



Responsible Office: Research Directorate

SUBJECT: The LaRC Metrology and Calibration Program

1. POLICY

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

- a. Comply with the 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 of and adequate measurement confidence in 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 (Ref: NASA-STD-8739.12, Appendix A):
 - (1) Testing, qualification, certification, and 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.

- (3) Operation of telecommunications and transmission systems where exact signal interfaces and circuit confirmations are essential to mission success.
- (4) Research and technology development, manufacturing, inspection, testing, operations, maintenance, support, or other applications where the accuracy of measurements is essential to ensure safety or achieve mission success.
- (5) Measurements used for publishing NASA research where the conclusions and/or recommendations of that research depend upon the quantitative accuracy of measurement results. 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.

Note: Calibration is not required for measurements where quantitative data accuracy is not a consideration, including process monitoring, “indication only” or “reference only” purposes.

3. AUTHORITY

- a. NPR 8735.2, “Hardware Quality Assurance Program Requirements”
- b. NASA-STD-8739.12, “Metrology and Calibration”
- c. ISO 9001:2015, “Quality Management Systems – Requirements”
- d. SAE AS9100D, “Quality Management Systems – Requirements for Aviation, Space, and Defense Organizations”
- e. NCSL/ANSI Z540.3-2006, “Requirements for the Calibration of Measuring and Test Equipment”
- f. ISO/IEC 17025:2017, “General Requirements for the Competence of Testing and Calibration Laboratories”
- g. NCSL/ANSI Z540.1-2006, “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 NASA-STD-8739.12, it remains an active document.)

4. APPLICABLE DOCUMENTS AND FORMS

- a. Langley Management System (LMS) Center Procedure (CP) 0506, “The LaRC Measuring and Test Equipment (M&TE) Procedures Manual”

- b. Langley Form (LF) 370, "Metrology Representative Change Form"

5. RESPONSIBILITY

- a. The Center Director is responsible for:
 - (1) Implementation and oversight of NASA-STD-8739.12 (as invoked by NPR 8735.2), 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 and Calibration Program, as directed by the Center Director.
 - (2) Appointing the LaRC Metrology and Calibration Program Manager.
- c. The Director of the Center Operations Directorate is responsible for:
 - (1) Assigning a NASA Contracting Officer's Representative (COR) and, as appropriate, a Deputy Contracting Officer's Representative (DCOR) for any Center-based operations contract with Instrument Service-related requirements.
- d. The COR or, as applicable, DCOR, is responsible for:
 - (1) Providing oversight of the implementation of the Instrument Service-related contract requirements.
 - (2) Orchestrating and arranging performance evaluations and satisfaction surveys related to the performance of the Instrument Service-related contract.
 - (3) Providing technical direction as necessary to resolve matters concerning expectations and execution of the Instrument Service-related contract.
- e. Organizational Directors (OD) / Branch Heads are responsible for:
 - (1) Implementation and oversight of NASA-STD-8739.12 (as invoked by NPR 8735.2), LAPD 8730.1, and LMS-CP-0506.
 - (2) Selecting a Metrology Representative (MetRep) if activities within their areas of responsibility require the use of calibrated equipment.

- a. MetReps shall be selected based on the qualifications of available personnel. Personnel selected for the position shall, at a minimum, be knowledgeable of the M&TE utilized within their area of responsibility and its intended application.
 - b. Assignment of a contractor as MetRep shall be included in the Contract Statement of Work (SOW) requirements, and approved by the CO.
- (3) Notifying the LaRC Metrology and Calibration (MetCal) Office of MetRep selection in writing per submitted and signed Langley Form (LF) 370.
 - (4) Identifying Designated Users for all Category 1, 2, and N M&TE and notifying the Branch MetRep to update the LaRC Metrology Information System (MIS) when record additions or changes are required.
- f. The LaRC Metrology and Calibration Program Manager is responsible for:
- (1) Representing LaRC at all meetings, workshops, and other designated activities of the NASA MCWG.
 - (2) Assuring that proper metrology-related procedures and Task Descriptions (TDs) are established and validated.
 - (3) Working with the center's user base to assure implementation of and compliance with all approved metrology policies and procedures.
 - (4) Advising the Office of Procurement on content of any statement of work related to LaRC contracts that involve calibration laboratory services.
 - (5) Serving as NASA Responsible Official for the LaRC MIS.
 - (6) 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.
 - (7) Informing and requesting assistance from the Director of the Research Directorate in resolution of significant non-compliance issues not adequately resolved.
 - (8) Coordinating and orchestrating all center-level responses and actions to the NASA Metrology and Calibration OSMA Liaison.

- g. Metrology Representatives (MetReps) are the focal point of metrology at the branch level. They are responsible for:
- (1) Being knowledgeable of the requirements, responsibilities, processes and procedures within LMS-CP-0506.
 - (2) Working with Branch Heads to assign a Designated User to all Category 1, 2, and N M&TE in the MIS.
 - a. An up-to-date listing of all Category 1, 2, and N M&TE in the branch is to be maintained via the MIS by the MetRep.
 - (3) Elevating any metrology and calibration issue, as necessary, to the LaRC MetCal Office and working in collaboration with them to resolve.
 - (4) Keeping Designated Users in their assigned areas informed of MetCal Program information and notices and ensuring they are aware of their role and responsibilities per LMS-CP-0506.
 - (5) Assisting Designated Users in various aspects of Metrological Compliance to include:
 - a. The input of new information or changes to current M&TE information in the MIS.
 - b. Timely resolution of metrology and calibration issues.
 - c. Reviewing and incorporating adequate documentation notes in the MIS regarding:
 - i. Out-of-Tolerance (OOT) impact analysis and reporting
 - ii. The inability to respond to calibration recall notices (i.e., Delinquent M&TE)
 - (6) Attending periodic training pertinent to their MetRep Responsibilities.
- h. Designated Users are individuals with the proper technical knowledge of the capabilities, functionality, and application of the M&TE assigned who maintain M&TE tracking (for measurement capability and OOT evaluation purposes). They are responsible for:
- (1) Maintaining M&TE tracking and use of M&TE assigned to them.
 - (2) Selecting (or approving) M&TE for use with adequate accuracies and measurement uncertainties to meet the requirements of the application.
 - (3) Determining if M&TE should be Category 1, 2, or N per LMS-CP-0506.
 - (4) Identifying and documenting Category 1 or 2 M&TE used in test per LMS-CP-0506.

- (5) Initiating requests for calibrations (including any specific or special requirements).
- (6) 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 assigned MetRep of any inconsistencies.
- (7) Capturing (via documentation in the MIS) justifications for using M&TE beyond the recommended calibration interval.

IMPORTANT

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

- (8) Performing a thorough impact analysis of any OOT condition on the results and validity of previously performed measurements (when notified via an OOT notice). This impact assessment shall be provided to the assigned MetRep in a timely manner (i.e., within 30 days of notification) for retention in the MIS.
- i. As set forth in their contracts, LaRC Instrument Service Contractors are responsible for:
 - (1) Adherence to applicable portions of NASA-STD-8739.12 (as invoked by NPR 8735.2), 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 calibrated.
 - d. OOT reports, audit findings, and service 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: April 3, 2019).

Original signed on file

/s/ _____
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.
- i. Measuring and Test Equipment (M&TE) – Any device used to perform measurements where distinct and precise values are required for system performance or to demonstrate conformance to specified requirements.



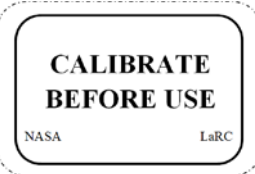



- j. Measuring and Test Equipment Categories – M&TE is designated as being in a particular calibration category depending on whether calibration is not required (Category N), calibration is performed before use (Category 2) or calibration is performed on an established interval (Category 1). See LMS- CP-0506 for specific details and requirements concerning M&TE categories.
- k. Metrology – The science of measurement and its application.
- l. Metrology Calibration & Working Group (MCWG) – Agency mandated working group consisting of center appointed Metrology and Calibration civil servant representatives and well-versed, contractor-based associate members. Mission of the MCWG includes developing, promoting and implementing technologically advanced, cost effective, standardized and compliant metrology and calibration actions, processes and innovations.
- m. 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.
- n. Metrology Information System (MIS) – The on-center, government-owned metrology database, per NRRS 1441.1, “NASA Records Retention Schedules.” This database includes information regarding M&TE previously calibrated (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.
- o. 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.
- p. Out-of-Tolerance (OOT) – Notification that an item, prior to adjustment (if available), has been found not to meet stated tolerances in the as-received condition during calibration. It serves as an indication that previous use of this item (prior to last calibration) may be suspect and must be evaluated.

ATTACHMENT B: CALIBRATION SYSTEM STATUSES AND LABELING


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

Calibration Status	Description	Labeling Description
Calibrated	<p>Calibration of a device to meet 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>
Limited Calibration	<p>Calibration of an instrument that can meet some, but not all, 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>
User Defined Calibration	<p>Calibration of an instrument for which the designated user has, based on 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&TE was calibrated to.</p>

ATTACHMENT B: CALIBRATION SYSTEM STATUSES AND LABELING (Continued)

Calibration Status	Description	Large Label (w/ Description)	Small Label (w/ Description)
Calibration Not Required (CNR)	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. Each sticker requires the signature of the individual who determined the CNR status of the item.	 <p>Red lettering on a white background with Red Trim border 1" x 1-1/2"</p>	 <p>Red lettering on a white background 1/2" x 1"</p>
Calibrate Before Use (CBU)	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&TE and any Category 2 M&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>Black Lettering on a White Background with black offset border 1" x 1-1/2"</p>	 <p>Black Lettering on a White Background 1/2" x 1"</p>
User Calibrated	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 LaRC MIS (MISSL). Note: Instrument Service Contractor (ISC) Supplied Calibration Labels are also acceptable for use on User Calibrated M&TE.	 <p>Blue lettering on a silver background 13/16" x 1-1/2"</p>	 <p>Blue lettering on a silver background 1/2" x 7/8"</p>

Other Equipment-Related Labeling (Usage is optional)

Status	Description	Label (w/ Description)
Measurement Controls Not Required	Optional identification for any equipment determined by the owning organization to be of value to be readily identified as not falling under the requirements of the LaRC Metrology Program. Examples include: office supplies (e.g. Rulers with less than 1/64" resolution), workshop fixtures (e.g. Parallels), environmental devices for personal comfort.	 <p>Red lettering on a white background. 1/2" x 1" (One Size Only)</p>