MPR 8730.5
REVISION P-1
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MARSHALL PROCEDURAL REQUIREMENTS

ED01

METROLOGY AND CALIBRATION

With Change 1 (3/3/22)

DOCUMENT HISTORY LOG

Status (Baseline/ Revision/ Change/ Revalidation/ Canceled)	Document Revision/ Change	Effective Date	Description
Baseline		5/14/99	Document converted from MSFC-P11.1 to a Directive. Previous history retained in system as part of cancelled or superseded ISO Document files.
Revision	A	8/16/99	Changed Responsible organization code. Added applicable documents. Added definition of "Calibration Contact Code". Added definition of "Interval". Deleted definition of NASA Metrology and Information System. Renumbered subsequent paragraphs. Added MCMS Web page to definition of "Marshall Calibration Management System". Modified definition of "NASA/MSFC Limited Calibration Sticker". Modified definition of "Non-Government Owned Test Equipment". Deleted reference to MSFC-P11.1 from definition of Test Software. Modified paragraph 2.1.7. Added paragraph 2.1.8. Renumbered subsequent paragraphs. Deleted Appendix H and added reference to MCMS Web Page from note associated with paragraph 2.1.19. Added paragraph 2.5.19. General revision to Appendix A. Added MSFC Form Numbers 4365 and 4364. Modified Form 4114. Modified Tag 15. Modified Appendix E. Changed Form 2035 to MSFC Tag 17. Deleted Appendix H. Deleted Appendix C, D, F, G, H. Re-labeled Appendix E to Appendix C. Deleted Referenced thereto. Updated table of contents. Added ISO 10012 to "References". Updated Organization Codes and names. Added permit to use indicators for Category III equipment to Appendix A and paragraph 1.8.
Revision	B	12/6/99	Add Appendix D to the Table of Contents. Add paragraph 2.5.26. Change Record Control Organization from the ULO to the MSFC MCL paragraph 4.1.2. Added Appendix D. Changed "should" to "is to" paragraph 2.2.3. Changed retention period paragraph 4.1.8. Modified paragraph 1.15. References to MSFC-P11.1 replaced with date paragraph 4.1.12. Changed retention period of paragraph 4.1.10 and 4.1.12 from 2 to 5 years. Added disposition statements to Section 4
Revision	C	6/13/00	Deleted references to MPG 1441.1 and replaced with applicable document MPG 1440.2. Incorporated title change of MWI 5330.1. Modified paragraph 2.1.18. Modified paragraphs 2.3 and 2.3.1. Added paragraph 2.5.27. Relocated note from paragraph 2.3.1 to 2.7. Modified paragraph 3.4.1. Added description of standard report #9 and #10 to Appendix C. Minor editorial changes throughout.
Revision	D	11/13/00	Revised definition of Recall Report (paragraph 1.16). Eliminated S&MA concurrence on extending calibration period with the exception of flight hardware and associated ground support equipment (paragraph 2.1.21.1). Added note to paragraph 2.1.12. Modified Appendix A to include items requiring periodic servicing and maintenance as Category 1. Added Category VI to Appendix A for equipment requiring "initial calibration only" which also required change to paragraph 2.1.8. Changed "Laboratory" to "Facility" in paragraph 2.2.1.
Revision	E	2/27/01	Added paragraph 1.24 Definition of "Verification." Modified paragraph 2.1.3.3 to include verifications. Modified paragraph 2.1.3.4 to include verification.
Revision	F	7/02/01	Added Funding requirement to paragraph 1.15. Added automated calibration to note following paragraph 2.1.2. Added clarification to paragraph 3.2.2. Modified retention requirements in Section 4.
Revision	G	1/29/03	Replaced Inspection, Measuring, and Test Equipment with MTE in several places. Replaced ISO 9002 with ISO 9001 in several places. Revised "ANSI/NCSL" from "NCSL/ANSI" and the title. Replaced ISO

			Guide 25 from Reference Section with ISO 17025. Added paragraph 1.5 on Equipment Categories. Major change is the combination of Categories IV and V, and changed Category VI to V. In paragraph 1.6 added "for capital equipment" and deleted "assigned to the test equipment" to clarify. In 1.7, combined sentence from 1.21. Moved last sentence in 1.9 to Appendix A. In paragraph 1.14 added "for MTE which does not have an ECN number assigned" and "when a NASA property ECN bar code label does not exist". Added "in 30 days", "in 60 days", and deleted "and will list overdue items only once" in Paragraph 1.17. Deleted first sentence in 1.2.1. In paragraph 2.1.3.9, added "limited" and deleted the last sentence. Moved " and notify the MSFC MCL Technical Monitor of any changes " in paragraph 2.1.4 to clarify. Deleted paragraph 2.1.5. In 2.1.5, added, "to accompany flight hardware, qualification hardware, or ground support equipment interfacing with flight hardware, and, at the discretion of the ULO, development hardware that could directly and significantly affect design of flight hardware. This tracking record will identify use of "and "Calibration of Category IV equipment prior to use or on a periodic interval will be noted in the tracking record." Added "or is within calibration interval" in paragraph 2.1.10. Added "calibration" in 2.1.16. Deleted last sentence of paragraph 2.1.18. Deleted 2.2.2.3. Deleted "Cal Mgr. No" in paragraph 2.2.2.5. In paragraph 2.2.4, added "by re-categorizing it" and deleted the last sentence. In paragraph 2.5.4, added "available" and "if". In paragraph 2.5.9, added "on-site". In 2.5.13, added "the data for". In paragraph 2.5.16, delete the last sentence. Add paragraph 2.5.21. Deleted paragraph 3.2.2. Added "notify calibration contact when equipment is being sent to OCV" in paragraph 3.2.8. Added filing and retention schedule in 4.1. Deleted paragraphs 4.1.11 and 4.1.12. In Appendix A replaced "calibration date" for "calibration status". Delete sentences in A.3, A.4, and A.5 that were moved to paragraph 1.5. Delete last sentence in A.4. In A.5, add "and shall only indicate the equipment is classified as Category III." Deleted last 3 sentences in A.6. Delete first sentence in A.7, and added "MSFC MCL will be contacted for verification that the MTE is appropriate for this category, and if so, will assign a NASA Calibration Control Number to the MTE unless it already has an ECN number, and issue…" Deleted last Note in paragraph A.7. In C.1.9, added "Category I test equipment listed here has already been given a 7 day grace period past its expiration date". Add paragraph C.1.11 and C.1.12. In C.2.1, added "NASA Calibration Control Number". In C.2.4, added "to the Army are at least 30 working days" to the last sentence. Deleted first two sentences in C.2.5.
Revision	H	7/17/2003	Change Section 2.1.3.3 to read: "Calibrations and verifications must employ a defined process (procedure), including: details of equipment utilized to perform the calibration or verification (equipment type, unique identification, such as model and serial number, equipment location); frequency of the calibration/verification (i.e. before each use, every 6 months, etc.); acceptance criteria (included in the procedure); and the action to be taken when results are unsatisfactory." Change sentence in 1.10 from "Intervals are determined by manufacturer's recommendations, experience, or statistical analysis of the "as found" condition of the MTE." To "The MCL determines calibration intervals based on such things as manufacturer's recommendations, Military designations, etc."
Revision	I	9/27/2004	Change MPG's to MPR's; Numerous punctuation, acronym, and grammatical corrections. Change must, should, and will to shall where applicable. Changed Section 1.16 to read: "Any test equipment or measuring device owned by a contractor employee, vendor, or corporation that is used as described in Appendix A, paragraph A.2." Section 2.1.6 was added to include requirements that were in the definitions section of 1.16 Non-Government-owned test equipment. In section 1.23, Test Software definition, the second sentence was deleted

			and the third sentence moved to section 2.1.7.7. Changed sentence in 2.2.2 to read "The information shall be provided on an MSFC Tag 15, an MSFC Form 4316, a marked up copy of the recall report, or an MCMS Web Page report. Added Section 2.3.2. In 2.5.14, deleted sentence "Privately-owned equipment used at MSFC will be tracked by serial number only." Deleted 2.5.22 and included it in 2.5.19. Some items that were previously "Notes" are now included in the numbered paragraph sections, resulting in re-numbering. Procedural steps in Section 3 were rewritten as requirements.
Revision	J	5/2/2006	Details of "Equipment Categories" moved from Definitions to Appendix A. Categories 1, 2, & 3 re-written in Appendix A. Calibration process and associated notes for Using Line Organization, MCL, and Outside Calibration Vendor put in a new detailed flow chart. Section 2.2.7 notes the change of a 20-working day turnaround for Category 2 equipment. Section 2.2.9, dealing with dispositioning out-of-tolerance conditions, was expanded to inform users of steps to take for flight and non-flight hardware. Responsibilities for MCL contractor updated to delete those items already specified in their contract. Appendix B updated to include Calibration Not Required Indicators and the new User Calibrated label. Records Section (section 4) revised to group required records by responsible organization. Added AS9100 to Applicable Documents.
Revision	K	3/16/2009	Revised applicability statement to include MSFC's MAF. Revised responsibilities section and various other sections to reflect that MSFC and MSFC's MAF have separate Calibration Facilities. Updated Records section 4.3.3 to clarify the retention of "tracking records" per NRRS 8/106 or 8/110, and section 4.4.3 to clarify that cal lab database shall be maintained such that production reports can be generated by calendar year, fiscal year, and contract year. Updated paragraph numbers and text in various places to ensure only one "shall" statement per paragraph. Implemented various editorial/grammatical corrections throughout the document.
Revision	L	5/3/2010	Changed MSFC's MAF to MAF throughout the document. Added a reference to MPR 8500.2 in P.1, Purpose, to satisfy requirements of ISO 14001 Environmental Management System, and resolve NCR 1208. Updated P.2 to match the new standard applicability statement template. Updated definition of "test report" to now be called "calibration report" and to clarify that it does not necessarily include a full uncertainty analysis of measuring equipment. Added a definition for NASA MCWG. Added a definition for Using Line Organization. Revised sections 1.20, 2.6.3, and 2.6.4 to separate out the designation of the MCWG Representative and the OPRD duties from the function of Technical Monitor for the MSFC Cal Lab. Updated sections 2.4.1 and 2.6.1 to reflect changes in the contractual mechanism utilized to provide calibration services at MSFC. Deleted the definition of stamp, and the associated requirement to maintain a listing of stamps, and revised sections 2.8.3, 4.4, CH21 and CH2.2 to remove the requirement for a technician stamp on the cal label, and replaced it with a requirement to include technician signature (or stamp) and date within the record system to ensure that it contains sufficient information to positively identify the technician who performed the calibration. Updated section 2.1.8 and 2.8.4 to clarify that the ULO provides funding for any required calibration reports. Clarified the requirement for "post-use verification" (section 2.1.15.1) to apply only when using MTE beyond its normal calibration interval. Added sections 2.1.20, 2.8.18, and 2.8.19, and revised section 2.2.7 to remove the concepts of normal/priority turnaround times, and replaced them with business model in which cal lab quotes estimated delivery time for each item and ULO provides funding for any overtime charges required to meet ULO schedule needs. Moved the responsibility for dispositioning OOT MTE and other responsibilities associated with MTE usage into a new section (2.3) for ULO end user. Added section

			2.8.1 to clarify that the internal cal labs (MSFC and MAF) shall be compliant with ISO 9001 and ANSI/NCSL Z540.1. Added section 2.1.10.1 through 2.1.10.3 and updated section 2.5.1.1 to clarify that the determination of "appropriate and beneficial to NASA" is made by the ULO, and to specify the criteria for such determination. In sections 2.8.16, 2.8.17, and 3.2.13 added allowance for use of appropriate labels in lieu of disposition tag. Significant text was added to section 3 in order to achieve compliance with MPR 1410.2., and to define the process requirements for the various types of calibrations performed and for new equipment. Updated section 4. Records to incorporate the new retention schedule for calibration records that was recently approved by National Archives and Records Administration. Updated section 4. Records to reflect the retention of ULO calibrated MTE records by the MCL. Removed the flowchart since all process steps are now defined in section 3 and all organizational responsibilities are specified in section 2. All appendices were changed to chapters (Appendix A changed to Chapter 1, etc.) in order to comply with the MWI 1410.1 prohibition against including requirement statements in appendices. In Chapter 1, added new categories for unserviceable MTE (Category 6) and inactive MTE (Category 7). Updated pictures of various labels and tags in Chapter 2 to match currently approved versions. Reference Documents were moved to a new Appendix A. Updated the section numbering in various places and other minor editorial changes throughout the document.
Revision	M	8/7/2014	Re-formatted to comply with new required template per MPR 1410.2J & as instructed in MWI 1410.1F. Major rewrite to realign with NPD 8730.1C. Changed title to match NPD 8730.1C, Metrology and Calibration. Changed Responsibilities and Requirements throughout the directive.
Change	1	3/27/2015	On 3/27/15, at the request of the OPRD, administrative changes were made at 2.7 Option 1&2 - Exception currently states 2.7.4, changed to 2.7.3.
Revision	N	5/20/2016	Section P.4 and 1.3.1: Deleted MPR 5000.1, Section 1.6.2: Added: Calibration categories are defined in Appendix E of this MPR. Section 1.7.5: Added: Metrology and Calibration Management System (MCMS). Added: NOTE: Information includes, but is not limited to: manufacturer, model, description, equipment control number, organization, calibration contact and phone number, calibration category, and pickup/delivery location (building and room number). Sections 1.7.5 and D.3.1.2: deleted category 3. Sections 2.2.8, 2.2.9, 2.3.4: Revised wording to clarify intent. Section 2.2.8: Added: NOTE: Category 1, 2, or 4 MTE may be submitted to the calibration performing organization at any time during the calibration period or at the end of its specific use (i.e., test, manufacture) for a minimum of an "as-found" check to identify any OOT MTE which could impact MSFC measurement process products/data before the product/data is delivered to the customer. Section 2.2.14.1: Added: At a minimum, the ECN or the calibration control number and the calibration due date shall be included in the MTE tracking record. Appendix A: Deleted term Calibration Contact Code and added information to Calibration Contact. Added: To the term Verification: An in-situ verification as a complement to calibration is a beneficial measurement assurance method for a measurement process. A verification does not eliminate the need for calibration on a periodic basis to ensure the health and reliability of the MTE. Appendix F.7: Deleted MSFC Tag 17 and Added Rejection Label. Document "ALL": Deleted all references of Michoud Assembly Facility (MAF). Changed associated language to imply for MSFC use only and renumbered and formatted. Changed 15 working days to 21 calendar days. Changed S&MA to SMA Added 2.2.10.1 for the ULO to notify the MCL that MTE was not used on flight before change to Cat. 2 or 3 and 2.10.14 for the MCL to apply a Rejection Label when MTE is unserviceable.

Change	1	6/23/2016	On 6/23/2016, at the request of the OPRD, administrative changes were made to delete "in precedence" from 2.9.2 due to a change of NPD 8730.1. Renumbered pages and updated Table of Contents.
Change	2	11/1/2017	On 11/1/17, at the request of the OPRD, administrative change made to add: 2.2.4 NOTE 3 Category 2 MTE that are passive devices, not safety critical, and there are no known or expected performance degradation while not being used, and the MCL has documented history to support the rationale, can be "Stored in Calibration" up to the original calibration interval due date. When needed, Category 2 MTE calibrated and labeled by the MCL with a "Stored in Calibration" label and are stored in the appropriate environmental conditions by the ULO; can be activated by the MCL and used as calibrated MTE. Added F.8 Stored In Calibration label example. Renumbered all pages.
Revision	O	4/9/2018	Revised sections P.1, P.3, P.4, 1.1.1, 1.2.1, 1.3.1, 1.3.2, 1.4.1, 1.5.1, 1.5.5, 1.5.6, 1.7.1, 1.7.5, 1.7.6, 1.8.1, 2.1, 2.1.1, 2.2.1, 2.2.1.1, 2.2.12.1, 2.3.1, 2.3.2, 2.3.3, 2.4.7, 2.5.2, 2.5.3, 2.5.4, 2.6.4, 2.9.2, 2.9.2.1, 2.10.1, 2.10.3, 2.10.4, 2.10.5, D.3.1.1, and D.4.1.3 to realign document requirements to new NASA-STD-8739.12. Deleted all references of NPD 8730.1. Changed E.5 Category 5 "Initial Calibration Only" to "Stored in Calibration" and provided a description. Revised wording for 2.2.4 NOTE 3 for 'Stored In Calibration." Revised Section 2.7 to delete option 2 manual OOT processing and associated requirements in D.3.2.3 and D.4.1.5 and provided requirements for processing OOTs via Impact Assessment System. Added Definitions for Impact Assessment System and Passive Devices. Added Acronyms CCN, ESD, and IAS. Deleted Appendix G. Renumbered sections and pages as needed.
Revision	P	3/16/2021	Revised: P4n, 1.2.2, 1.5.2, 1.5.9, 1.7.2, 2.2.4/Note 2, 2.2.5, 2.2.8/Note, 2.3.2, 2.4.3, 2.5.3, 2.5.4, 2.5.6, 2.6.5, 2.9.2, 2.9.2.1, D.2, D.3.2.3, D.3.2.4, D.4.1.3, and D.4.4, Added: 1.5.6 and 1.5.13 and renumbered section, 1.8.2, 2.3.2.1, and Appendix G. Deleted: D3.1.2
Change	1	3/3/2022	On 3/3/22, at the request of the OPRD, the following administrative changes were made: P.1 & P.3 Deleted NPD 8730.5, Added NPR 8735.2; P.4, Deleted ANSI/ESD S20.20-2014, Added NASA-STD-8739.6; 2.7.1.2 Note Changed OOT System to IAS; 1.5.7, 1.7.6, 2.3.3, & 2.4.7 Changed S20.20-2014 to NASA-STD-8739.6; D.3.2.3 & D.3.2.4 Changed NRRS 8/103 to NRRS 8/107; D.4.4 Deleted NRRS 8/103.

TABLE OF CONTENTS

PREFACE

P.1 PURPOSE

To establish Center requirements and responsibilities for metrology and calibration activities for Measuring and Test Equipment (MTE) at MSFC in accordance with NPR 8735.2, MPR 1280.10, and NASA-STD-8739.12.

P.2 APPLICABILITY

a. This MPR applies to Center personnel, programs, projects, and activities, including contractors and resident agencies to the extent specified in their respective contracts or agreements. ("Contractors" for purposes of this paragraph, include contractors, grantees, Cooperative Agreement recipients, Space Act Agreement partners, or other agreement parties.)

b. This MPR does not apply to the Michoud Assembly Facility.

c. This MPR applies the following: all mandatory actions (i.e., requirements) are denoted by statements containing the term "shall." The terms: "may" or "can" denote discretionary privilege or permission, "should" denotes a good practice and is recommended, but not required, "will" denotes expected outcome, and "are/is" denotes descriptive material.

d. This MPR applies the following: all document citations are assumed to be the latest version unless otherwise noted.

P.3 AUTHORITY

NPR 8735.2, Hardware Quality Assurance Program Requirements for Programs and Projects

NASA-STD-8739.12, Metrology and Calibration

P.4 APPLICABLE DOCUMENTS AND FORMS

a. NRRS 1441.1, NASA Records Retention Schedules

b. NASA-HDBK-8739.19-2, Measuring and Test Equipment Specifications

c. NASA-STD-8739.6, Implementation Requirements for NASA Approved Workmanship Standards

d. MPR 1280.10, Marshall Quality Management System

e. MPR 1440.2, MSFC Records Management Program

f. MPR 4000.2, Property Management

g. MPR 8730.3, Control of Nonconforming Product

h. MWI 8621.1, Mishap and Close Call Reporting and Investigation Program

i. MSFC-RQMT-2918, Requirements for Electrostatic Discharge Control

j. MSFC Form 460, Discrepancy Record

k. MSFC Label 63, User Calibrated Label

l. ANSI/NCSL Z540.1-1994-(R2002), Calibration Laboratories and Measuring and Test Equipment - General Requirements

m. ANSI/NCSL Z540.3-2006 (R2013), Requirements for the Calibration of Measuring & Test Equipment

n. ISO/IEC 17025; 2017, General Requirements for the competence of testing and calibration laboratories

o. NCSL RP-1, Establishment & Adjustment of Calibration Intervals

P.5 MEASUREMENT/VERIFICATION

None

P.6 CANCELLATION

MPR 8730.5O, Control of Inspection, Measuring, and Test Equipment, dated April 9, 2018.

Electronically approved by

Steven C. Miley for
Jody Singer
Director

CHAPTER 1. RESPONSIBILITIES

1.1 Center Director or designee:

Establish, implement, and monitor metrology and calibration requirements in accordance with NPD 8730.5 and NASA-STD-8739.12.

1.2 Program/Project Managers or designee:

1.2.1 Establish, implement, and monitor metrology and calibration requirements for program/project management functions in accordance with NASA-STD-8739.12, MPR 1280.10, and this MPR.

1.2.2 Ensure program/project record retention requirements are defined and documented in a Data Management Plan, in accordance with MPR 1440.2, to include organizational responsibilities and retention requirements for records involving calibrated MTE used to provide a service or product for the program/project.

1.3 Engineering Directorate Test Laboratory Manager or designee:

1.3.1 Ensure the Statement of Work in Requests for Proposals and resulting contracts for calibration services contain metrology and calibration program requirements which are appropriate for the contract in accordance with NASA-STD-8739.12, MPR 1280.10, and this MPR.

1.3.2 Ensure all MTE processed by the MSFC Metrology and Calibration Laboratory (MCL) affecting safety and mission success is calibrated in accordance with NASA-STD-8739.12, MPR 1280.10, and this MPR.

1.3.3 Recommend to the Center Director an individual for designation as the MSFC representative to the NASA Metrology and Calibration Working Group (MCWG).

1.3.4 Designate the Office of Primary Responsibility Designee for this MPR.

1.3.5 Designate a Technical Representative for the MSFC MCL.

1.4 Safety and Mission Assurance (SMA) Directorate Director or designee:

1.4.1 Ensure compliance with NASA metrology and calibration requirements in accordance with NASA-STD-8739.12, MPR 1280.10, and this MPR.

1.4.2 Designate a Quality Assurance Representative (QAR) for MCL service contracts, to monitor the performance and effectiveness of SMA requirements over the period of performance.

1.4.3 Review and concur with MTE calibration interval extension for MTE associated with flight hardware or associated ground support equipment.

1.5 Using Line Organization (ULO) Supervisor or designee:

1.5.1 Ensure the accuracy, reliability, calibration status, and use of ULO MTE in measurement processes for the functions and conditions listed in Section 2.1 are in accordance with NASA-STD-8739.12, MPR 1280.10, and this MPR.

1.5.2 Ensure ULO MTE are assigned the proper MSFC calibration category in accordance with this MPR. Refer to Appendix E for Category descriptions.

1.5.3 Ensure work instructions which utilize calibrated MTE are properly documented and implemented to maintain control and traceability of MTE within their respective organization.

1.5.4 Ensure calibrated MTE being used for the functions and conditions listed in 2.1 are taken out of service on or before the calibration due date in accordance with this MPR.

1.5.5 Ensure Category 4, ULO calibrated MTE, are repaired, calibrated, and records are controlled in accordance with NASA-STD-8739.12 and this MPR.

1.5.6 Ensure the ULO calibration system has been assessed by the MSFC Metrology and Calibration Program and is compliant to Section 2.3 prior to performing Category 4 calibrations.

1.5.7 Ensure electrostatic discharge (ESD) controls are in place for the calibration and/or repair of MTE when applicable in accordance with NASA-STD-8739.12, NASA-STD-8739.6 or MSFC-RQMT-2918, and this MPR.

1.5.8 Ensure Category 8, Standardize Before Use, MTE are utilized in accordance with Section 2.4.

1.5.9 Ensure all Outside Calibration Vendor (OCV) or Original Equipment Manufacturer (OEM) services procured by the ULO are processed in accordance with Section 2.5.

1.5.10 Review and concur with MTE calibration interval extensions.

1.5.11 Designate MSFC Calibration Contacts to interface with the MCL.

1.5.12 Ensure the lists of ULO MSFC Calibration Contacts at the MCL are current.

1.5.13 Recommend the review of applicable SATERN Metrology And Calibration Training Courses in Appendix G to ULO personnel that utilize MTE.

1.6 ULO Calibration Contact:

1.6.1 Coordinate metrology and calibration services with the MCL for assigned MTE in accordance with this MPR.

1.6.2 Coordinate with the ULO Supervisor and MTE User regarding assigned MTE requirements to include but not limited to: Calibration Contact requirements, MTE status, MTE requiring calibration or repair, over-due Category 1 MTE, MTE found to be Out-of-Tolerance (OOT), program/project records, and special calibration requests.

1.6.3 Ensure all OCV and OEM services are processed in accordance with Section 2.5.

1.6.4 Notify the MCL of excessed or transferred MTE. (MTE which is no longer in the MSFC inventory).

1.6.5 Maintain and keep current Category 1, 2, 4, 5, and 8 ULO MTE information and status in the Metrology and Calibration Management System (MCMS) by submitting additions or changes to MCL Production Control at MSFC: 256-544-4076.

> *NOTE: Information includes, but is not limited to; manufacturer, model, description, equipment control number, organization, calibration contact and phone number, calibration category, and pickup/delivery location (building and room number).*

1.6.6 Ensure MTE is submitted in accordance with 2.2.7, 2.2.8, and 2.2.10 when there is a potential impact to flight hardware, to associated ground support equipment, to directly affect design of flight hardware, or a risk to the customer's product.

1.7 ULO MTE User:

1.7.1 Select MTE based on its application and use in accordance with NASA-STD-8739.12, MPR 1280.10, and this MPR.

1.7.2 Ensure that measuring systems and the MTE calibration status conforms to the requirements consistent with the application prior to use in accordance with this MPR.

1.7.3 Assess and document OOT MTE in accordance with Section 2.7.

1.7.4 Ensure MTE are submitted in accordance with 2.2.7, 2.2.8, and 2.2.10 when there is a potential impact to flight hardware, to associated ground support equipment, to directly affect design of flight hardware, or a risk to the customer's product.

1.7.5 Ensure Category 4, ULO calibrated MTE, are repaired, calibrated, and records are controlled in accordance with NASA-STD-8739.12 and this MPR.

1.7.6 Ensure ESD controls are in place for the calibration and/or repair of MTE in accordance with NASA-STD-8739.12, NASA-STD-8739.6 or MSFC-RQMT-2918, and this MPR.

1.7.7 Notify the MCL when ULO MTE calibration records are to be maintained in the MCMS by the MCL for a program/project.

1.8 MCL:

1.8.1 Perform all metrology and calibration services in accordance with NASA-STD-8739.12, MPR 1280.10, this MPR, and/or calibration services contract requirements.

1.8.2 Recommend the review of applicable SATERN Metrology And Calibration Training Courses in Appendix G to MCL personnel.

CHAPTER 2. METROLOGY AND CALIBRATION REQUIREMENTS

2.1 Functions and Conditions Requiring Calibrated Measuring and Test Equipment

2.1.1 The measurement processes for the functions and conditions listed below, as identified in NASA-STD-8739.12, shall be controlled by the ULO to ensure the accuracy of measurement results:

a. Testing, qualification, certification, and acceptance measurements of flight hardware, ground support equipment, test systems, or other flight-related products.

b. Measurements essential to the safety of personnel and the public or for the protection of Government or private property.

c. Operation of telecommunications and transmission systems where exact signal interfaces and circuit confirmations are essential to mission success.

d. 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.

e. 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.

f. Physical measurements used to apportion, levy, or otherwise assign cost(s), or ensure local, State, or Federal regulatory compliance.

2.2 Calibrated MTE

2.2.1 Calibrated MTE shall be used to make measurements by the ULO when quantitative accuracy is required for measurement processes in support of the functions and conditions listed in 2.1.

NOTE 1: Calibration should not be confused with self-adjustment of MTE, often mistakenly called "self-calibration," or with verification of calibration. A calibration, which includes all requirements in accordance with NASA-STD-8739.12, may include verification that specified requirements, such as tolerances, performance, or other decision criteria have been met. Refer to NASA-HDBK-8739.19-2, section 10.2.3 on "Self-Calibrating Equipment."

NOTE 2: The term calibration is commonly misused when describing a measurement process control where the operation may only perform a verification, alignment, check,

or characterization with which calibrated MTE is used to monitor or check selected performance parameters of a system or operation.

2.2.1.1 To ensure the MTE measurement level of risk is acceptable for its criticality of use and will meet its required accuracy, MTE shall be selected and used by the ULO MTE User in accordance with NASA-STD-8739.12, MPR 1280.10, and this MPR. Refer to NASA-HDBK-8739.19-2, section 13.3 on the "Selection of MTE."

2.2.2 The use of calibrated MTE shall be specified by the ULO in Job Hazard Analysis (JHAs), Safety Awareness Training, and procedures when essential for the safety of personnel.

2.2.3 When the accuracy and reliability of MTE is essential for the safety of personnel, the MTE shall be designated by the ULO as Category 1. Refer to Appendix E for Category descriptions.

2.2.4 Category 1, 2, 4, 5, and 8 MTE shall have a MSFC label. Refer to Appendix F for MSFC Labels and Indicators Examples.

NOTE 1: Category 1 and 2 MTE may have a Limited Calibration label which defines the difference from an OEM performance specification.

NOTE 2: Exception: When the ULO has proof of calibration and the MTE is being used in a condition that does not allow the MSFC label to be attached or the environment has made the label illegible. The MSFC label may be stored in a book or other storage location that is easily accessible upon request.

NOTE 3: MTE can be placed in Category 5 up to the original calibration interval due date (maximum of 24 months) when they are passive devices, they are not safety critical, they have no known or expected performance degradation while not being used, they have documented history by the MCL to support the rationale, and they are stored in environmental conditions which are appropriate for the type item. When needed, Category 5 MTE is activated by the MCL and can be used as calibrated MTE from the activation date and for the defined calibration interval on the MCL assigned label.

2.2.5 Category 1, 2, or 4 MTE shall be verfied to be within its calibration interval by the ULO MTE User before use.

2.2.6 Before or by close of business of the calibration due date the ULO MTE User shall either take out of service Category 1, 2, or 4 MTE or obtain a calibration due date extension in accordance with Section 2.6.

2.2.7 Category 1 MTE shall be submitted by the ULO to the MCL within 21 calendar days past the calibration due date.

2.2.8 Category 2 MTE shall be submitted by ULO to the MCL for an "as-found" check within 21 calendar days past the calibration due date or at the end of its specific use prior to the

calibration due date (i.e., test, manufacture) to verify the MTE is still within specified tolerance when there is a potential impact to flight hardware, to associated ground support equipment, to directly affect the design of flight hardware, or a risk to the customer's product.

NOTE: Category 1, 2, or 4 MTE may be submitted for calibration at any time during the calibration period or at the end of its specific use (i.e., test, manufacture) for a minimum of an "as-found" check to identify any OOT MTE which could impact MSFC measurement process products/data before the product/data is delivered to the customer.

2.2.9 Category 2 MTE should be submitted by ULO to the MCL for an "as-found" check within 21 calendar days past the calibration due date or at the end of its specific use to verify the MTE is still within specified tolerance and calculate End of Period Reliability (EOPR) for all applications not identified in 2.2.8.

2.2.10 MTE which is being changed from Category 1 to Category 2 or Category 3 shall be submitted by the ULO to the MCL within 21 calendar days past the due date when there is a potential impact to flight hardware, to associated ground support equipment, to directly affect the design of flight hardware, or a risk to the customer's product.

2.2.10.1 When there is no potential impact in accordance with 2.2.10 and before the change will be made, the ULO shall provide the MCL with an email (or other documented record) with information to substantiate that the conditions described in 2.2.10 do not exist in this particular case. The MCL will determine whether or not the information provided is adequate to justify making the requested change in the MTE category.

2.2.11 MTE submitted to the MCL by the ULO shall be clean and free of process fluids.

NOTE: Unacceptable items will be returned to the ULO unserviced.

2.2.12 The calibration and use of customer-owned MTE shall be addressed by the ULO in a Customer Supplied Product Arrangement, in accordance with MPR 4000.2.

2.2.12.1 When associated with NASA programs and projects, the calibration and use of customer-owned MTE shall be verified by the ULO to be in accordance with NASA-STD-8739.12, this MPR, and/or contract requirements.

2.2.13 The handling, operation, storage, and transportion of MTE shall be appropriately performed by the ULO to maintain the MTE specified accuracy.

2.2.14 A MTE tracking record shall be provided by the ULO for Category 1, 2, 4, and 8 MTE to accompany flight hardware, qualification hardware, or ground support equipment interfacing with flight hardware and at the discretion of the ULO, development hardware that could affect design of flight hardware.

2.2.14.1 At a minimum, the Equipment Control Number (ECN) or the Calibration Control Number (CCN) and the calibration due date shall be included in the MTE tracking record.

2.2.14.2 Projects should review the calibration tracking record at major milestones (e.g. pre-ship reviews) and assess the risk of any measurements and/or verifications made with equipment that has not yet been verified that the MTE is still within specified tolerance. (See 2.2.8, 2.2.9, and 2.2.10.)

2.3 ULO Calibrated MTE

2.3.1 Category 4 MTE shall be calibrated by the ULO in accordance with NASA-STD-8739.12 and this MPR.

2.3.2 The ULO calibration system shall be compliant to either ANSI/NCSL Z540.1-1994 (R2002), ISO/IEC 17025; 2017, or ANSI/NCSL Z540.3-2006 (R2013).

2.3.2.1 The ULO calibration system shall be assessed to be compliant by the MSFC Metrology and Calibration Program prior to the ULO performing any calibrations.

2.3.3 ESD controls shall be maintained when applicable for the calibration and/or repair of MTE in accordance with NASA-STD-8739.12, NASA-STD-8739.6 or MSFC-RQMT-2918, and this MPR.

2.3.4 A Category 4 "User Calibrated" label shall be applied by the ULO to the MTE. The label will be provided by the MCL.

> *NOTE: Exception: When the ULO has proof of calibration and the MTE is being used in a condition that does not allow the label to be attached or the environment has made the label illegible.*

2.3.5 Category 4 MTE information to include the calibration data/test report shall be provided by the ULO to the MCL within 21 calendar days following the ULO calibration or "as-found" check of the MTE.

2.3.6 Category 4 MTE shall have an "as-found" check within 21 calendar days past the calibration due date or at the end of its specific use prior to the calibration due date (i.e., test, manufacture) performed by the ULO to verify the MTE is still within specified tolerance when there is a potential impact to flight hardware, to associated ground support equipment, to directly affect design of flight hardware, or a risk to the customer's product.

2.4 ULO Standardized MTE

2.4.1 Before use, Category 8 MTE information shall be provided by the ULO to the MCL.

2.4.2 A "Standardize Before Use" label shall be provided by the MCL to the ULO.

2.4.3 The Standard Reference Material (SRM) or "other standard" used to standardize ULO Category 8 MTE shall have a calibration in accordance with NASA-STD-8739.12 and this MPR.

2.4.4 The SRM or "other standard" information, to include the calibration data/test report, shall be provided by the ULO to the MCL if not already entered in the MCMS.

2.4.5 A MSFC calibration label shall be provided by the MCL for the ULO SRM or "other standard."

2.4.6 A documented standardization process or procedure for Category 8 MTE shall be used by the ULO.

> *NOTE: The OEM operation or maintenance manual normally defines the minimum frequency and the standardization process. Dependent upon the MTE or the criticality of the measurement being made, the standardization process may be performed prior to each measurement or it may be performed hourly or daily.*

2.4.7 ESD controls shall be maintained when applicable for the standardization process of MTE in accordance with NASA-STD-8739.12, NASA-STD-8739.6 or MSFC-RQMT-2918, and this MPR.

2.4.8 Each standardization occurrence shall be documented by the ULO to include the standardization date, SRM or other standard used, and the qualified person performing.

2.5 OCV and OEM Services

2.5.1 MTE requiring OCV and OEM services should be submitted by the ULO to the MCL.

2.5.2 All actions to procure (to include purchasing card; i.e., P-card) and process MTE for calibration and repair services by an OCV or OEM shall be understood and performed by the MCL or the ULO in accordance with NASA-STD-8739.12, MPR 1440.2, MPR 4000.2, and this MPR.

2.5.3 An OCV and OEM calibration compliant to one of the following: ANSI/NCSL Z540.1-1994-(R2002), ISO/IEC 17025; 2017, or ANSI/NCSL Z540.3-2006 shall be required by the MCL or the ULO procurement.

2.5.4 When calibrations compliant to ANSI/NCSL Z540.1, ANSI/NCSL Z540.3, or ISO/IEC 17025; 2017 are not available, the OEM may provide calibrations for their MTE. In such cases, evidence of traceability and documented test data shall be obtained from the OEM.

2.5.5 All actions associated with 2.5.2 shall be documented by the MCL or ULO to ensure all requirements are performed. The actions include, but are not limited to: vendor qualification, procurement quality requirements, NASA MTE Property Custodian notifications, receiving inspection, and record update within the MCMS.

2.5.6 The OCV or OEM MTE calibration data/test report and all associated information shall be provided by the ULO to update the MCMS MTE record to the MCL within 21 calendar days following the receipt of the calibrated MTE and prior to use.

2.6 MTE Calibration Intervals

2.6.1 Calibration intervals for MTE processed by the MCL shall be established and adjusted by the MCL to maximize MTE availability without adversely affecting the accuracy and quality of tests and measurements, or the reliability of operating systems.

NOTE: The calibration interval is influenced by equipment design, accuracy, operating environment, application, and end-item test criticality.

2.6.2 Category 4 MTE calibration intervals shall be established and adjusted by the ULO to maximize MTE availability without adversely affecting the accuracy and quality of tests and measurements, or the reliability of operating systems. The ULO may contact the MCL for assistance.

2.6.3 Calibration intervals shall be adjusted based on the condition of instruments as they are received for scheduled calibration (as-received condition) by the MCL or ULO.

NOTE: Equipment is calibrated, adjusted, or repaired to restore the as-built accuracy and stability specifications. A specified portion of the instrument population is expected to maintain accuracy throughout the assigned interval. This is referred to as the EOPR objective. The population is defined as all units having a common nomenclature (e.g., all micrometers) or all units having a common manufacturer and model number (e.g., all Weston Model 6440 microphones). Consideration may be given to subdividing nomenclature categories or manufacturers in order to improve useful time by eliminating poor performing instruments from the reliability data.

2.6.4 Calibration intervals should be adjusted by the MCL or ULO to achieve an EOPR target of ≥ 89% for OEM specified accuracy in accordance with NASA-STD-8739.12 and NCSL RP-1. When MTE OEM specified accuracy is not required for a measurement process in which it is being used, the ULO may request a limited calibration using the ULO specified accuracy and the calibration interval can be readjusted to maintain an EOPR target of > 89%.

2.6.4.1 When the MTE OEM specified accuracy is not required for Category 4, the ULO specified accuracy and interval shall be documented by the ULO.

2.6.5 A MTE calibration due date extension may be requested by the ULO to meet mission requirements prior to the end of the calibration due date.

2.6.5.1 An evaluation and concurrence by the MCL of the MTE history, measurement application, and other factors shall be requested by the ULO to ensure measurement reliability is commensurate with the ULO need.

2.6.5.2 The extension shall be documented by the ULO in an email and not exceed 10% of the calibration interval.

2.6.5.3 The ULO supervisor's and customer's (if the extension could increase the risk to the customer's product) documented concurrence shall be obtained by the ULO.

2.6.5.4 The SMA representative's documented concurrence shall be obtained by the ULO for MTE calibration due date extensions supporting flight hardware, associated ground support equipment, or when it directly affects the design of flight hardware.

2.6.5.5 The ULO shall obtain an updated calibration label from the MCL with the extended due date.

2.6.5.6 After the ULO measurement process has been completed, MTE in which the calibration due date has been extended shall be submitted by the ULO to the MCL for an "as-found" check within 21 calendar days.

2.7 Out-of-Tolerance (OOT) MTE

2.7.1 Upon receipt of an Impact Review OOT email notification from the MCL, the previous measurements taken by the suspect MTE shall be assessed by the ULO to determine the validity of and the impact to the ULO product or service in the MCMS Impact Assessment System (IAS) within 30 calendar days of receipt.

NOTE: The Impact Review OOT email notification will have a link to the IAS via the highlighted ECN or CCN under Item.

2.7.1.1 When the assessment takes longer than 30 calendar days, a justification and a projected suspense date shall be documented by the ULO MTE User on an email and sent to the NASA MCL Technical Representative for approval.

NOTE: The NASA Technical Representative's contact information will be provided on the email and OOT notification.

2.7.1.2 The email approving the extension shall be attached by the ULO in the IAS.

NOTE: The email will need to be converted to a pdf document before uploading to the MCMS IAS.

2.7.2 The OOT MTE impact assessment shall be documented by the ULO in the IAS and closed.

2.7.3 When there is a potential impact to flight hardware or associated ground support equipment, or when approvals outside the ULO are required, the records shall be documented and maintained by the ULO in accordance with MPR 8730.3 on a Discrepancy Record (DR), MSFC Form 460.

2.7.3.1 A copy of the completed MSFC Form 460 shall be attached or the MSFC Form 460 DR assigned number be entered into the MSFC MCMS IAS and closed.

2.7.4 If the OOT assessment identifies a potential impact to the safety of personnel or property, an evaluation by the ULO to determine if a MSFC Close Call Report or Mishap report in accordance with MWI 8621.1, if applicable, should be performed.

2.8 Non-Calibrated MTE

2.8.1 Non-calibrated MTE shall NOT be used by the ULO MTE User to perform inspections, take measurements, or collect data where quantitative measurement accuracy is required. Non-calibrated MTE may be used as an indication only in non-hazardous and non-critical applications. Category 3 (Calibration Not Required), Out-of-Date Category 2 and 4 MTE, and MTE without a label are considered to be Non-Calibrated.

NOTE 1: Exception: When the ULO has proof of calibration and the MTE is being used in a condition that does not allow the label to be attached or the environment has made the label illegible.

NOTE 2: To assist in identifying the calibration status of non-calibrated MTE being used in an indication only application, the ULO may place a "Calibration Not Required" label or draw a red diagonal line through the "Out-of-Date" Cat. 2 calibration label.

2.9 New MTE Purchases

2.9.1 New MTE purchases should be coordinated by the ULO with the MCL manager or designee prior to purchase to identify any future metrology and calibration support issues.

NOTE: The ULO may be required to purchase a calibration procedure, calibration software, and/or associated accessories. Typically, associated items can be obtained for free or for reduced cost when purchased with new MTE.

2.9.2 When available and purchased with new MTE, an OEM calibration compliant to one of the following: ANSI/NCSL Z540.1-1994-(R2002), ISO/IEC 17025; 2017, or ANSI/NCSL Z540.3-2006 shall be required by the ULO if the ULO plans to use the vendor calibration.

2.9.2.1 When calibrations compliant to ANSI/NCSL Z540.1, ISO/IEC 17025; 2017, or ANSI/NCSL Z540.3 are not available, original equipment manufacturers (OEM) may provide calibrations for their MTE. In such cases, evidence of traceability and documented test data shall be obtained from the OEM.

NOTE: In lieu of an OEM calibration, the ULO may utilize the MCL to perform the initial calibration. This will serve as an acceptance test and will allow performance issues to be addressed under the vendor's warranty. The MSFC MCL has experienced failure rates of >25% on some new MTE during initial calibrations of vendor calibrated

MTE, these items were returned immediately for warranty service minimizing ULO downtime.

2.9.3 An ECN or a CCN, as applicable, shall be obtained by the ULO for new MTE.

2.9.4 MTE information and the OEM Calibration Data/Test Report shall be provided by the ULO to the MCL to create a new MTE record in the MCMS and to obtain a MSFC calibration label before use.

2.10 Center Metrology and Calibration Services

2.10.1 Metrology and calibration services shall be developed, implemented, and maintained by the MCL contractor in accordance with NASA-STD-8739.12, MPR 1280.10, this MPR, and/or calibration services contract requirements.

2.10.2 The MCMS shall be maintained by the MCL for MTE records and management reports and also include, but not be limited to, calibration data/test reports, calibration status, due date of the next calibration, and repair data. Refer to Appendix D for Record retention.

2.10.3 Documented procedures shall be established and maintained by the MCL to control, calibrate, and maintain MTE to include associated calibration software in accordance with NASA-STD-8739.12 and this MPR.

2.10.4 Calibration procedures compliant with NASA-STD-8739.12 from other NASA Centers and other sources should be utilized by the MCL to minimize procedure development when applicable.

2.10.5 A qualified vendors list for OCV services processed by the MCL shall be established and maintained for MTE in accordance with NASA-STD-8739.12 and this MPR.

2.10.6 An estimated turnaround time for each item of MTE submitted shall be provided to the ULO by the MCL.

2.10.7 An estimated cost for priority charges required to expedite MTE turnaround time shall be provided by the MCL.

2.10.8 When ULO MTE is sent outside the MCL for any reason, the ULO shall be notified by the MCL.

2.10.9 When MTE is sent offsite for more than 30 calendar days or upon its return, the NASA Property Custodian shall be notified by the MCL for MTE property accountability tracking in accordance with MPR 4000.2.

2.10.10 "Calibration Void if Broken" labels or torque sealant shall be applied by the MCL on critical adjustment locations to prevent unauthorized adjustment of MTE. Refer to Appendix F for MSFC Labels and Indicators Examples.

2.10.11 Monthly reports shall be generated and provided by the MCL to include, but not limited to, Category 1 calibration due, courtesy Category 2 calibration due, overdue Category 1 MTE, calibration services contract Data Requirement Document reports, and other reports as requested.

NOTE: The calibration due and overdue reports are commonly referred to as Recall Reports.

2.10.12 An OOT notification for MTE where the "as-found" condition does not conform to specified tolerances shall be provided by the MCL.

2.10.13 When the MTE user requests a Category 1 change to Category 2 or Category 3 an email shall be sent by the MCL to the requester as a notice to assess in accordance with 2.2.10.

2.10.14 A "Rejection Label" shall be attached by the MCL to MTE that cannot be serviced. Refer to Appendix F for MSFC Labels and Indicators Examples.

APPENDIX A.

DEFINITIONS

Acceptance Test A measurement process which verifies a procured part, component, or system meets the specification requirements as received for the first time.

Calibration The set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material, and the corresponding values realized by standards. As used herein, a calibration may also include verification that specified requirements, such as tolerances, performance, or other decision criteria, have been met. It may also include actions to take when requirements have not been met.

Calibration Contact An individual appointed to act as a single point of contact for one or more pieces of test equipment. A code will be assigned by the MCL to the Calibration Contact and will be used in the MCMS to link MTE to the responsible Calibration Contact.

Calibration Control Number (CCN) A unique number assigned to MTE by the MCL for MTE which does not receive a NASA ECN from the NASA Property Organization.

Calibration Interval The period of time the MTE is expected to meet the performance specifications to which it was calibrated and the environmental conditions to which it was designed to operate. The calibration interval is usually expressed in months, to meet or exceed an EOPR target commensurate with organizational goals and end use criticality.

Calibration Data/Test Report A report that gives correction, measured value(s), conditions of test, curves, charts, error limits, or other pertinent data relating to the calibration performed on the MTE.

Calibration Software Software that controls an automated calibration system or conditions a data signal from the point of measurement to the end point of use.

Equipment Control Number (ECN) A unique number assigned to equipment by the Property Management Office for controlled equipment.

End of Period Reliability (EOPR) The in-tolerance probability for a MTE attribute or parameter at the end of its calibration interval.

Impact Assessment System (IAS) A MSFC MCMS web-based system to document the impact review and archival of OOT or discrepant MTE.

Limited Calibration A calibration that is performed and identified to a limited number of functions or to different specifications from the OEM specifications. It can also be used to identify a unique or characterized calibration, the extension of a calibration interval, and mating MTE as a calibration system.

Measurement Process Control Performed during the operational phase, where bias and precision values are compared to previous values to assure that the measurement process is operating within the designed uncertainty range. It can identify tendencies where the acceptable uncertainty range may be exceeded and when to take corrective actions before out-of-tolerance conditions develop.

Measuring and Test Equipment (MTE) Any device used to perform a measurement(s) where distinct measurement values are required for system performance or to demonstrate conformance to specified requirements.

Measuring and Test Equipment Category The calibration category a ULO assigns to MTE to assist in identifying MTE, usage, serviceability, and calibration status. (See Appendix E for details concerning MTE Categories.)

Metrology The science of measurement, embracing both experimental and theoretical determinations at any level of uncertainty in any field of science and technology.

Metrology and Calibration Laboratory (MCL) The official onsite specialized laboratory responsible for performing calibration services, tests, and minor repairs of MSFC MTE.

Metrology and Calibration Management System (MCMS) The MSFC database which is used for production control of MTE supported by the respective MCL and contains all pertinent MTE and calibration records for the Center.

NASA Metrology and Calibration Working Group (MCWG) The MCWG acts as a technical forum to discuss Agency policy and issues common to all standards and calibration operations and to recommend research projects that meet the present needs and future strategic goals of the Agency.

Outside Calibration Vendor Any calibration service provider other than the MCL.

Passive Device A device without complex internal electronics, internal power supplies, amplifiers, or analog to digital conversion. Passive devices may contain electronics including resistors, capacitors, inductors, etc. that are stable. These devices generally convert mechanical properties to an output that can be recorded. Examples of passive devices include wheatstone bridge based sensors, analog pressure gages, analog micrometers, and vane flowmeters with magnetic pickups. Passive MTE is generally stable over a long period of time and do not deteriorate from a measurement perspective if properly stored while not in use.

Recall Report A report generated from the MCMS which provides a listing of MTE due for calibration and of MTE which are overdue (delinquent) for calibration.

Technical Representative The NASA Civil Servant assigned to be the Technical Representative for the contract managed MCL. Also may serve as the MCWG Representative and contract Technical Monitor.

Traceability Where a calibration is traceable through the National Institute of Standards and Technology (NIST) or a National Metrology Laboratory recognized by NIST to the International System of Units (SI) by an unbroken chain of calibrations.

Tracking Record A record that accompanies flight hardware, qualification hardware, ground support equipment interfacing with flight hardware and, at the discretion of the ULO, development hardware that could directly and significantly affect design of flight hardware. The record lists MTE used in an associated measurement process so that in the event a piece of MTE is found to be out-of-tolerance an investigation may be performed.

Using Line Organization (ULO) An Organization that utilizes MTE in the performance of providing a service or product in a measurement process in the implementation of the functions and conditions listed in Section 2.1. The ULO is generally the customer that receives metrology or calibration services from the MCL, although the ULO may perform user calibrations of MTE.

Verification Tests and analyses to be performed during the design, development, assembly, integration, and operational phases of a measurement system to assure that specified requirements have been met. It can include all subsystem and system tests done at the functional level. An in-situ verification as a complement to calibration is a beneficial measurement assurance method for a measurement process. A verification does not eliminate the need for calibration on a periodic basis to ensure the health and reliability of the MTE.

APPENDIX B.

ACRONYMS

ANSI	American National Standards Institute
CCN	Calibration Control Number
DR	Discrepancy Record
ECN	Equipment Control Number
EOPR	End of Period Reliability
ESD	Electrostatic Discharge
HDBK	Handbook
IAS	Impact Assessment System
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
JHA	Job Hazard Analysis
MCL	Metrology and Calibration Laboratory
MCMS	Metrology and Calibration Management System
MCWG	Metrology and Calibration Working Group
MTE	Measuring and Test Equipment
NCSL	National Conference of Standards Laboratories
NIST	National Institute of Standards and Technology
NRRS	NASA Records Retention Schedules
OCV	Outside Calibration Vendor
OEM	Original Equipment Manufacturer
OOT	Out of Tolerance
OSHA	Occupational Safety and Health Administration
RP	Recommended Practice
SI	International System of Units
SMA	Safety Mission Assurance
SRM	Standard Reference Material
ULO	Using Line Organization

APPENDIX C. VERIFICATION MATRIX (Reserved)

None

APPENDIX D.

RECORDS

D.1 Records will be retained in accordance with NRRS 1441.1 and MPR 1440.2.

D.2 Unless otherwise noted, records will be filed and retained in accordance with NRRS 08/041.5.A. The retention/disposition for these records are "destroy when no longer needed."

> *NOTE: The retention period for records relating to environmental protection, Occupational Safety and Health Administration (OSHA) or other regulatory requirements may be lengthened (as required) in order to meet any applicable retention requirements established by federal/state legislation or regulation.*

D.3 ULO Records:

D.3.1 The ULO will provide the following records/information to the MCL (which is designated as Office of Record for these records):

D.3.1.1 Calibration records and calibration software records (for MTE calibrated by the ULO) will be in accordance with NASA-STD-8739.12, and this MPR.

D.3.2 The ULO (or as specified in documented agreement with Program/Project Office) will be the Office of Record for the following records associated with MTE usage in support of program/project activities:

D.3.2.1 Calibration interval extension concurrence record (i.e., memos, emails, etc.). This is a temporary record that is not essential for the ongoing operation of the program/project. As such, it will be maintained in accordance with NRRS 8/106 or 8/110. The retention and disposition is "temporary. Destroy/delete when no longer needed." The interval extension concurrence record may be destroyed after the post-use verification is performed and the disposition of any out-of-tolerance condition has been completed.

D.3.2.2 Tracking record. The tracking record is a temporary record that contains a duplication of the information contained in other program/project records and that is not essential for the ongoing operation of the program/project. As such, it will be maintained in accordance with NRRS 8/106. The retention and disposition is "temporary. Destroy/delete when no longer needed." The tracking record may be destroyed after the post-use verification is performed and the disposition of any out-of-tolerance condition has been completed.

D.3.2.3 "Standardize Before Use." A record retained by the ULO to document each standardization event in accordance with 2.4.7. It may also have retention requirements as temporary program/project records that have operational value throughout the life of the program/project. As such, a copy will be maintained as part of the applicable program/project case file, in accordance with NRRS 8/107 . The disposition is temporary. Destroy/delete

between 0 and 30 years after Program/Project Termination. This retention period is in parallel to the period specified by NRRS 08/041.5.A. Destroy when no longer needed..

D.3.2.4 Copies of calibration records retained as program/project records. These calibration records may have retention requirements as temporary program/project records that have operational value throughout the life of the program/project. As such, they are to be maintained as part of the applicable program/project case file, in accordance with NRRS 8/107. The disposition is temporary. Destroy/delete between 0 and 30 years after Program/Project Termination.

D.4 MCL Records:

D.4.1 The MCL will be the Office of Record for the following records:

D.4.1.1 Metrology and Calibration Management System Database.

D.4.1.2 Calibration certificates/reports from OCV or OEM. (Those obtained by the MCL and those forwarded by the ULO.)

D.4.1.3 OCV quality verification. Records verifying that the OCV is compliant with NASA-STD-8739.12, Metrology and Calibration. As such, they are retained per NRRS 08/041.5.A. The retention/disposition for these records are "destroy when no longer needed."

D.4.1.4 Traceability.

D.4.1.5 IAS to archive Out of Tolerance notifications and assessments.

D.4.1.6 Calibration records of MTE calibrated by the ULO (provided by the ULO to the MCL).

D.4.2 Calibration data, MTE information, and Calibration Contacts will be kept current in the calibration database.

D.4.3 The calibration database will also be maintained such that production reports can be generated by calendar year, fiscal year, and contract year.

D.4.4 Calibration records associated with ULO MTE used on a program/project and retained by the MCL when notified by the ULO or program/project. The calibration records and the retention period are in parallel to the period specified by NRRS 08/041.5.A. The retention/disposition for these records are “destroy when no longer needed.” These calibration records may have retention requirements as temporary program/project records that have operational value throughout the life of the program/project. As such, the record will be annotated in the MCL MCMS as part of the applicable program/project case file and maintained in accordance with 8/107. The disposition is temporary. Destroy/delete between 0 and 30 years after cutoff.

D.5 SMA Directorate Records:

D.5.1 The SMA Directorate will be the Office of Record for the following records:

D.5.2 DRs, MSFC Form 460s, will be maintained in accordance with MPR 8730.3. DRs are used to document the disposition of out-of-calibration/out-of-tolerance condition, impacts, and subsequent action plans for MTE used on flight hardware or associated ground support equipment.

APPENDIX E.

MTE CATEGORIES

E.1 **Category 1** MTE on Recall. Calibrations performed by the MCL, OCV, or OEM on an established interval.

E.1.1 MTE used regularly in a measurement process where MTE accuracy and reliability are essential for the safety of personnel will be designated as Category 1. MTE frequently used, may be placed in this category at the discretion of the ULO.

E.2 **Category 2** Calibrate Before Use. Infrequently used MTE that requires a MCL, OCV, or OEM calibration before being used and post processed in accordance with 2.2.8 or 2.2.9 before storing.

E.3 **Category 3** Calibration Not Required. ULO determined non-calibrated MTE routinely used in applications where quantitative accuracy is not required, and for "indication only" purposes in non-hazardous, non-critical applications.

E.4 **Category 4** ULO Calibrated. MTE calibrated prior to use or on a periodic interval by the ULO. The ULO accepts the liability of calibrating the MTE and providing the required documentation and records to the MCL. The ULO will obtain "User Calibrated" labels from the MCL.

E.5 **Category 5** Stored in Calibration. MTE can be placed in Category 5 up to the original calibration interval due date (maximum of 24 months) when they are passive devices, they are not safety critical, they have no known or expected performance degradation while not being used, they have documented history by the MCL to support the rationale, and they are stored in environmental conditions which are appropriate for the type item. When needed, Category 5 MTE is activated by the MCL and can be used as calibrated MTE from the activation date and for the defined calibration interval on the MCL assigned label.

E.6 **Category 6** Unserviceable. MTE found to be inoperable and determined to be "infeasible to repair" by the MCL. The MTE is tagged with a Disposition Tag (Unserviceable), or "Do Not Use" or "Reject" label, and returned to the user.

E.7 **Category 7** Inactive. MTE no longer in use at MSFC due to being excessed, disposed of, transferred to a non-MSFC entity, or is no longer in the NASA/MSFC property inventory. MTE is placed in this category based on notification from the ULO with the records retention time based on the date it was placed into this category.

E.8 **Category 8** Standardize Before Use. MTE which is normalized, spanned, or otherwise adjusted prior to use.

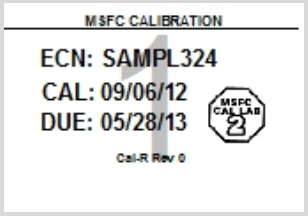
NOTE: Examples include hardness testers, pH meters, gas chromatographs.

APPENDIX F.

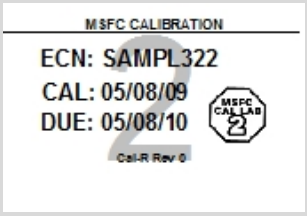
MSFC LABELS AND INDICATORS EXAMPLES

NOTE: A missing or illegible decal does not void the calibration of the MTE provided the calibration records are documented to be current. The label may be affixed to the MTE, to a tag affixed to the MTE, or the case or container associated with the MTE.

F.1 Calibration label (MCL controlled). Applied by the MCL for Category 1 and Category 2 MTE calibrated to original specifications. The label will have a shadowed number 1 or 2 to identify the MTE category. The label can be printed in various sizes.



Category 1



Category 2

(Black on White)

F.2 Limited Use Calibration label (MCL controlled). Applied by the MCL for limited calibrations. This includes but not limited to include MTE that cannot be restored to original specifications; MTE with no parameters for calibration; function or verification check only; ULO does not require full calibration; or OCV calibrated MTE quality requirements cannot be verified from the OCV report. It may also be applied for ULO defined MCL special calibrations. The label will have a shadowed number 1 or 2 to identify the MTE category. The label can be printed in various sizes.

Category 1

Category 2

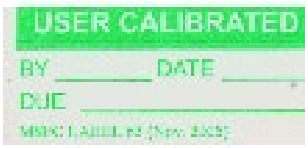
(Black on Yellow)

F.3 Calibration Not Required labels. The labels are to assist in identifying Non-calibrated MTE, but not required, the ULO should place a "Calibration Not Required" label when using MTE as indication only. The silver with red labels are obtained at the MCL. The orange and white labels may be used, but are no longer available.

(Red on Silver)

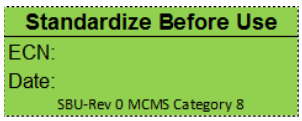
(Orange on White)

F.4 User Calibration label (MSFC Label 63). A label affixed to a piece of MTE indicating it was calibrated by a ULO. The labels are obtained at MCL.



(Green on White)

F.5 Standardize Before Use label (MCL controlled). A label affixed to a piece of MTE which is normalized, spanned, or otherwise adjusted prior to use.

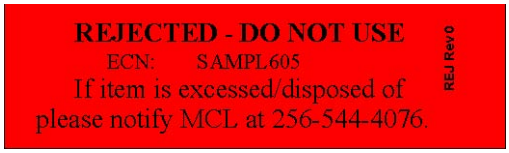


(Black on Green)

F.6 Calibration Void if Broken label and indicators. A frangible label or affixed by the MCL to a piece of MTE to preclude user access to adjustments.

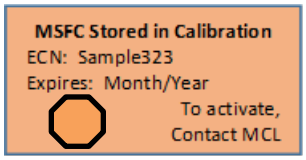
NOTE: Torque Sealant may also be used for the same purpose. Various versions dependent on use.

F.7 Rejection label. A label attached by the MCL to MTE that cannot be serviced.



(Black on Red)

F.8 Stored In Calibration label. A label affixed by the MCL to calibrated MTE which will be stored by the ULO until needed.



(Black on Orange)

APPENDIX G

SATERN METROLOGY AND CALIBRATION TRAINING COURSES

G.1 Recommended Metrology and Calibration training courses:

NOTE: Courses G.1.1 through G.1.4 are recommended for ULO Supervisors, ULO Calibration Contacts, ULO MTE Users, and MCL personnel. Course G.1.5 is recommended for ULO MTE Users and applicable MCL personnel. Courses G.1.6 and G.1.8 are recommended for applicable MCL personnel.

G.1.1 SMA-HQ-WBT-103, NASA Metrology and Calibration Program Requirements Overview
This course provides an introduction to, and overview of, the requirements levied by the NASA Metrology and Calibration program. It explains the flow down of metrology and calibration requirements to the NASA Programs, Projects, and Centers. The learner will be able to identify what voluntary consensus standards apply and describe what is expected for implementation of the voluntary consensus standards.

G.1.2 SMA-HQ-WBT-106, More Than a Sticker: The Importance of Calibrating Measuring and Test Equipment
This course provides an overview of the technical benefits and necessity of calibration, beyond expected requirements and standards. The learner will be able to define calibration, recognize the benefits of calibration, including why it is necessary, describe why measuring and test equipment must be calibrated on a periodic basis and identify what can go wrong with calibrated measuring and test equipment.

G.1.3 SMA-HQ-WBT-107, Handling, Transport, Storage & Shipping of Measuring & Test Equipment
This course provides an overview of the proper physical handling, transport, storage, and shipping of MTE to ensure it will continue to meet its accuracy specifications. The learner will be able to describe key aspects of proper physical handling of MTE, recognize common ways of mishandling MTE, identify requirements for handling ESD-sensitive MTE, describe good practices for transporting and storing MTE, and describe good practices for packaging MTE in preparation for shipping.

G.1.4 SMA-QE-WBT-148, Metrology and the Consequences of Bad Measurement Decisions
Metrology is the science of measurement, and, in the simplest terms, provides the measurement data used to make decisions. Measurement-based decisions impact all phases of product development. This presentation demonstrates metrology's influence throughout the lifecycle and then, through factual case studies, illustrates the negative consequences when one or more of metrology's elements fail.

G.1.5 SMA-QE-WBT-342, Measurement Uncertainty Analysis
This course discusses methods of evaluating and expressing uncertainty in measurement referenced to NASA Measurement Quality Assurance Handbook - Annex 3, NASA-HDBK-8739.19-3, Measurement Uncertainty Analysis Principles and Methods. The learner will be able to: - Identify the relationship of measurement uncertainty to measurement-based decisions; - Identify sources (e.g., Standards) requiring estimation or mitigation of measurement uncertainty; - Demonstrate an understanding of the principles and methods related to measurement uncertainty analysis; - Perform a measurement uncertainty analysis.

G.1.6 SMA-QE-WBT-343, Measurement Decision Risk
This course covers analysis and management of measurement decision theory using risk analysis methods and procedures referenced to NASA Measurement Quality Assurance Handbook - Annex 4, NASA-HDBK-8739.19-4, Estimation and Evaluation of Measurement Decision Risk. The learner will be able to: Demonstrate an understanding of measurement decision risk methods; Understand the differences between different decision risk methods; Demonstrate an understanding of the principles and methods related to estimating measurement decision risk; Be able to discuss the probability of false accept risk for each method described.

G.1.7 SMA-HQ-WBT-217, 4:1 Test Accuracy Ratio for Compliance with Z540.1-1994 (R2002) Sub-clause 10.2 B
ANSI/NCSL Z540.1-1994 (R2002), Calibration Laboratories and Measuring and Test Equipment – General Requirements [Z540.1] includes a requirement for calibration procedures to have a minimum test accuracy ratio (TAR) of 4:1. This course includes an overview of the TAR, the formulas for calculating a TAR, and examples of TAR calculations. The course also covers the calculation and use of guard-bands for calibrations in which the 4:1 TAR cannot be achieved.

G.1.8 SMA-HQ-WBT-102. Programmable Josephson Voltage Standard (PJVS)
This course provides an overview of the theory and operation of the NASA Programmable Josephson Voltage Standard (PJVS), addresses safety concerns when working with the PJVS, and demonstrates the NASA procedure for handling and operating the PJVS. This primarily to provide refresher training to current PJVS operators and initial training to personnel preparing to become approved PJVS operators.