NOT MEASUREMENT SENSITIVE

MIL-HDBK-1839
27 AUGUST 1996

SUPERSEDING
MIL-STD-1839B
20 AUGUST 1995

DEPARTMENT OF DEFENSE HANDBOOK

CALIBRATION AND MEASUREMENT REQUIREMENTS

This handbook is for guidance only.
Do not cite this document as a requirement.

AMSC N/A **AREA QCIC**

FOREWORD

1. This military standard is approved for use by all Departments and Agencies of the Department of Defense.

2. Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to AGMC/MLSR, 813 Irving-Wick Dr W, Newark AFB OH 43057-0001, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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1. SCOPE

1.1 Purpose. This standard describes the requirement to provide a means for calibration and measurement traceability of all system, subsystem, and equipment parameters that must be measured to ensure system and equipment operational integrity and accuracy. It describes the process of establishing measurement traceability from actual system and equipment level measurement requirements to the National Institute of Standards and Technology (NIST) or other approved measurement sources. These measurement requirements are traced through properly selected and calibrated test, measurement, and diagnostic equipment (TMDE) or appropriate measurement sensors, through individual Military Department or commercial calibration facilities, to approved national measurement standards.

1.2 Applicability. The requirements of this standard apply to all systems, subsystems, and equipment that require measurement of any type to ensure proper operation.

1.2.1 Application guidance

a. When Logistics Support Analysis (LSA), MIL-STD-1388-1 and Logistics Support Analysis Record (LSAR), MIL-STD-1388-2, are compliance documents on an acquisition program, the requirements of this standard should be an integral part of the LSA/LSAR effort. Data developed as a result of this standard should be documented in and become part of the LSA documentation and LSAR. Work accomplished and data developed shall not duplicate any other effort or data developed by the contractor.

b. When LSA and LSAR are exempted or their application tailored to exempt development of the data requirements in this standard, this standard can become an independent compliance document on the acquisition program and tailored in accordance with the contract.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4, and 5 of this standard. This section does not include documents cited in other sections of this standard or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements document cited in sections 3, 4, and 5 of this standard, whether or not they are listed.

2.2 Government documents

2.2.1 Specifications, standards and handbooks. The following standards and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation (see 6.2).

STANDARDS

DEPARTMENT OF DEFENSE

MIL-STD-1388-1	-	Logistics Support Analysis
MIL-STD-1388-2	-	Logistics Support Analysis Record

HANDBOOK

DEPARTMENT OF DEFENSE

MIL-HDBK-300 - Military Handbook, Technical Information File of Support Equipment

(Unless otherwise indicated, copies of above military standards and handbooks are available from the Standardization Documents Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.2.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

TO 33K-1-100-1	-	Technical Manual TMDE Calibration Notes, Maintenance Data Collection Codes, Calibration Measurement Summaries, Transportable Field Calibration Unit Configuration and Automatic Calibration System Supportable Equipment
TO 33K-1-100-2	-	Technical Manual TMDE Calibration Manual TMDE Calibration Interval Technical Order and Work Unit Code Reference Guide
TB 43-180	-	Calibration and Repair Requirements for the Maintenance of Army Material
NAVAIR 17-35MTL-1	-	Metrology Requirements List
TM-10510-14/1	-	U.S. Marine Corps Electronics Test Equipment Listing
TO 33K-1-101	-	Technical Manual, Calibration Standards and Associated Equipment
NAVAIR 17-35NCE-1	-	Navy Calibration Equipment List (NCE)

(Copies of Air Force TO 33K-1-100-1, 33K-1-100-2, Army TB 43-180, NAVAIR 17-35MTL-1, TO 33K-1-101, or NAVAIR 17-35NCE-1 should be obtained as directed by the contracting officer. The Marine Corps Technical Manual is available from HQMC, Technical Manual Sec., Washington, DC 20380-0001.)

2.3 Order of precedence. In the event of a conflict between the text of this standard and the references cited herein, the text of this standard shall take precedence. Nothing in this standard, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. DEFINITIONS

3.1 Calibration. A comparison between items of equipment, one of which is a measurement standard of known accuracy, to detect, correlate, adjust, and report any variation in the accuracy of the other item(s).

3.2 Support Equipment (SE). All equipment used in calibration and maintenance support of mission and operational equipment. Support equipment that provides for measurement traceability is usually designated as TMDE.

3.3 Test, Measurement, and Diagnostic Equipment (TMDE). Any system or device used to test, measure, evaluate, inspect, or otherwise examine materials, supplies, equipment, or a system to identify or isolate (or both) any actual or potential malfunction, or to determine compliance with specifications established in technical documents (research, development, test, and evaluation documents; specifications; engineering drawings; technical orders).

3.4 Measurement Traceability. The ability to relate individual measurement results through an unbroken chain of calibrations to a common recognized source. This is achieved by tracking a required system or equipment measurement accuracy through a more accurate measurement device that has been calibrated by a higher accuracy standard (as used in a Military Department calibration facility), ultimately reaching a recognized national standard.

3.5 Test Accuracy Ratio (TAR). The maximum permitted error of the unit to be measured or calibrated divided by the maximum known error of the measuring or generating device used to perform the measurement. For example, if it is required that a system or equipment output parameter be accurate to 8% (maximum permitted error) and the known accuracy (maximum known error) of the measuring device used to measure the output parameter is 2%, then the TAR is 4.

3.6 Military Department Calibration Facility. A military laboratory or equivalent facility that possesses and uses measurement standards and performs calibration and repair of TMDE.

3.7 Logistics Support Analysis (LSA). The selective application of scientific and engineering efforts undertaken during the acquisition process, as part of the system engineering and design process, to assist in complying with supportability and other Integrated Logistics Support (ILS) objectives. (MIL-STD-1388-1, Logistics Support Analysis). The LSA process is a planned series of tasks performed to examine all elements of a proposed system to determine the logistics support required to keep that system useable for its intended purpose; and to influence the design so both the system and support can be provided at an affordable cost.

3.8 Logistics Support Analysis Record (LSAR). Documentation resulting from performance of LSA task conducted under MIL-STD-1388-1 and MIL-STD-1388-2.

3.9 Support Equipment Recommendation Data (SERD). A report used to identify and justify support equipment requirements.

3.10 Calibration and Measurement Requirements Summary (CMRS). A report which details the measurement requirements of a system, subsystem, or equipment; the test, measurement, and diagnostics equipment (TMDE); and the calibration standards and equipment required to assure traceability of all measurements through the individual Military Department's metrology and calibration programs to approved National Standards.

3.11 Automatic Test Equipment (ATE) Unit Under Test (UUT) Interface. The point located on the ATE where all input and output signals are accessible for connection to an external UUT or calibration standard.

4. GENERAL REQUIREMENTS

4.1 Assess test and measurement requirements. The contractor shall assess system and equipment test and measurement requirements during all phases of design, development, and production. The contractor shall identify all parameters that must be measured to ensure proper and accurate operation of the system and equipment. The system shall be designed to reduce maintenance by keeping the frequency, number, and duration of the tests required to verify proper system operation to a minimum.

4.2 Ensure accessibility of parameters. The contractor shall, by designing for testability, ensure ready accessibility of parameters which must be measured to verify proper and accurate system and equipment operation.

4.3 Ensure technical documentation verifies required parameters. The contractor shall ensure that the system, equipment, and recommended support equipment technical documentation provide for measurement or verification of all parameters that must be measured in order to assure proper and accurate operation of the system and equipment.

4.4 Calibration support and measurement traceability. The contractor shall consider calibration support and measurement traceability of system, subsystem, and equipment measurement requirements during all design, development, and production phases of the contract. This effort shall be maintained to current system and equipment configuration during performance of the contract and shall include all support TMDE.

4.5 Impose provisions of this document to subcontractors. The contractor shall impose the provisions of this document on subcontractors and associate contractors. Parameters developed by subcontractors and associate contractors in Section 5 shall be maintained and integrated into the total requirements by the contractor.

5. DETAILED REQUIREMENTS

5.1 System, subsystem, and equipment measurement parameters.

5.1.1 Assessment of parameters. The contractor shall assess all system, subsystem, and equipment parameters that must be measured or tested to ensure proper system or equipment operation and accuracy, and to ensure intended mission goals are met.

5.1.1.1 Selecting TMDE. This assessment of parameters shall be used by the contractor as the basis for recommending or selecting TMDE and developing support documentation.

5.1.1.2 Sequence of relationship. This assessment of parameters shall portray the logical sequence of relationship within and between the system, subsystem, and equipment, and identify the parameters requiring measurement and verification.

a. System parameters are those parameters that require measurement and verification to ensure proper operation and nondegradation of the system so the mission requirements of the system can be accomplished.

b. Subsystem parameters are those parameters that require test and measurement to ensure interchangeability, proper operation, and nondegradation of the subsystem when integrated into the complete system.

c. Equipment parameters are those parameters that require test and measurement to ensure interchangeability, proper operation, and nondegradation of the equipment when used as part of or connected with the system or subsystem.

5.1.1.3 Description of items. The system, subsystem, equipment, assembly, module, or component that has parameters that require measurement shall be identified by nomenclature, manufacturer and manufacturer's code, part or model number, and type designation. If an item does not have an approved part number, but does have an approved or proposed end item specification number or system number, that number shall be referenced. Each requirement shall identify:

a. Function: The function (specific input, output, or other characteristic which has units of measurement such as volts, frequency, power, current, length, force, etc.) which must be measured, tested, checked, or adjusted to determine or maintain the item's operational condition.

b. Operational range or specific value: The range of values or actual value that shall be measured to satisfy operational requirements.

c. Operational Tolerance: The tolerance of the range or specific value within which the equipment must perform to meet operational specifications.

d. Interval: The contractor shall recommend a maximum time lapse between tests or other method of scheduling tests.

e. Built-In Test (BIT) and Built-In Test Equipment (BITE). For parameters of Built-In Test (BIT) and Built-In Test Equipment (BITE), or other internal measurements which are part of the operational equipment requiring test or measurement, the nomenclature, manufacturer or code, part number or model number, range and accuracy of the item shall be identified, as well as the parameters being monitored or generated. When built-in references are employed, a method of test or measurement shall be identified or, if not required, a narrative justification shall be documented.

5.2 System, subsystem, and equipment test points. The contractor shall ensure measurements can be accomplished; i.e., test points are identified in technical data, can be found in the system and equipment, and are accessible with minimum disturbance to configuration of the system and equipment.

5.3 Test, measurement, and diagnostic equipment (TMDE).

5.3.1 TMDE. The contractor shall ensure that TMDE is recommended to satisfy all measurement requirements identified in accordance with 5.1.

a. The equipment recommended shall be capable of functioning in the system operational measurement environment and satisfy all parameters of each measurement in accordance with 5.3.3.

b. The contractor shall assess TMDE specifications in support of measurement requirements identified in accordance with 5.1. Where several items of TMDE are used in combination, the overall test configuration specification and accuracy shall be considered.

5.3.2 TMDE in support of other TMDE.

a. The contractor shall identify calibration equipment and standards required support TMDE recommendations in accordance with 5.3.1 which are not currently supportable (i.e. not listed with calibration procedures and intervals) by the applicable Military Department metrology and calibration program. Refer to Air Force TO 33K-1-100-1/2, Army TB 43-180, Navy NAVAIR 17-35MTL-1, or Marine Corps TM-10510-14/1 to determine TMDE supportability. Refer to Air Force TO 33K-1-101, Army TB 43-180 or Navy NAVAIR 17-35NCE-1 and MIL-HDBK-300 to identify existing Military Department calibration equipment and standards.

b. The calibration equipment and standards identified shall satisfy all parameters of each measurement in accordance with 5.3.3.

c. The contractor shall assess specifications of the calibration equipment and standards used in support of other TMDE. Where several items are used in combination to support other TMDE, the overall test configuration specification and accuracy shall be considered.

5.3.3 Test accuracy ratio (TAR). Unless otherwise specified, the recommended TMDE shall be capable of measuring or generating to a higher accuracy than the measurement parameters being supported. A minimum TAR of 4 to 1 is required. The actual TAR shall be documented.

a. If a TAR of 4 to 1 cannot be achieved, the contractor shall analyze the measurement requirements and justify the lesser TAR.

b. A minimum TAR of 4 to 1 is required when an actual test is being conducted to characterize performance of operational equipment or to calibrate other TMDE.

c. A TAR of 4 to 1 is not required when the TMDE only provides input stimuli which is not used to characterize performance of the operational equipment or other TMDE. In this case, the TAR does not need to be greater than 1 to 1.

5.3.4 Automatic Test Equipment (ATE).

5.3.4.1 ATE design. The ATE performance specifications shall be more accurate than the system or equipment operational requirements. (See 5.3.3.).

5.3.4.2 ATE Technical Description.

a. The contractor shall assess the complete measurement and stimuli capabilities that can be made available at the ATE UUT interface.

b. The contractor shall determine the subset of ATE capabilities actually used for UUT testing.

c. Support equipment recommended for test, measurement, and calibration of ATE shall be selected to support ATE capabilities actually being used for UUT testing and ATE self testing.

5.3.4.3 ATE calibration. The contractor shall assess all functions and parameters required for UUT testing, ATE self-test, and calibration of the ATE. ATE calibration is implemented as a test program set (TPS) with the program running on the ATE host computer.

a. The calibration TPS shall measure the ATE parameters at the ATE UUT interface.

b. The ATE calibration TPS shall be structured to provide traceability of every calibrated function and parameter via external standards to approved national standards. To this end, external standards and calibrated ATE components, used as working or secondary standards, shall be used.

c. The calibration TPS shall not calibrate the ATE to more than a TAR of 4 to 1. This includes, but is not limited to, the most stringent support requirements of the UUT, self-test, and the calibration TPS itself.

d. In the case of ATE that uses built-in calibration standards, these standards shall be identified with their full measurement and stimuli capabilities. Provisions of 4.2 for accessibility shall apply.

e. Calibration standards or calibration procedures used to support built-in standards shall be recommended.

5.4 Technical data.

5.4.1 The contractor shall ensure all system, subsystem, or equipment measurements required for operational integrity and accuracy are supported by appropriate test procedures or directions in the applicable technical documentation.

5.4.2 The test procedures or directions in the technical documentation shall show use of approved SE.

5.4.3 A cross reference shall be maintained between required system, subsystem, or equipment tests and technical documentation.

5.5 Calibration and Measurements Requirements Summary (CMRS). When required by the contract, data developed in Section 5. shall be used by the contractor to prepare a CMRS in accordance with 6.3.

6. NOTES

(This section contains information of a general or explanatory nature which may be helpful, but is not mandatory)

6.1 Intended use. This document provides a means for calibration and measurement traceability to ensure system and equipment operational integrity and accuracy.

6.2 Issue of DoDISS. When this standard is used in acquisition, the applicable issue of the DoDISS must be cited in the solicitation (see 2.2.1).

6.3 Associated Data Item Descriptions (DIDs). This standard is cited in DoD 5010.12-L, Acquisition Management Systems and Data Requirements Control List (AMSDL), as the source document for the following DID. When it is necessary to obtain the data, the applicable DID must be listed on the Contract Data Requirements List (DD Form 1423), except where the DoD Federal Acquisition Regulation Supplement exempts the requirement for a DD Form 1423.

DID Number	DID Title
DI-QCIC-80278	Calibration and Measurement Requirements Summary (CMRS)

The above DID was current as of the date of this standard. The current issue of the AMSDL must be researched to ensure that only current and approved DIDs are cited on the DD Form 1423.

6.4 Military department regulatory documents

The following documents are for information only:

AF Instruction 21-113	Air Force Metrology and Calibration (AFMETCAL) Program
Army Regulation 750-43	Army Test, Measurement, and Diagnostic Equipment Calibration and Repair Support Program
NAVELEX 4355.2	Department of the Navy Metrology and Calibration (METCAL) Program
TO 00-20-14	Air Force Metrology and Calibration Program
TB 750-25	Maintenance of Supplies and Equipment: Army Test, Measurement, and Diagnostic (TMDE) Calibration and Repair Support Program
OPNAV 4790.2	Naval Aviation Maintenance Program
TO 33-1-27	Logistic Support of Precision Measurement Equipment in FSC
MCO 4733.1	MARCOR Test, Measurement, and Diagnostics Equipment Calibration and Maintenance Program
SC-6625	Support Concept for MACOR TMDE

6.5 Subject term (keyword) listing.

Accuracy	Tests
Checked	Traceability
Metrology	Specifications
Parameters	Standards

6.6 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue do to the extent of the changes.

CONCLUDING MATERIAL

Custodians:
Army - MI
Navy - OS
Air Force - 30

Review Activities:
Army - AR, AT, AV, CR, SC, TM
Navy - AS, EC, MC, NM, SH, TD
Air Force - 11, 13, 16, 17, 19

Preparing Activity:
Air Force - 30
(Project QCIC 0157)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.

2. The submitter of this form must complete blocks 4, 5, 6, and 7.

3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:	**1. DOCUMENT NUMBER** MIL-HDBK-1839	**2. DOCUMENT DATE (YYYYMMDD)** 950820

DOCUMENT TITLE CALIBRATION AND MEASUREMENT REQUIREMENTS

4. NATURE OF CHANGE *(Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)*

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME *(Last, First, Middle Initial)*	b. ORGANIZATION	
c. ADDRESS *(Include Zip Code)*	d. TELEPHONE (Include Area Code) (1) Commercial (2) DSN *(if applicable)*	**7.DATE SUBMITTED** (YYYYMMDD)

8. PREPARING ACTIVITY

a. NAME AGMC/MLS	b. TELEPHONE *Include Area Code)* (1) Commercial 614-522-7550 (2) DSN 346-7550
c. ADDRESS *(Include Zip Code)* 813 IRVING-WICK DR W. NEWARK, AFB OH 43057-0001	**IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:** DEFENSE STANDARDIZATION PROGRAM OFFICE (DLSC-LM) 8725 John J. Kingman Road, Suite 2533 Fort Belvoir, Virginia 22060-6221 Telephone (703) 767-6888 DSN 427-6888