

- Successful calibration methods include procedures, software, training, equipment, standards, and metrologists!
- Totally replacing the legacy calibration methods will require years of effort.
- Adopting a systematic approach will improve the rate of method development and ensure consistent results.
- The new calibration methods have been well received by the metrologists that use them.

- Thanks to Mechanical Calibration Laboratory