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| PPPL | PRINCETON PLASMA PHYSICS LABORATORY | PROCEDURE | No. ENG-002 Rev 3 page 1 of 8 |
| Subject: Control of Measuring Test Equipment and Calibration | Effective Date: February 12, 2018 | Initiated by: Head, Engineering Department | |
| | NEW | Approved: Director | |
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Management System (Primary): 03.00 Engineering
Management System Owner: Head, Engineering Department
Management Process: 03.04 ES&H - Construction Safety / Industrial Safety
Process Owner: Head, Engineering Department
Sub-Process: 03.04.04 Calibration of Measuring and Test Equipment (M&TE)
Sub-Process Owner: Head, Project Management
Subject Matter Experts (SMEs): Head, Fabrication Group

Applicability

This procedure defines PPPL's system to control Measuring and Test Equipment (M&TE) used at the Laboratory. Calibrated M&TE is required for Graded Approach (Classifications A1, A2, and A3).

Introduction

M&TE are those items which are used to measure, gauge, troubleshoot, test, inspect, or verify conformance to specified requirements.

A list of M&TE shall be maintained in a Calibration Database, which tracks when calibrations are done and when they expire, location of the M&TE, and the Custodian. The database is updated by the Custodian (see Attachment 1).

M&TE shall be clearly labeled with the last calibration date, or are assumed to be not calibrated and may only be used for indicator only use. Users are responsible for using calibrated M&TE for acceptance measurements and testing for all quality levels.

Calibrations may be performed in one of PPPL's Calibration Laboratories or by a certified external facility. In all cases, calibrations shall be traceable to the National Institute of Standards, and shall be performed using the methods specified by the manufacturer or an accepted industry standard.

Calibration Labs - There are four Calibration Laboratories within PPPL: the Electrical/Electronic Calibration (EEC) Lab, the Quality Assurance Inspection Lab (QAIL), the PPPL, Environmental, Analytical and Radiological, Laboratory (PEARL) and Health Physics Calibration & Services Laboratory (HP CASL). Calibration methods for the tools, gauges, and electrical/electronic instruments are specified and maintained in the respective Calibration Lab

Departmental Procedures Manuals, or from calibration instructions provided in the equipment manufacturers' documentation maintained in the respective Calibration Lab. Each calibration Laboratory uses reference standards which are traceable to the National Institute of Standards.

The data records collected when calibrating M&TE is maintained in a database for the Mechanical and Electronic M&TE. The database is maintained by the database administrator who is identified in the Calibration Laboratory and Shop list maintained on the Engineering website:

<http://engineering.pppl.gov/PPPL%20Calibration%20Laboratories%20and%20Shops.pdf>

The **Electrical/Mechanical Calibration Laboratory** performs testing, repair, and calibration of electrical, electronic and mechanical measuring devices.

Categories of electrical/electronic devices submitted to the Calibration Lab for calibration include: analog and digital meters, oscilloscopes, probes, recorders, amplifiers, analyzers, bridges, counters, generators, megohmmeters, and hi-pot testers.

Categories of mechanical measuring devices submitted to the Calibration Lab for calibration include: gage blocks, micrometers, height gages, calipers, slot-in-groove gages, go-no-go gages, and dial test indicators.

The Electrical/Mechanical Calibration Laboratory maintains calibration data and calibration certificates in the Laboratory Calibration File for calibration traceability of electronic and mechanical measuring devices.

The **Quality Assurance Inspection Laboratory** performs inspections of purchased components and machined parts.

A set of gage blocks are maintained by the Inspection Laboratory for calibration of M&TE by qualified Quality Assurance personnel.

The Quality Assurance Inspection Laboratory maintains calibration data and calibration certificates in the same Calibration Laboratory Calibration File as the Electrical/Mechanical Calibration Laboratory.

The **PPPL, Environmental, Analytical and Radiological, Laboratory (PEARL) and Health Physics Calibration & Services Laboratory (HP CASL)** - The PEARL and HP CASL performs calibrations and maintains an M&TE program for all fixed and portable radiation measuring instruments for the Health Physics & Nuclear MC&A Division at PPPL.

Radiation instruments calibrated include Geiger counters, scintillation counters, ion chambers, fission chambers, neutron detectors, tritium monitors, gamma spectroscopy systems, environmental dosimeter services, analytical balances, and weights. Instrument calibrations are performed electronically and through the use of radioactive nuclide sources. The HP CASL evaluates new radiological detection equipment.

The HP CASL maintains calibration data and calibration certificates in an HP CASL Calibration File for traceability of HP measuring devices

Calibration Shops - There are various Department, Project, and Division Calibration Shops, which provide calibrating services in support of the Calibration Lab. These Calibration Shops perform specific calibration services on specialized equipment and systems, such as vacuum and pressure gauges, pressure and relief valves, valve switches, instrumentation, components within

computer systems, etc. The Calibration Shops perform secondary Calibrations using the M&TE provided by the Calibration Labs.

PPPL authorized Calibration Shops are:

CAS Material Test Lab (MTL)

D-Site Vacuum Preparation Lab (VPL)

These Calibration Shops shall have operating procedures for their calibration services including the maintenance of records.

Reference Documents

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| DOE O 414.1D | Quality Assurance |
| QA-005 | Control of Nonconformances |
| P-086 | Calibration of Measuring and Test Equipment |

Definitions

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| Accuracy | The degree of conformity of a measurement to a standard or true value. |
| Calibrated | Any device which presents or records data where the accuracy of that data is critical should be identified as a calibrated instrument, should be self-contained, and have the ability to be calibrated to standards traceable to the National Institute of Standards and Technology (NIST), formerly the National Bureau of Standards (NBS). |
| Calibration | A comparison of the performance of a piece of measuring equipment with that of a standard of higher accuracy to detect, correlate, adjust, rectify and document the accuracy of the equipment relative to the standard. |
| Calibration Lab | A PPPL authorized facility for calibrating M&TE. |
| Calibration Shop | A designated workplace established to perform specific calibration services on specialized equipment and systems using the M&TE tools maintained by one of the official Calibration Laboratories. |
| Contact | An individual who is the assigned “owner” of a piece of M&TE and directly responsible for that M&TE. |

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| Custodian | Custodian maintains the data and records for the M&TE in the database. A custodian may or may not be the user of the M&TE, but is accountable for the traceability of the M&TE. |
| Indicator Only | A measuring device used to obtain general data, which will not be used to determine acceptability or verify conformance to established criteria. |
| Measuring and Test Equipment (M&TE) | All of the measuring instruments, measurement standards, reference materials, and auxiliary apparatus that are necessary to perform a measurement. This includes measuring equipment used in the course of testing and inspection, as well as that used in calibration. (From ANSI/NCSL Z540-1-1994.) |
| Nonconformance | A deficiency in characteristic, specification, documentation, or procedure that renders the quality of a piece of equipment or an activity unacceptable or indeterminate. |
| Reference Standard | A standard, generally of the highest metrological quality available at a given location, from which measurements made at that location are derived. (From ANSI/NCSL Z540-1-1994.) |
| Tolerance | The total permissible variation in specifications or requirements. The tolerance is the difference between the limits of the specifications or requirements. |
| Traceability | The property of a result of a measurement whereby it can be related to appropriate standards, generally national or international standards, through an unbroken chain of comparisons. (From ANSI/NCSL Z540-1-1994.) |
| Transfer Standard | Designated measuring equipment used in a calibration system as a medium for transferring the basic value of reference standards to a lower echelon transfer standard or Measuring and Test Equipment. |
| User | An individual who requests to use an item of M&TE for measurements. |

Procedure

A. New M&TE Purchases

Responsibility

Action

Requester

1. Completes a procurement for required M&TE.
 - a. Specifies required documentation, calibration data sheets, calibration certification, calibration procedures, performance test procedures, etc., on the Requisition.
 - b. Specifies new M&TE be delivered to PPPL Receiving or to one of the three Calibration Labs.

Procurement

2. Obtains approval and submits Requisition to Procurement.
3. Procures M&TE specifying required documentation on the contract order.
4. Specifies delivery to Receiving and the appropriate Calibration Lab.

Receiving

5. Notifies appropriate Calibration Lab upon delivery of M&TE.

Appropriate
Calibration Lab

6. Performs M&TE acceptance tests.
 - a. When M&TE passes acceptance testing: Lab enters M&TE data into Calibration Database System and sets up an M&TE record file folder.
 - b. When M&TE fails acceptance testing: Lab notifies QC and Procurement, QC issues an NCR and applies a "Hold Tag" to the M&TE which is segregated from operational M&TE until disposition of the NCR. (Disposition would typically be returned to vendor).
7. Determines calibration cycle with input from user for the M&TE. Enters calibration cycle information into the Lab's Calibration Data Base System.
8. Forwards accepted M&TE to requisitioner.
9. Maintains M&TE calibration standards, calibration records, and certificates in M&TE File History.

Contact

10. Maintains M&TE and provides M&TE to users on request, reflects change of status in the M&TE Database.

B. M&TE Requiring Calibration From a Calibration Lab

Responsibility

Action

Calibration Lab

1. Issues a recall notice informing Custodian of impending due date for M&TE recalibration.

Custodian

2. Logs out and forwards M&TE to Calibration Lab for calibration.

NOTE: M&TE may be forwarded to the Calibration Lab at any time if the M&TE is determined or suspected to be “out of calibration” before the normal calibration cycle is due. Suspect M&TE shall be tagged out of service and forwarded to the appropriate Calibration Lab. All calibrated M&TE are required to be recalibrated if dropped or otherwise subjected to abusive treatment, if the accuracy is suspect, or if recalibration is due.

- Calibration Lab 3. Performs M&TE calibration by one of the following methods:
- a. Uses supplier calibration instruction and data sheets (preferred method) or uses Calibration Lab internal procedures.
 - b. Sends M&TE out to vendor’s site for calibration (via shipping order, work order, etc., as appropriate).
 - c. Requests vendor to calibrate M&TE on site at PPPL.

Refer to Calibration Lab Operating Procedures to determine method of calibration and specific M&TE calibration procedures.

- Calibration Lab 4. Calibrates M&TE via reference standard tests and adjustments.
- a. If passed, go to step B5.
 - b. If the M&TE failed initial calibration, adjustments or repair were performed, and passed recalibration:
 - i. Notifies the custodian that the M&TE failed calibration and completes the NCR Form if adjustments are two times greater than the allowed error. Notes on the NCR form that adjustment or repair was performed on the M&TE, and then the M&TE passed calibration.
 - ii. Forwards the NCR to QC for number and verification.
 - c. The Quality Assurance Nonconformance System (QA-005) shall be used to document instruments failing the initial calibration if adjustments are two times greater than the allowed error, or if instruments cannot be calibrated at all.
 - d. If the M&TE could not be calibrated:
 - i. Notifies the owner and QC for impact analysis.
 - ii. Quarantines the failed M&TE in a calibration holding area pending the NCR disposition determination by the custodian with assistance from the Calibration Lab.

5. Removes old calibration label (and any other old calibration notices) and replaces with new calibration label containing the updated information.

6. Updates M&TE calibration file in the Calibration database; completes and files M&TE calibration certificates in M&TE history file folder. Records shall be maintained for each piece of calibrated equipment, including the name of the item, a unique identifier, the date of the next required calibration, allowable variations, and history of damage, malfunction, modification, or repair.
7. Notifies custodian that calibration of M&TE is complete.
8. Places M&TE in service, or forwards M&TE to assigned user.

Custodian

C. Calibration Shop Services

Responsibility

Action

Calibration Shop

1. Performs calibration on equipment or system of equipment using M&TE calibrated by a Calibration Lab. The Calibration Shop does not perform calibration on M&TE.
2. Maintains an equipment calibration file, equipment calibration standards, equipment calibration records in a Calibration Database System for equipment calibration history and traceability. Records shall be maintained for each piece of calibrated equipment, including the name of the item, a unique identifier, the date of the next required calibration, allowable variations, and history of damage, malfunction, modification, or repair.

Training

Head, Fabrications
Group

A. Target Audience: Task Managers, Element Owners, QA, QC, Designers, Drafting

Instructor: Head, Fabrications Group

Training Method:

X Read only

X Email distribution only

Frequency:

X Once only

X Other: When this procedure has changes

Records Requirements Specific To This Procedure

Records Custodians must assure records are maintained as follows:

| Record Title | Record Custodian | Location | Retention Time |
|--------------------------|---|----------------------------|--|
| M&TE Database | Designated Calibration Lab Database Admin | Designated Calibration Lab | Destroy when superseded. <i>Reference: Admin 17, Cartographic, Aerial Photography, Architectural and Engineering Records (18.a)</i> <u>Hold indefinitely - DOE</u> |
| Calibration Certificates | Designated Calibration Lab Database Admin | Designated Calibration Lab | Destroy when superseded |

Attachments

1. PPPL Calibration Laboratories and Shops

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| PPPL Calibration Laboratories and Shops | | | Attachment 1 |

SAMPLE ONLY

For current list of Calibration Laboratories and Shops, please visit
<http://engineering.pppl.gov/PPPL%20Calibration%20Laboratories%20and%20Shops.pdf>

Database Administrator: Michael Viola

PPPL Calibration Laboratories:

| Lab | Records Location | Custodian | Applicable Database |
|--|-------------------------|----------------------|----------------------------|
| Electrical/Mechanical Calibration Laboratory (EMC) | Shop Building | K. Gilton / M. Styer | PPPL Calibration Database |
| Quality Assurance Inspection Lab | Shop Building | G. Doroshenko | PPPL Calibration Database |
| PPPL, Environmental, Analytical and Radiological, Laboratory (PEARL) and Health Physics Calibration & Services Laboratory (HP CASL) | HP Database | P. Bruno | HP CASL Calibration File |

PPPL Calibration Shops:

| Shop | Records Location | Custodian | Applicable Database |
|-------------------------------------|-------------------------|------------------|----------------------------|
| CAS Material Test Lab (MTL) | CAS Building | S. Jureczynski | MTL |
| D-Site Vacuum Prep Lab (VPL) | FCPC Building | T. Czeizinger | VPL |