

MIL-STD-1839 (USAF)
31 December 1986

MILITARY STANDARD
CALIBRATION AND MEASUREMENT
REQUIREMENTS



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MIL-STD-1839

DEPARTMENT OF DEFENSE
WASHINGTON DC 20402

Calibration and Measurement Requirements

1. This military standard is approved for use by the Department of the Air Force and is available 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, Newark AFS OH 43057-5475, by using the self-addressed 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 means for calibration, verification, 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 Bureau of Standards (NBS) 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 the US Air Force Precision Measurement Equipment Laboratories (PMELs) or other military services' (Army or Navy) equivalent or commercial calibration facilities, to approved national measurement standards.

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

2. REFERENCED DOCUMENTS

The documents cited in this section are for guidance and information.

2.1 Government Documents

2.1.1 Standards

MIL-STD-1519 - Test Requirements Document, Preparation of

MIL-STD-1388-1 - Logistics Support Analysis

2.1.2 Other Government Documents and Publications.

TO 33K-1-100 - TMDE Interval, Calibration and Repair Technical Order Reference Guide and Work Unit Code Manual

MATE Guides - Modular Automatic Test Equipment Guides

2.2 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.

2.3 Source of Documents

a. Copies of listed military standards are available from the Department of Defense single stock point, Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120-5099.

b. Copies of TO 33K-1-100 should be obtained as directed by the contracting officer.

c. The MATE Guides are available from the San Antonio Air Logistics Center MATE Operations Center, SA-ALC/MMTMM Kelly Air Force Base, TX 78241-5000.

3. DEFINITIONS

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For the purpose of this standard, the following definitions shall apply:

- a. Calibration: Calibration is 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).
- b. Support Equipment (SE): Equipment used in calibration and maintenance support of mission and operational equipment and other support equipment. Support equipment that measures or imparts measurement traceability is normally designated as TMDE.
- c. Test, Measurement, and Diagnostic Equipment (TMDE): Those devices used to test, measure, evaluate, inspect, or otherwise examine materials, supplies, equipment, and systems to identify or isolate any actual or potential malfunction, or to determine compliance with specifications established in technical documents (RDT&E documents, specifications, engineering drawings, technical orders).
- d. Traceability: Traceability of measurements is the process of documenting that all measurements are based on 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 the PMELs), ultimately reaching a recognized national standard. Measurement ratios of at least 4:1 are desirable.
- e. Precision Measurement Equipment Laboratory (PMEL). An Air Force laboratory that possesses and uses measurement standards and performs calibration and repair of designated TMDE.
- f. Test Requirements Document (TRD). A contractor-prepared document, described by MIL-STD-1519, which records performance and calibration requirements of testable end items.
- g. 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, Logistic 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.
- h. Modular Automatic Test Equipment (MATE). A systematic approach to the definition, acquisition and support of automatic testing capabilities.
- i. Support Equipment Recommendation Data (SERD). A data item used to identify and justify support equipment requirements.

4. GENERAL REQUIREMENTS

4.1 The contractor shall consider system and equipment measurement requirements during all phases of design, development and production. He 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

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system operation to a minimum. A TRD prepared in accordance with MIL-STD-1519 may provide the basis for documenting parameters.

4.2 The contractor shall ensure ready accessibility of parameters which must be measured to verify proper and accurate system and equipment operation.

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

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

4.5 Measurement traceability is established when system, subsystem, or equipment measurement requirements are supported by properly selected TMDE which has been calibrated by a PMEL or other approved calibration facility.

4.6 The contractor shall impose the provisions of this MIL-STD on subcontractors and associate contractors. List developed by subcontractors and associate contractors in 5. shall be maintained and integrated by the contractor.

5. DETAILED REQUIREMENTS

5.1 System, Subsystem, and Equipment Measurement Parameters.

5.1.1 The contractor shall develop a list of all system, subsystem, and equipment parameters that must be measured, tested, or verified to ensure proper system or equipment operation and accuracy, and to ensure intended mission goals are met. This list shall not duplicate any other data prepared by the contractor as part of the overall technical effort for the program.

5.1.1.1 This list of parameters will serve as a basis for recommending or selecting support equipment (SE) and developing support documentation.

5.1.1.2 This list 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 measurement and verification to ensure the proper operation and nondegradation of the subsystem when integrated into the complete system.

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

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5.1.1.3 Description of measurement requirements. 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. Initially, 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. For each item, the list shall identify:

a. Function. The function (specific input or output, etc., such as volts, frequency, power, current, length, or force) which must be measured, tested, verified, checked, or adjusted in order to determine the item's operational condition.

b. Operational Range or Specific Value. The range of values or actual value that shall be measured to satisfy the operational requirements.

c. Operational Tolerance. The accuracy requirements within which the equipment must perform to meet the operational specifications.

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

e. 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 verification shall be identified. In such cases, 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 or standards are employed, a method of measurement or verification shall be identified or, if not required, a narrative justification will 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 satisfy all parameters of each measurement such as range, specific value, and accuracy.

b. Documentation shall list TMDE specifications in support of measurement requirements identified in accordance with 5.1.

5.3.2 TMDE in support of TMDE.

a. The contractor shall identify equipment required to support recommended TMDE not currently supportable by the Air Force metrology and calibration program. Refer to TO 33K-1-100 to determine Air Force TMDE supportability.

b. Documentation shall list specifications of TMDE used in support of other TMDE.

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5.3.3 Test Accuracy Ratio. The recommended TMDE shall be capable of measuring or generating to a higher accuracy than the measurement parameters being supported (a minimum accuracy ratio of 4 to 1 is desired; however, this may not be possible in all applications). The actual test accuracy ratio (TAR) shall be documented.

5.3.4 Automatic Test Equipment (ATE).

5.3.4.1 ATE design. ATE design is based on the measurement requirements of the operational system, subsystem, or equipment being supported. ATE design is directed toward equipment items which meet standards contained in the MATE Guides. The ATE performance specifications shall be more accurate than the system or equipment operational requirements. (See 5.3.3)

5.3.4.2 ATE specifications.

a. The ATE specifications shall reflect complete measurement and stimuli capabilities that can be made available at the Unit Under Test (UUT) interface.

b. The subset of ATE capabilities actually used for UUT testing shall be identified.

c. Support equipment recommended for measurement verification and calibration of ATE shall be selected to support ATE capabilities being used.

5.3.4.3 ATE calibration. Calibration of ATE shall include all functions and parameters used during UUT testing, ATE Self Test, and ATE calibration. This calibration shall be implemented as a Test Program Set (TPS) with the program running on the ATE host computer. The Calibration TPS shall certify the ATE at the UUT interface. 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. In the case of ATE that uses built-in calibration standards, these standards shall be identified with their full measurement and stimuli capabilities. Calibration standards or calibration procedures used to support built-in standards shall be identified.

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 (title or TO number and content).

6. NOTES

6.1 Data Requirements. When this standard is used in an acquisition which incorporates a DD Form 1423, Contract Data Requirements List (CDRL), the data requirements identified below shall be developed as specified by an approved Data Item Description (DD Form 1664) and delivered in accordance with the approved CDRL

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incorporated into the contract. When the provisions of DOD FAR Supplement Part 27, sub-part 27.410-6 are invoked and the DD Form 1423 is not used, the data specified below shall be delivered by the contractor in accordance with the contract or purchase order requirements. Deliverable data required by this standard is cited in the following paragraph:

<u>MIL-STD Task Paragraph</u>	<u>Data Requirement Title</u>	<u>Applicable DID No</u>
5.	Calibration and Measurements Requirement Summary	DI-QCIC-80278

(Data item descriptions related to this standard, and identified in section 6 will be approved and listed as such in DOD 5010.12-L, AMSDL. Copies of data item descriptions required by the contractors in connection with specific acquisition functions should be obtained from the Naval Publications and Forms Center or as directed by the contracting officer.)

6.2 Information and Reference Documents

The documents listed in this section are for information only:

AF Regulation 74-2	Air Force Metrology and Calibration Program
TO 00-20-14	Air Force Metrology and Calibration Program
TO 33-1-27	Logistic Support of Precision Measurement Equipment in FSC
MIL-STD-45662	Calibration Systems Requirements

6.3 Subject Term (Keyword) Listing

Accuracy
Calibration
Checked
Measurements
Metrology
Parameters
Tests
Traceability
Specifications
Standards
Verifying

Custodian:
Air Force - 30

Preparing Activity
AGMC/MLSR - 30
(Project QCIC F057)

Review Activities:
Air Force - 05, 10, 11, 13, 14, 15, 17, 18, 19, 95

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions - Reverse Side)

1. DOCUMENT NUMBER

2. DOCUMENT TITLE

3a. NAME OF SUBMITTING ORGANIZATION

4. TYPE OF ORGANIZATION (Mark one)

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☐

USER

☐

MANUFACTURER

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OTHER (Specify): _____

b. ADDRESS (Street, City, State, ZIP Code)

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER (Last, First, MI) - Optional

b. WORK TELEPHONE NUMBER (Include Area Code) - Optional

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8. DATE OF SUBMISSION (YYMMDD)

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NOTE: This form may not be used to request copies of documents, nor to request waivers, deviations, or clarification of specification 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.

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