



**Responsible Office: Research Directorate**

**SUBJECT:** The LaRC Metrology Program

## 1. POLICY

It is Langley Research Center's (LaRC) policy to:

- a. Comply with all metrology and calibration regulations, procedures and standards listed in the "Authority" section of this directive (Section 3).
- b. Provide a comprehensive metrology and calibration program that identifies the authority and responsibilities of:
  - (1) The management and control of Measuring and Test Equipment (M&TE).
  - (2) The issuance and validation of calibration-related task descriptions.
  - (3) Operation, maintenance and control of calibration reference standards.
  - (4) The validation of locally generated calibration-related software.
  - (5) Assuring traceability and adequate measurement confidence of the M&TE utilized in LaRC applications.

## 2. APPLICABILITY

- a. This directive is applicable to all LaRC personnel, programs, projects, and organizations. Deviation from this directive is strictly prohibited.
- b. This directive is applicable to LaRC on-site / off-site contractors to the extent specified in their contracts.
- c. This directive is applicable to all M&TE used at LaRC within the following functions and conditions (NPD 8730.1C, Attachment A):
  - (1) Testing, qualification, certification, and / or acceptance measurements of flight hardware, ground support equipment, test systems, or other flight-related products.
  - (2) Measurements essential to the safety of personnel and the public or for the protection of Government or private property, including hazardous and / or critical applications.

- (3) Operation of telecommunications and transmission systems where exact signal interfaces and circuit confirmations are essential to mission success.
- (4) Research and technology development (see NPR 7120.8), manufacturing, inspection, testing, operations, maintenance, support, or other applications where the accuracy of measurements is essential to achieve mission success.
- (5) NASA publications or other documents released for external review whose conclusions / recommendations depend upon the accuracy of measurement results and that impact the safety or success of NASA missions. Excluded are preliminary research papers and research instruments under development that have not had traceable units of measurement established.
- (6) Physical measurements used to apportion, levy, or otherwise assign cost(s), or ensure local, State, or Federal regulatory compliance.

### **3. AUTHORITY**

- a. NPD 8730.1, "Metrology and Calibration."
- b. ISO 9001:2008, "Quality Management Systems – Requirements."
- c. SAE AS9100C, "Quality Management Systems – Requirements for Aviation, Space and Defense Organizations."
- d. NCSL/ANSI Z540.3-2006, "American National Standard for Calibration Requirements for the Calibration of Measuring and Test Equipment."
- e. ISO/IEC 17025:2005, "General Requirements for the Competence of Testing and Calibration Laboratories."
- f. NCSL/ANSI Z540.1-2006, "General Requirements for Calibration Laboratories and Measuring and Test Equipment." (Note: ANSI/NCSL Z540.1-1994 has been withdrawn as an active standard by the applicable industry standards writing body. For the purposes of the LaRC Metrology Program, as permitted by NPD 8730.1 Rev. C, it remains an active document.)

### **4. APPLICABLE DOCUMENTS**

- a. LMS-CP-0506, "Selection, Calibration, Use, Control, Recall, Procurement and Storage of Measuring and Test Equipment (M&TE)."

### **5. RESPONSIBILITY**

- a. The Center Director is responsible for:

- (1) Implementation and oversight of NPD 8730.1, LAPD 8730.1 and LMS-CP-0506.
  - (2) Ensuring formal representation to the NASA Metrology and Calibration Working Group (MCWG), workshops, and other related activities addressing Agency-wide metrology issues.
- b. The Director of the Research Directorate is responsible for:
- (1) Implementation and oversight of the LaRC Metrology Program, as appointed by Center Director.
  - (2) Appointing the LaRC Metrology Manager.
  - (3) Sponsoring the LaRC MCWG.
  - (4) Determining which Organizational Units require representation at the LaRC MCWG.
- c. The Director of the Center Operations Directorate is responsible for:
- (1) Assigning a NASA Contracting Officer's Representative (COR) for the Instrument Services Contract (i.e. Metrology COR).
- d. The Metrology COR is responsible for:
- (1) Providing oversight of the implementation of the Instrument Services Contract requirements.
  - (2) Orchestrating and arranging performance evaluations and satisfaction surveys related to the performance of the Instrument Services Contract.
  - (3) Providing technical direction as necessary to resolve matters concerning expectations and execution of the Instrument Services Contract.
- e. Organizational Unit Managers (OUMs) / Branch Heads are responsible for:
- (1) Implementation and oversight of NPD 8730.1, LAPD 8730.1, and LMS-CP-0506.
  - (2) Recommending and appointing Organizational Unit Representatives who will attend the LaRC MCWG meetings.
  - (3) Selecting a Metrology Representative (MetRep) if branch activities require the use of calibrated equipment.

- (a) MetReps shall be selected based on the qualifications of available personnel. Personnel selected for the position should, at a minimum, be knowledgeable of the M&TE utilized by the branch and its intended application.
  - (b) Assignment of a contractor as MetRep must be agreed to by the Office of Procurement, COR, and contractor management.
  - (4) Notifying the LaRC Metrology Manager of MetRep selection in writing (i.e. via e-mail).
  - (5) Identifying Designated Users for all Category 1 and 2 M&TE and notifying the Branch MetRep to update LaRC Metrology Information System (MIS) when record additions or changes are required.
- f. The LaRC Metrology Manager is responsible for:
- (1) Representing LaRC at the Agency-mandated (per NPD 8730.1) annual NASA MCWG.
  - (2) Scheduling and chairing meetings of the LaRC MCWG.
  - (3) Assuring that proper metrology-related procedures and Task Descriptions (TDs) are established and validated.
  - (4) Working with the LaRC MCWG to assure implementation of and compliance with all approved metrology policies and procedures.
  - (5) Advising the Office of Procurement on content of any statement of work related to LaRC contracts that involve calibration laboratory services.
  - (6) Serving as NASA Responsible Official for the LaRC MIS.
  - (7) Direct interaction and involvement with LaRC's MetRep Program. This includes:
    - (a) Training new MetReps and granting MIS MetRep-level access.
    - (b) Initiating requests to add / delete / update the MIS master list.
    - (c) Assisting MetReps with Metrology issues above the branch level.
  - (8) Informing and requesting assistance from the Director of the Research Directorate in resolution of significant non-compliance issues not adequately resolved by the LaRC MCWG.
- g. The LaRC MCWG is responsible for:

- (1) Meeting quarterly to establish and review metrology and calibration policy and identifying organizational noncompliance issues at LaRC including:
    - (a) Failures to determine measurement system uncertainty for critical applications.
    - (b) Improper calibration interval adjustments.
    - (c) Calibration-related task descriptions that are incomplete.
  - (2) Working with MetReps in their organizations to effectively implement LaRC's metrology program. (e.g., Ensure compliance with all relevant Center procedures.)
  - (3) Working with OUMs / Branch Heads to resolve significant metrology-related noncompliance issues.
  - (4) Investigating / developing new technological advancements, control techniques, and measures to assure a cost-effective, efficient, and reliable metrology program.
  - (5) Establishing surveillance and monitoring requirements for LaRC metrology activities to assure quality.
  - (6) Championing LaRC's metrological and calibration successes in resource and cost mitigation.
- h. The Metrology Representatives (MetRep) are the focal point of metrology at the branch level. They are responsible for:
- (1) Being knowledgeable of the requirements and processes within LMS-CP-0506, "Selection, Calibration, Use, Control, Recall, Procurement, and Storage of Measuring and Test Equipment (M&TE)."
  - (2) Working with Branch Heads to assign a Designated User to all Category 1 and 2 M&TE in the MIS. An up-to-date listing of all Category 1 and 2 M&TE in the branch shall be maintained via the MIS by the MetRep.
  - (3) Ensuring Designated Users in their assigned areas are aware of their responsibilities per LMS-CP-0506.
  - (4) Working with M&TE Designated Users to resolve metrology issues in a timely manner.
  - (5) Assisting Designated Users with input of new information or changes to current M&TE information in the MIS.

- (6) Assisting the Designated User with adding adequate documentation notes in the MIS concerning the resolution of the following issues:
  - (a) The inability to respond to calibration recall notices. (i.e. Delinquent M&TE.)
  - (b) Out-of-tolerance (OOT) notifications (and subsequent impact analysis and report).
- (7) Attending periodic metrology training.
- (8) Elevating metrology issues, as required, and working with the LaRC Metrology Office to resolve issues.
- i. Designated Users are individuals with the proper technical knowledge of the capabilities, functionality, and application of the M&TE assigned and who maintain M&TE tracking (for OOT evaluation purposes). They are responsible for:
  - (1) Selecting (or approving) M&TE for use with adequate accuracies and measurement uncertainties to meet the requirements of the application.
  - (2) Determining if M&TE should be Category 1 or 2 per LMS-CP-0506.
  - (3) Identifying and documenting Category 1 or 2 M&TE used in test per LMS-CP-0506.
  - (4) Initiating requests for calibrations (including any specific or special requirements).
  - (5) Reviewing calibration results to confirm requirements and specifications were met and that M&TE labeling and MIS records are correct. Also responsible for notifying the cognizant MetRep of any inconsistencies.
  - (6) Documenting (via notation in MIS) justifications for using M&TE beyond the recommended calibration interval.

**NOTE**

*Data taken after interval expiration is considered noncompliant until the M&TE is proven to be in tolerance per post-use calibration.*

- (7) Performing a thorough impact analysis of any OOT condition on the results and validity of previously performed measurements (when notified via an OOT notice). A report of the impact is to be adequately documented via notation in MIS (with MetRep assistance).

- j. As set forth in their contract, the LaRC Instrument Services Contractor is responsible for:
  - (1) Adherence to applicable portions of NPD 8730.1, LAPD 8730.1 and LMS-CP-0506.
  - (2) Monthly reporting of calibration-based metrics to the COR. At a minimum, metrics shall include the following considerations:
    - (a) Calibration expenditures and additional costs.
    - (b) Turn-around-time (TAT).
    - (c) Number of items of M&TE processed and calibration.
    - (d) Out of Tolerance (OOT) reports findings and delinquencies.
    - (e) Customer Satisfaction (as measured by customer feedback and complaints).

**6. DELEGATION OF AUTHORITY**

None

**7. MEASUREMENT/VERIFICATION**

None

**8. CANCELLATION**

LAPD 8730.1 (Effective Date: 18 May 2010).

*Original signed on file*

Lesa B. Roe  
Center Director

Distribution:

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**ATTACHMENT A: DEFINITIONS**

- a. Calibration – The set of operations that establish, under specified conditions, the relationship between values indicated by a measuring instrument or measuring system and the corresponding standard or known values derived from standards.
- b. Calibration Interval – The established period of time between calibrations designed to meet a specified end-of-period reliability (EOPR). The calibration interval is based on calibration history, M&TE usage, manufacturer's recommendations, military designations, etc.
- c. Calibration Laboratory (Cal Lab) – The on-site / off-site, contractor-operated facility where calibrations and minor repairs are performed on customer M&TE.
- d. Calibration Report – A report that gives correction, measured value(s), conditions of test, curves, charts, error limits, measurement uncertainties or other pertinent data relating to the calibration performed on the M&TE.
- e. Calibration Traceability – The property of a result of a measurement whereby it can be related to appropriate standards, typically international or national standards, through an unbroken chain of comparisons.
- f. Designated User – An individual with the proper technical knowledge of the capabilities, functionality, and present application of the M&TE assigned and maintains M&TE tracking (for OOT evaluation purposes). Responsibilities of the designated user are as described in Paragraph 5.i. of this directive. Also referred to as: end user.
- g. End-of-Period Reliability (EOPR) – The probability that an instrument can perform its intended function within given tolerances throughout a specified interval under stated conditions.
- h. Equipment Control Number (ECN) – A unique number assigned to equipment by the Property Management Office for controlled equipment (>\$5,000.00 value). The numbers are imprinted on a bar code label that may be affixed to the equipment, to a tag affixed to the equipment, or to the case or container associated with the test equipment.

**ATTACHMENT A: DEFINITIONS (Continued)**

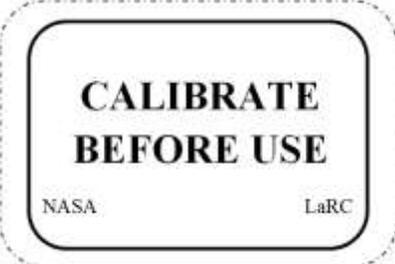
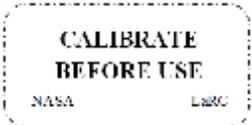
- i. Measuring and Test Equipment (M&TE) – Any device used to perform measurements where distinct values are required for system performance or to demonstrate conformance to specified requirements.
- j. Measuring and Test Equipment Categories – Equipment is designated being in a particular calibration category depending on whether calibration is not required (Category N), calibration is performed before use (Category 2) or calibration is performed on an established interval (Category 1). See LMS-CP-0506 for specific details and requirements concerning M&TE Categories.
- k. Metrology – The science of measurement and its application.
- l. Metrology Control Number (MCN) – A unique number assigned to all M&TE. These numbers are imprinted on a bar code label that may be affixed to the equipment, to a tag affixed to the equipment, or the case or container associated with the test equipment.
- m. Metrology Information System (MIS) – LaRC's calibration database, Equipment Measuring Information Technology (EMIT). This database includes information regarding M&TE previously calibrated (ECN / MCN, model number, serial number, manufacturer, description), the calibration contact associated with the equipment, and previous calibration data for the equipment. This database may be used to generate the monthly recall report and various other data reports.
- n. Metrology Representative (MetRep) – The focal point of metrology and calibration within the branch. Responsibilities of the MetRep are as described in Paragraph 5.h. of this directive.

**ATTACHMENT B: CALIBRATION SYSTEM STATUSES AND LABELING**

All instruments serviced are to be labeled with the appropriate calibration labeling.

| <b>Calibration Status</b>       | <b>Description</b>   | <b>Labeling Description</b>  |
|---------------------------------|--|--|
| <b>Calibrated</b>               | <p>Calibration of a device to meet the manufacturer performance requirements throughout its stated range of operation. These instruments are calibrated at specified intervals.</p>  | <p>Labels will vary per calibration provider. At a minimum, the label must include: MCN, Calibration date, Technician ID and Calibration Due Date. Please see the “User Calibrated” section for an example of an acceptable label.</p> <p>NOTE: A smaller calibration label, indicating MCN and calibration due date only, may be used only in the event of geometric or operational impracticality of the above label and requires metrology office concurrence prior to use.</p> |
| <b>Limited Calibration</b>      | <p>Calibration of an instrument that can meet some, but not all, the manufacturer stated performance requirements and / or is not calibrated throughout its entire stated range of operation or functionality.</p>   | <p>Labels will vary per calibration provider. At a minimum, the label must include: MCN, Calibration date, Technician ID, Calibration Due Date, some form of visual indication as to the calibration being limited in nature and a brief description of the limitations of the item.</p>   |
| <b>User Defined Calibration</b> | <p>Calibration of an instrument for which the designated user has, based on their specific needs or an engineering decision point made prior to calibration service, determined accuracy specifications different from those of the manufacturer.</p> <p>NOTE: User requests for omission of ranges or functionality are considered Limited Calibrations, not User Defined Calibrations.</p> | <p>Labels will vary per calibration provider. At a minimum, the label must include: MCN, Calibration date, Technician ID, Calibration Due Date, some form of visual indication as to the calibration being user specified in nature (e.g. “Special” or “User Defined”) and a description of the specifications the M&amp;TE was calibrated to.</p>   |

**ATTACHMENT B: CALIBRATION SYSTEM STATUSES AND LABELING (Continued)**

| Calibration Status                           | Description   | Large Label (w/ Description)  | Small Label (w/ Description)   |
|--|---|---|--|
| <p><b>Calibration Not Required (CNR)</b></p> | <p>Instruments marked Calibration Not Required do not require calibration and are limited to non-critical, non-accuracy-sensitive, or non-hazardous measurements. They are not to be used for any measurement purpose mentioned in the “Applicability” section of this directive (Section 2). Calibration Not Required stickers should appear only on Category N items (and should be the only calibration label affixed to the item.) Each sticker requires the signature of the individual who determined the CNR status of the item.</p> |  <p>Red lettering on a white background with red trim border.<br/>1" x 1-1/2"</p>      |  <p>Red lettering on a white background<br/>1/2" x 1"</p>       |
| <p><b>Calibrate Before Use (CBU)</b></p>     | <p>This instrument requires calibration prior to any measurement purpose defined in the “Applicability” section of this directive (Section 2). All newly procured Category 1 M&amp;TE and any Category 2 M&amp;TE without a valid calibration sticker or with an expired calibration sticker shall have a Calibrate Before Use sticker applied until a valid calibration has been accomplished on the item.</p>   |  <p>Black Lettering on a white background with black offset border<br/>1" x 1-1/2"</p> |  <p>Black lettering on a white background<br/>1/2" x 1"</p>     |
| <p><b>User Calibrated</b></p>                | <p>Calibration of an instrument performed using a Langley Management System (LMS) Task Description (TD). Once calibration is complete, the datasheet shall be uploaded into the MIS (EMIT).</p>   |  <p>Blue lettering on a silver background<br/>13/16" x 1-1/2"</p>                    |  <p>Blue lettering on a silver background<br/>1/2" x 7/8"</p> |
|  |   | <p>Note: Contractor Supplied Calibration Labels are also acceptable for use on User Calibrated M&amp;TE.</p>  |  |