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MILITARY HANDBOOK

EVALUATION OF CONTRACTOR'S CALIBRATION SYSTEM



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DEPARTMENT OF DEFENSE
Washington, DC 20301

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Evaluation of Contractor's Calibration System

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1. This standardization handbook was developed by the Department of Defense with the assistance of the Department of the Army in accordance with established procedure.
2. This publication was approved on 17 August 1984 for printing and inclusion in the military standardization handbook series.
3. This document provides information and guidance to personnel concerned with the evaluation of a contractor's calibration system, primarily in connection with MIL-STD-45662, "Calibration System Requirements." The handbook is not intended to be referenced in purchase specifications, nor shall it supersede any specification requirements.
4. Every effort has been made to reflect the latest information on the evaluation of a contractor's calibration system. It is the intent to review this handbook periodically to insure its completeness and accuracy. Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, US Army Missile Command, ATTN: DRSMI-EDS, Redstone Arsenal, AL 35898-5270 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) at the end of this document or by letter.

MIL-HDBK-52A
17 August 1984

CONTENTS

	Page
Paragraph 1 INTRODUCTION-----	1
1.1 Purpose-----	1
1.2 Scope-----	2
2 REFERENCED DOCUMENTS-----	2
3 DEFINITIONS-----	2
4 GENERAL STATEMENT OF REQUIREMENTS-----	2
4.1 General-----	2
4.2 Quality Assurance Provisions-----	3
5 DETAILED STATEMENTS OF REQUIREMENTS-----	5
5.1 Description-----	5
5.2 Adequacy of Standards-----	6
5.3 Environmental Controls-----	7
5.4 Intervals of Calibration-----	8
5.5 Calibration Procedures-----	10
5.6 Out of Tolerance Evaluators-----	11
5.6.1 Adequacy of the Calibration System-----	11
5.6.2 Notification of Out of Tolerance Conditions-----	12
5.7 Calibration Sources-----	13
5.7.1 Domestic Contracts-----	13
5.7.2 Foreign Contracts-----	16
5.8 Application and Records-----	17
5.9 Calibration Status-----	18
5.10 Control of Subcontractor Calibration-----	20
5.11 Storage and Handling-----	21
5.12 Amendments and Revisions-----	22
Appendix Checklist for Evaluation of Contractor's Calibration System-----	23

MIL-HDBK-52A
17 August 1984

EVALUATION OF CONTRACTOR'S CALIBRATION SYSTEM

1. INTRODUCTION

1.1 Purpose. This handbook outlines the individual parts of a theoretically complete calibration system. It is not necessarily the ideal system for any particular application or contractor, but the information contained herein is intended as a text for the guidance of Department of Defense personnel in the uniform evaluation of each aspect of the various contractor calibration systems. The following amplifications of the purpose is provided:

- a. It is recognized that each contractor functions individually and consequently the calibration system of each may differ in the specific methods of accomplishment. It is not the intent of this handbook to attempt to standardize these systems, but to present the basic, functional concepts that, when conscientiously implemented, will provide assurance that the contractor's measuring and test equipment (M&TE) is sufficiently accurate to assure conformance of supplies and services to contractual requirements. Evaluation of a contractor's calibration system is to be made when military standard MIL-STD-45662, "Calibration System Requirements," is prescribed as a contractual requirement.
- b. Throughout the handbook emphasis is placed on "controls" in the form of reviews, documentation, audits, labels, and other means. These controls permit the Government representative to evaluate contractor operations and to determine their effectiveness. In addition, these controls will serve in the collection of important data. It is the responsibility of the evaluator to determine, in each case, those calibration system requirements that are made applicable by contractual documents. These requirements are paramount and are not intended to be infringed by any interpretive or informational material supplied in this handbook. The evaluator must determine, to the extent necessary, the accuracy in the use of M&TE applicable to the particular contract. Any determination by the evaluator that an aspect pertaining to the calibration system is not satisfactory must be supported by objective evidence, and followed by a request to the contractor for corrective action.

MIL-HDBK-52A
17 August 1984

c. Department of Defense personnel responsible for evaluating the effectiveness of contractor calibration systems are referred to collectively in the handbook as the "Government representative".

1.2 Scope. This handbook is intended to provide the basis for a more thorough understanding by the Government representative of the requirements of each paragraph of MIL-STD-45662.

2. REFERENCED DOCUMENTS

2.1 Referenced documents. The following document of the issue in effect on the date of invitation for bids or request for proposal, form a part of this handbook to the extent specified herein.

STANDARDS

MILITARY

MIL-STD-45662 - Calibration System Requirements

(Copies of specifications, standards, drawings, and publications required by contractors in connection with specific procurement functions should be procured from the procuring activity or as directed by the contracting officer).

3. DEFINITIONS

3.1 Definitions. The terms used herein are defined in MIL-STD-45662.

4. GENERAL STATEMENT OF REQUIREMENTS

4.1 General. This section presents a discussion of each requirement in sections 4 and 5 of MIL-STD-45662. Each pertinent paragraph is extracted from the standard, and is followed by a discussion of its concept and application. The "Concept" discusses the purpose of the requirement, while the "Application" presents specific areas for the evaluator's consideration.

(a) Requirement.

"4.1 General. The contractor shall establish or adapt and maintain a system for the calibration of all measuring and test equipment used in fulfillment of his contractual requirements. The calibration system shall be coordinated with his Inspection or Quality Control Systems and shall be designed to provide adequate accuracy in use of measuring and test equipment. All measuring and test equipment applicable

MIL-HDBK-52A
17 August 1984

to the contract, whether used in the contractor's plant or at another source, shall be subject to such control as is necessary to assure conformance of supplies and services to contractual requirements. The calibration system shall provide for the prevention of inaccuracy by ready detection of deficiencies and timely positive action for their correction. The contractor shall make objective evidence of accuracy conformance readily available to the Government representative."

(b) Concept.

It is the responsibility of the contractor to utilize only M&TE of required accuracy in fulfillment of his contractual requirements. Since the accuracy of this equipment, wherever used, must be effectively controlled, the contractor must have an established system for its calibration. This calibration system, whether established at the contractor's facility, at a subcontractor facility, or provided by some other source, must exercise the proper controls over all applicable M&TE and provide measures for prevention, ready detection, and prompt correction of discrepancies. In addition, the system must be coordinated with the contractor's proposed or established inspection system or quality program. The contractor must provide objective evidence, in the form of records, of conformance to the required accuracy. The records shall be available for Government review.

(c) Application.

The Government representative must assure that an adequately described system for calibration support of the contractor's M&TE exists and is implemented. The contractor's calibration system shall be coordinated with his inspection or quality control system, and shall be designed to provide adequate accuracy in use of M&TE. For example, it is necessary that the contractor's calibration system make provision for the prevention of equipment inaccuracies by readily detecting deficiencies and providing positive action for their correction. Therefore, the Government evaluator should verify the existence of a quality program, or inspection system, that provides notification to the calibration agency of damaged or inoperative instruments, erratic readings, or other observed factors which could degrade instrument performance.

4.2 Quality Assurance Provisions.

(a) Requirement.

MIL-HDBK-52A
17 August 1984

"4.2 Quality assurance provisions. All operations performed by the contractor in compliance with this standard will be subject to the Government verification at unscheduled intervals. Verification will include but not be limited to the following:

a. Surveillance of calibration operation for conformance to the established system.

b. Review of calibration results as necessary to assure accuracy of the system. The contractor's gages, measuring and testing devices shall be made available for use by the Government when required to determine conformance with contract requirements. If conditions warrant, contractor's personnel shall be made available for operation of such devices and for verification of their accuracy and condition."

(b) Concept.

The surveillance portion of the requirement provides the evaluator with an indication that the contractor is performing as required. When surveillance indicates that the contractor may not be performing as required, the evaluator must conduct a more in-depth review. The first step in extracting more information concerning the adequacy of the contractor's performance is a review of calibration results. This may be a sample of a day's output, a sample of a specific instrument type, or other sources of data. When a review of calibration results further confirms that the contractor may not be performing as required, the evaluator may require a recalibration of suspect items already calibrated. The contractor's equipment shall be made available for use by the Government representative in performing the recalibration, or contractor's personnel will be made available for this purpose. The scope of the contractor's support shall be defined and agreed to before starting the verification.

(c) Application.

The Government representative must assure that the contractor's calibration operation conforms to the written, established system. The unscheduled reviews must verify that each element of the contractor's operation is in conformance with his written, established system. These elements are described in paragraph 5.1(c)1-7 and outlined in the appendix of this handbook.

MIL-HDBK-52A
17 August 1984

When surveillance indicates that the contractor may not be performing as required, the Government representative shall review the results of a representative sample of M&TE and standards calibrated by the contractor. If warranted by unsatisfactory results of the review, the Government representative may request recalibration of suspect items and request that the contractor implement appropriate corrective action.

5. DETAILED STATEMENTS OF REQUIREMENTS

5.1 Description.

(a) Requirement.

"5.1 Calibration system description. The contractor shall provide and maintain a written description of his calibration system covering measuring and test equipment and measurement standards to satisfy each requirement of this standard. The portion dealing with measuring and test equipment shall prescribe calibration intervals and sources and may be maintained on the documents normally used by the contractor to define his inspection operations. The description for calibration of measurement standards shall include a listing of the applicable measurement standards, both reference and transfer, and shall provide nomenclature, identification number, calibration interval and source, and environmental conditions under which the measurement standards will be applied and calibrated. The description of the calibration system and applicable procedures and reports of calibration shall be available to the Government representative."

(b) Concept.

To assure uniformity of understanding and performance, and to assure continuity of satisfactory operations when personnel changes occur, it is necessary that all proposed or existing procedures or practices intended to implement the contractor's calibration system be documented. System documentation also provides a basis for evaluation and control by both contractor and the Government representative. Without written guides, policy and procedural questions are bound to arise, and variations in practice that occur may result in confusion and uncertainty. It is desirable for the contractor to establish or adapt his calibration system in advance of production requirements, thus allowing the Government representative to complete his review prior to the start of production.

MIL-HDBK-52A
17 August 1984

(c) Application.

The Government representative shall ascertain that a written description of the contractor's calibration system is prepared and available for his review. A specific format is not required. Documents normally used by the contractor in his inspection or quality control operation, if adequate coverage is provided, are acceptable. The description must provide a complete detailed plan for controlling the accuracy of M&TE and measurement standards utilized in determining conformance with contractual requirements. A method, procedure, or standard practice must be prescribed for the satisfaction of each applicable requirement of MIL-STD-45662. Areas for consideration by the Government representative are to:

1. Determine that calibration intervals are established and assigned for M&TE and for each measurement standard and that satisfactory calibration sources are designated for these items.
2. Verify the maintenance of a listing of all measurement standards, with proper nomenclature and identification numbers assigned.
3. Ensure that the environmental conditions to be provided by the contractor or commercial calibration source under which the standards will be utilized and calibrated are adequate, or appropriate compensating corrections are made to the degree necessary.
4. Ensure the use of calibration procedures for all equipment and standards; including calibration reports, if required.
5. Determine that the calibration system is properly coordinated with the necessary areas of the contractor's inspection system or quality control program.
6. Review samples of labels, decals, reject tags, etc., intended to be used for calibration control.
7. Review samples of forms intended to be used by the contractor in his record system, i.e., instrument and gage record cards, data sheets, test reports or certificates, reject forms, etc.

5.2 Adequacy of Standards.

(a) Requirement.

MIL-HDBK-52A
17 August 1984

"5.2 Adequacy of standards. Standards established by the contractor for calibrating the measuring and test equipment used in controlling product quality shall have the capabilities for accuracy, stability, range, and resolution required for the intended use."

(b) Concept.

Measurement standards prescribed in the contractor's calibration system must reflect an accuracy level, history of stability and acceptable calibration range that satisfies the requirements imposed by M&TE specifications or use.

(c) Application.

The standards used for calibrating M&TE shall have capabilities for accuracy, stability, range and resolution required for the intended use. Accuracy ratios may be used for determining adequacy. The accuracy ratio may be high (4:1, 10:1, or higher) or low (3:1, or 2:1). The exact ratio depends on state-of-the-art limitations, and the contractor's measurement requirements. The Government representative must verify that standards used by the contractor are capable of calibrating the M&TE for the intended use. The accuracy of the standards must at least be equal to the tolerance required (i.e., 1:1) but in most cases should be greater. A 1:1 comparison is permitted only when state-of-the-art limitations preclude a higher accuracy ratio. Normally, when only a 1:1 accuracy ratio can be achieved, any out of tolerance condition of the M&TE will be significant. The measurement standards selected by the contractor must have a stability which is proven by long usage, industry acceptance, or manufacturer's specifications. Standards selected solely on the basis of manufacturer's specifications require close surveillance until a history of stability is established by succeeding calibrations.

5.3 Environmental Controls.

(a) Requirement.

"5.3 Environmental controls. Measuring and test equipment and measurement standards shall be calibrated and utilized in an environment controlled to the extent necessary to assure continued measurements of required accuracy, giving due consideration to temperature, humidity, vibration, cleanliness, and other controllable factors affecting precision measurement. When applicable, compensating corrections shall be applied to calibration results obtained in an environment which departs from standard conditions."

MIL-HDBK-52A

17 August 1984

(b) Concept.

Only those environmental conditions which will affect the accuracy and stability of M&TE or measurement standards require control by the contractor. Controls need only be to the extent necessary to prevent measurement inaccuracies, and are determined by the environmental susceptibility of the accuracy of the M&TE or measurement standard being calibrated.

(c) Application.

The Government representative shall ascertain that all measurement standards and M&TE applicable to the contract are calibrated and/or utilized in an area in which the contractor has provided controls for environmental conditions to the degree necessary to assure measurements of the required accuracy. Environmental conditions in the calibration area must be controlled to the degree necessary to maintain detrimental factors within acceptable limits for the calibration being performed, or adequate compensating corrections must be made. Examples of environmental conditions which may affect some measurements are temperature, radio frequency interference, vibration, dust, noise and humidity.

5.4 Intervals of Calibration.

(a) Requirement.

"5.4 Intervals of calibration. Measuring and test equipment and measurement standards shall be calibrated at periodic intervals established on the basis of stability, purpose, and degree of usage. Intervals shall be shortened as required to assure continued accuracy as evidenced by the results of preceeding calibrations and may be lengthened only when the results of previous calibrations provide definite indications that such action will not adversely affect the accuracy of the system. The contractor shall establish a recall system for the mandatory recall of standards and measuring and test equipment within established time limits or interval frequencies."

(b) Concept.

Measurement standards and M&TE shall be calibrated as often as necessary to maintain prescribed accuracy. If the contractor's records indicate the equipment requires frequent adjustment, the interval should be shortened. Intervals may be lengthened if the results of previous calibrations can be shown to provide definite indications that the accuracy of the system will not be adversely affected. Some contractors

MIL-HDBK-52A
17 August 1984

employ a floating interval system in which the interval for each item of M&TE is adjusted based on its individual calibration history. To ensure calibration within the specified interval, the contractor must have a mandatory recall system.

(c) Application.

The Government representative will ascertain that all measurement standards and M&TE requiring calibration are assigned an interval for calibration. In the absence of an established calibration interval (based on equipment manufacturer's recommendation, authorized Government specification, etc.) for a particular item, an initial interval shall be assigned by the contractor's standards laboratory or calibrating service. The intervals are to be specified in terms of time or usage.

The establishment of intervals shall be upon the basis of inherent stability, purpose or use, accuracy, and degree of usage. If intervals are established on a usage basis, the contractor must positively define what constitutes a usage. The intervals may be shortened or lengthened by evaluation of the results of the previous and present calibrations and adjusting the schedule to reflect the findings. These evaluations must provide positive assurance that calibration interval adjustments will not adversely affect the accuracy of the system.

The contractor must maintain historical records for all equipment to such an extent that the Government representative can ascertain that an adjustment of calibration interval is in accordance with the contractor's written description.

In order to insure that calibration schedules are being followed, a documented recall program must be in operation. The program must include schedules for each type of equipment consistent with its use, accuracy, and precision required. The evaluator must have evidence that some provision exists for:

1. Recall of equipment for calibration according to predetermined schedules.
2. The prompt release of equipment or standards for calibration.
3. The issuing of calibration overdue notices and prevention of use of overdue items.

MIL-HDBK-52A
17 August 1984

4. Assignment of intervals for all calibrated M&TE, and for each measurement standard.

5. Controls for interval adjustments, based on results of previous and present calibrations, and changes in stability, purpose, and degree of usage. Major changes in any factor must be promptly taken into consideration, if an effective calibration system is to be maintained.

Some contractors' calibration systems may include provisions for approval of temporary extension of an interval or calibration due date for a limited period of time, under certain specified conditions, such as completion of a test in progress. If such provisions are included, the temporary extension must be adequately determined and controlled. The approval for the extension must be based on favorable (in tolerance) results of past calibrations. In addition, the item of M&TE involved must be found to be in tolerance upon calibration, after the authorized extension.

5.5 Calibration Procedures.

(a) Requirement.

"5.5 Calibration procedures. Written procedures shall be prepared or provided and utilized for calibration of all measuring and test equipment and measurement standards used to assure the accuracy of measurements involved in establishing product conformance. The procedures may be a compilation of published standard practices or manufacturer's written instructions and need not be rewritten to satisfy the requirements of this standard. As a minimum, the procedures shall specify either the measurement standard to be used or the required accuracy of the standard and the accuracy of the instrument being calibrated. The procedure shall require that calibration be performed by comparison with higher accuracy level standards."

(b) Concept.

Written methods or procedures for calibrating M&TE and measurement standards must be provided by the contractor in order to eliminate possible measurement inaccuracies due to differences in techniques, environmental conditions, choice of higher level standards, etc. These calibration procedures may be prepared by the contractor, or he may utilize published standard practices or written instructions that accompany purchased equipment. When available, published Army, Navy, or Air Force procedures may also be used. The Government and Industry Data Exchange Program (GIDEP) maintains a file of calibration procedures which the

MIL-HDBK-52A
17 August 1984

contractor may desire to utilize. The calibration procedures contained in the file may not be adequate for the intended use and should be reviewed by the contractor before use. The contractor can obtain information about GIDEP from the Fleet Analysis Center, GIDEP Operations Center, Naval Weapons Station, Seal Beach, Corona Annex, Corona, CA 91720.

(c) Application.

The Government representative must ascertain that written procedures exist for performing tests and calibrations on each type of M&TE or measurement standard requiring calibration. These procedures must be readily available and used by calibration personnel. Calibration procedures must be maintained current, with a method for initiating revisions as applicable. The written procedures may be prepared by the contractor, or he may use equipment manufacturers' instructions or other standard practices if they contain the necessary information and detail. Essential to all calibration procedures is the required accuracy for each instrument characteristic to be calibrated. The calibration procedures must specify either the measurement standard to be used or the required accuracy of the measurement standard.

5.6 Out of Tolerance Evaluators.

5.6.1 Adequacy of the Calibration System.

(a) Requirement.

"5.6.1 Adequacy of the calibration system. The contractor shall establish a procedure to evaluate the adequacy of the calibration system, based on out of tolerance data generated from calibrating test and measuring equipment. The procedure shall include, but not be limited to, adjustment of calibration frequency, adequacy of the measuring or test equipment, calibration procedures and measuring or test procedures. The procedures shall specifically provide for the identification and prevention of use of any equipment which does not perform satisfactorily."

(b) Concept.

To assure the adequacy of the contractor's calibration system, it is necessary for the contractor to have a procedure to record and evaluate out of tolerance conditions on M&TE, as determined during calibration. The procedure shall provide for the identification and prevention of use of any equipment found to be out of tolerance, until the deficiency is corrected. The procedure shall also specify

MIL-HDBK-52A
17 August 1984

methods of using the out of tolerance data to evaluate the adequacy of the M&TE, adjust calibration intervals and evaluate the adequacy of calibration and test procedures. The procedures shall also provide for the identification and prevention of use of M&TE which does not perform satisfactorily.

(c) Application.

The government representative will determine that the contractor's procedure includes a requirement to record all out of tolerance conditions, (not necessarily variables data) and that this data is used to:

1. Justify changes in calibration frequency, either by family or individual items of M&TE.
2. Evaluate the adequacy of the M&TE for the intended use.
3. Evaluate the effectiveness of the calibration procedures and the measuring or test procedures.

The procedure shall provide for the identification and prevention of use of any equipment not performing satisfactorily, or found to be out of tolerance, until the deficiency is corrected. The intent is to prevent the use of unsatisfactory equipment and does not apply to items in process of being corrected by repair or adjustment. Prevention of use may be by physical removal, labeling or tagging, or by other effective means. The procedure shall also provide for the identification and prevention of use of equipment which is repetitively found to be out of tolerance at recalibration.

5.6.2 Notification of out of tolerance conditions.

(a) Requirement.

"5.6.2 Notification of out of tolerance conditions. The contractor's procedure shall include the requirement for the calibration activity to notify the measurement and test equipment user, or appropriate contractor element, of significant out of tolerance conditions so that appropriate action can be taken by the contractor, or test and measuring equipment user to correct possible nonconforming products. The procedure shall define what constitutes a significant out of tolerance condition."

MIL-HDBK-52A
17 August 1984

(b) Concept.

The contractor must have a procedure which requires that the calibration agency notify the user of the M&TE (or other appropriate designated contractor element) of M&TE found to be significantly out of tolerance during calibration. The procedure must also clearly define what constitutes a significant out of tolerance condition. Based upon the notification, appropriate action can be taken by the contractor to correct possible nonconforming products. Such appropriate action may include shortening of calibration intervals, as well as determining M&TE reliability.

(c) Application.

The government representative will determine that the contractor's procedure includes the requirement for recording and reporting significant out of tolerance conditions and clearly identifies channels for the reporting. This may be directly to the M&TE user, to the quality assurance department or other organizations within the contractor's organizational structure, that will take action to correct possible nonconforming products. The scope of MIL-STD-45662 extends only to notification of the significantly out of tolerance conditions. Such notification may require that corrective action be taken by the contractor under the quality provision of the contract. The reporting channels may vary for different items of M&TE, depending upon the contractor's organizational structure and type of product or business involved. The procedure must define what constitutes a significant out of tolerance condition. An out of tolerance condition should be considered significant when it will result in acceptance of a nonconforming product. The definition of significantly out of tolerance may vary from contractor to contractor. Some contractors may have a calibration program which is closely related to product test, enabling the out of tolerance definition to be closely related to product test. Other contractor's calibration may not be as directly related to product; therefore a different definition may be required.

5.7 Calibration Sources.

5.7.1 Domestic contracts.

(a) Requirement.

"5.7.1 Domestic contracts. Measuring and test equipment shall be calibrated by the contractor, or a commercial facility utilizing standards whose calibration is certified as being traceable to the National Standards, has been

MIL-HDBK-52A
17 August 1984

derived from accepted values of natural physical constants, or has been derived by the ratio type of self-calibration techniques. Standards requiring calibration by a higher level standards laboratory shall be calibrated by a commercial facility capable of providing the required service, a Government Laboratory, under arrangements made by the Contracting Officer, or by the National Bureau of Standards. All standards used in the calibration system shall be supported by certificates, reports, or data sheets attesting to the date, accuracy, and environmental or other conditions under which the results furnished were obtained. Statements of certification shall contain as a minimum, the requirements prescribed in paragraph 5.8. All subordinate standards and measuring and test equipment shall be supported by like data when such information is essential to achieving the accuracy control required by this standard. In those cases where no data is required, a suitably annotated calibration label on the item shall be sufficient to satisfy the support data requirements of this paragraph. Certificates or reports from other than the National Bureau of Standards or Government laboratory shall attest to the fact that the standards used in obtaining the results have been compared at planned intervals with the National Standard, either directly or through a controlled system, utilizing the methods outlined above. The contractor shall be responsible for assuring that the sources providing calibration services, other than the National Bureau of Standards or a Government laboratory, are, in fact, capable of performing the required service to the satisfaction of this standard. All certificates and reports shall be available for inspection by authorized Government representatives."

(b) Concept.

All M&TE used to assure compliance with the contract must be calibrated by use of standards whose calibration is:

1. Traceable to National Standards; or
2. Obtained from independent reproducible standards (derived from accepted values of natural physical constants); or
3. Derived from the ratio type of self-calibration techniques; or
4. Traceable to National Standards of a foreign country, which are compared to International or US National Standards; or

MIL-HDBK-52A
17 August 1984

5. Industry consensus standards, where no suitable standard exists.

If calibration services are required for these standards, the contractor may obtain the same from a commercial metrology laboratory, a Government laboratory, from NBS, or a foreign national laboratory (if their standards are compared to International or US National Standards). Certificates, test reports or data sheets must state the date, accuracy, and environmental conditions under which the reference standard was calibrated. Information of a like nature, if necessary for accuracy control of the calibration system, is required to support subordinate standards and measuring and test equipment. In addition, reports from commercial laboratories must state the standards used in performing the calibrations were periodically compared, directly or indirectly, with a National Standard, or where calibrated by one of the methods outlined in 2 or 3 above. The contractor must assure that contract calibration services from other than NBS or a Government laboratory are capable of performing services in compliance with the requirements of MIL-STD-45662.

(c) Application.

The Government representative shall ascertain that all measurements or calibrations performed by or for the contractor in determining compliance with his contractual requirements can be traced, directly or indirectly, through an unbroken chain of properly conducted calibration (supported by reports or data sheets) to an appropriate reference standard, maintained by a national organization such as NBS, or some ultimate reference standard, such as an independently reproducible standard, i.e., a standard which depends upon accepted values of natural physical constants. Typical examples are--the specific gravity of a given element, such as mercury-in-glass manometers, or the freezing point of distilled water, such as ice bath recertification of ASTM thermometers.

In accomplishing the investigation of traceability, the Government representative should request to examine the reports or data sheets supporting the contractor's standards. There must be a report for each reference standard (except independent reproducible standards such as atomic frequency standards, metals freezing points, ratio type of self-calibration, or parameters for which NBS does not maintain standards) used in the contractor's calibration system. Reports are also required for transfer standards or M&TE, if their accuracy is such as to require supporting

MIL-HDBK-52A
17 August 1984

data. If the contractor's calibration services are performed by a commercial laboratory or facility on a contract basis, copies of reports issued by them must be available.

All reports should be kept in a suitable file and shall contain the following information:

1. Identification or serial number of the standard or test equipment to which the report pertains.
2. Relevant condition under which the calibration was performed (temperature, relative humidity, etc.) as required.
3. Accuracy of the standard under test (expressed in percentage or other suitable terms).
4. Relevant deviation or corrections.
5. Report number.
6. Reports for the highest level standards of sources other than NBS or a Government laboratory must bear a statement that comparison has been made and is traceable to National Standards at planned intervals. An NBS test number is one means of substantiating comparison.
7. Corrections which must be applied if standard conditions of temperature, gravity, air buoyancy, etc., are not met or differ from those at place of calibration.

If calibration services are obtained from foreign nations, the contractor must determine that the above information is available on the reports and that the standards of that nation are periodically compared with International or US National Standards.

Since the contractor is responsible for assuring that sources providing his calibration services are capable of performing these services, other than NBS or Government laboratories, to the satisfaction of the requirements of MIL-STD-45662, the Government representative may request, from the contractor, any factual evidence upon which he based his assurance or determination that the company providing service is, in fact, capable. Contracts for calibration services shall include agreements with a commercial facility that the laboratory is operated in conformance with the applicable requirements of MIL-STD-45662.

5.7.2 Foreign contracts.

MIL-HDBK-52A
17 August 1984

(a) Requirement.

"5.7.2 Foreign contracts. The provisions in paragraph 5.7.1 shall apply, with the exception that the National Standards Laboratories of countries whose standards are compared with International or US National Standards may be utilized."

(b) Concept.

The same concept applies to foreign contracts as for domestic contracts (see 5.7.1. above) except as stated in the requirement of this paragraph.

(c) Application.

Guidelines for the Government representative are the same as for domestic contracts (see 5.7.1. above) except as stated in the requirement of this paragraph.

5.8 Application and Records.

(a) Requirement.

"5.8 Application and records. The application of the above requirements will be supported by records designed to assure that established schedules and procedures are followed to maintain the accuracy of all measuring and test equipment, and supporting standards. The records shall include an individual record of calibration, or other means of control, for each item of measuring and test equipment and measurement standards, providing description or identification of the item, calibration interval, date of last calibration and calibration results of out of tolerance condition. In addition, the individual record of any item whose accuracy must be reported via a calibration report or certificate will quote the report or certificate number for ready reference. These records shall be available for review by authorized Government personnel."

(b) Concept.

Records provide objective evidence that calibration schedules are complied with and that the accuracy of the equipment or standards is being maintained. The records also provide a history of equipment stability, which may be evaluated and utilized as a basis for the adjustment of calibration intervals. Records will be provided and maintained for each item of measuring and test equipment and each measurement standard. They must be readily available to the Government representative.

MIL-HDBK-52A
17 August 1984

(c) Application.

The Government representative shall ascertain that adequate calibration records are provided and maintained to identify and categorize each item of measuring and test equipment and measurement standard. Records can be in format developed at the contractor's discretion, but must be kept in a suitable file, readily available for use by authorized personnel, or for review by a Government representative. The file may also be in electronic media, such as computer discs.

The Government representative may consider a record system as being satisfactory when it readily reveals the following data:

1. Identification of each item.
2. The item's history.
3. Calibration interval and date of last calibration.
4. Reference to calibration procedure(s) used or source of calibration.
5. Calibration report or certificate number, if required.
6. Calibration results of out of tolerance conditions found in previous calibrations.

5.9 Calibration Status.

(a) Requirement.

"5.9 Calibration status. Measuring and test equipment and standards shall be labeled or some other suitable means shall be established for monitoring the equipment to assure adherence to calibration schedules. The system shall indicate date of last calibration, by whom calibrated and when the next calibration is due. The system may be automated or manual. Items which are not calibrated to their full capability, or which require functional check only, shall be labeled to indicate the applicable condition."

(b) Concept.

Labeling provides a visual means of indicating the calibration serviceability status of measuring and test equipment or measurement standards. Access to calibration adjustments, or the adjustments themselves should be made

MIL-HDBK-52A
17 August 1984

tamper-proof. If the tamper-proof mechanism, such as a seal, is broken, the calibration is void. All such items used to assure compliance with the contract must be labeled or otherwise controlled to indicate their status. Equipment or standards used at partial capability must indicate the usable scales or ranges, or portions of the equipment. Equipment or standards exceeding the calibration expiration date must not be used until they have been recalibrated.

(c) Application.

The Government representative shall ascertain that the current calibration status of all measuring and test equipment and standards used to assure compliance with the contract, and requiring calibration, is readily identifiable. Status may be identified by tags, labels, codes, or recall records. The Government representative shall also determine that calibration expiration dates have not been exceeded by any standard or item of equipment. If labels are used as the sole means of monitoring equipment status, such labels should be distinctive, and must be located on the equipment in such a manner that they are clearly visible at all times. When it is impractical to apply labels to the equipment, (such as gage blocks) the label may be applied to the container. The information on such labels shall include, as a minimum, the date of last calibration, by whom it was calibrated, and the date when next calibration is due. If a means of control other than labeling is used, it must reflect the same information supplied by the label or tag, and must be readily accessible for monitoring this information. When other means of monitoring equipment status are used in addition to labeling, the label should include as a minimum, the next calibration due date. The system must further provide for labels or tags, indicating the applicable condition of all equipment or standards which are not required to be used to their full capabilities, or which require functional checks only. Usable scales, ranges, or portions of the equipment must be indicated on the label or tag.

Equipment where no test data is recorded, e.g., null indication, wave form monitoring, etc., may be labeled "No Calibration Necessary," or words to that effect. Independent reproducible standards which are derived from accepted values of natural physical constants in such a way that they do not require calibration against other standards to establish their accuracy, may be labeled "No Calibration Necessary," or words to that effect. Typical examples are an interferometer using a Krypton-86 orange light source for dimensional calibrations, and the cesium type of microwave

MIL-HDBK-52A
17 August 1984

frequency standard. However, accessory equipment associated with these standards is not precluded from periodic calibration controls or labeling.

The contractor's system of controlling calibration status must extend and apply to every item of measuring and test equipment or measurement standard, under his jurisdiction, which is used in determining compliance with a production or services contract as follows:

1. Contractor owned or leased equipment which is calibrated by the contractor or a commercial source.
2. Contractor owned or leased equipment which is calibrated by a Government laboratory.
3. Government owned equipment, furnished to a contractor for his use in connection with a related contract.
4. Equipment personally owned by contractor employees, if used for product acceptance.

The system must include provisions for identifying equipment that has not been recalibrated in accordance with an established schedule, or has been found to exceed allowable limits. This equipment must be immediately removed from service. If physical removal is impractical due to weight, service connections, or other characteristics of the equipment, it must be impounded by the attachment of signs, tags, labels or other means.

5.10 Control of Subcontractor Calibration.

(a) Requirement.

"5.10 Control of subcontractor calibration. The contractor is responsible for assuring that the subcontractor's calibration system conforms to this standard to the degree necessary to assure compliance with contractual requirements."

(b) Concept.

The government must be assured that the accuracy of all measurements and calibrations performed outside the contractor's plant, which may affect the quality or conformance to requirements of supplies or services presented to the Government for acceptance, is effectively controlled. This need not result in complete uniformity or standardization of calibration policies or practices between

MIL-HDBK-52A
17 August 1984

contractor and subcontractor. However, the controls imposed by the subcontractor should satisfy the requirements of MIL-STD-45662 to the degree necessary. Objective evidence of this conformance should be available to the contractor.

(c) Application.

The government representative shall ascertain what provisions the contractor has imposed on his subcontractor (including vendors when necessary) to assure himself of their conformance to the requirements and intent of MIL-STD-45662 to the degree necessary. Some areas for consideration by the Government representative are as follows:

1. Incorporation, by the contractor, of MIL-STD-45662 in subcontracts when practicable.
2. A general specification or other document, provided by the contractor covering calibration requirements, which is sufficiently comprehensive to assure a subcontractor program that will provide adequate control of the overall calibration system.
3. Review of objective evidence substantiating subcontractor compliance with the applicable requirements of MIL-STD-45662.

5.11 Storage and Handling.

(a) Requirement.

"5.11 Storage and handling. All measuring and test equipment shall be handled, stored and transported in a manner which shall not adversely affect the calibration or condition of the equipment."

(b) Concept.

Proper storage, handling and transportation of measuring and test equipment is essential to assure that it maintains the required levels of accuracy. The contractor must offer objective evidence that procedures are developed and followed which assure that measuring and test equipment is properly handled, stored and transported in a manner which does not adversely affect its calibration or condition.

(c) Application.

MIL-HDBK-52A
17 August 1984

The Government representative shall review the contractor's procedure for handling, storing and transporting measuring and test equipment. He will also evaluate, if possible, the actual handling, storage and transporting of this equipment. Factors the Government representative should base his review on are as follows:

1. Equipment is handled during movement using manufacturers recommendations or good handling practices.
2. Equipment is properly packaged prior to and during transportation, as required.
3. Storage areas and stored equipment are monitored for good warehousing practices to preclude deterioration of the equipment.
4. Contractor verification of calibration status prior to issue of measuring and test equipment and standards for use.
5. Contractor's procedures require that instances of improper handling, storage, or transportation be reported, and that the affected equipment be removed from service until recalibration is performed.

5.12 Amendments and Revisions.

(a) Requirement.

"5.12 Amendments and revisions. Whenever this standard is amended or revised subsequent to a contractually effective date, the contractor may follow or authorize his subcontractor to follow the amended or revised military standard provided no increase in price or fee is involved. The contractor shall not be required to follow the amended or revised standard except as a change in the contract. If the contractor elects to follow the amended or revised military standard, he shall notify the contracting officer in writing of this election."

(b) No explanation required.

MIL-HDBK-52A
17 August 1984

APPENDIX

CHECKLIST FOR EVALUATION OF CONTRACTOR'S CALIBRATION SYSTEM

This checklist provides the evaluator with a reference to the requirements of MIL-STD-45662 (and to the background material provided by this Handbook). When completed, the checklist serves as a record of the evaluation, including the adequacy of the contractor's written procedures and his compliance with those procedures. Hence, it serves also as a record of the contractor's compliance with MIL-STD-45662.

MIL-HDBK-52A
17 August 1984

APPENDIX (Cont'd)
CHECKLIST FOR EVALUATION OF CONTRACTOR'S CALIBRATION SYSTEM

MIL-STD REF. PARAGRAPH	TITLE AND REQUIREMENT	CONTRACTOR'S PROCEDURE REF.	ADEQUACY			
			PROCEDURE		COMPLIANCE	
			SAT	UNSAT	SAT	UNSAT
5.1	<p>1. Calibration System Description. Written description provided and maintained which:</p> <p>(a) Satisfies each requirement of MIL-STD-45662.</p> <p>(b) Includes listing of standards with:</p> <p>(1) Nomenclature and identification number.</p> <p>(2) Intervals and sources.</p> <p>(3) Environmental conditions required to be maintained.</p> <p>(c) Prescribes M&TE calibration intervals and sources.</p> <p>(d) Is coordinated with inspection system.</p> <p>(e) Includes forms, labels and decals to be used.</p> <p>(f) Provides for description, procedures, and reports of calibration to be made available to the Government.</p>					
5.2	<p>2. Adequacy of Standards. Adequate with respect to:</p> <p>(a) Accuracy.</p> <p>(b) Stability.</p> <p>(c) Range.</p> <p>(d) Resolution.</p>					

MIL-HDBK-52A
17 August 1984

APPENDIX (Cont'd)
CHECKLIST FOR EVALUATION OF CONTRACTOR'S CALIBRATION SYSTEM

MIL-STD REF. PARAGRAPH	TITLE AND REQUIREMENT	CONTRACTOR'S PROCEDURE REF.	ADEQUACY			
			PROCEDURE		COMPLIANCE	
			SAT	UNSAT	SAT	UNSAT
5.3	<p>3. <u>Environmental Controls.</u></p> <p>(a) Controlled to the extent necessary.</p> <p>(b) Factors that may affect accuracy include temperature, humidity, vibration, cleanliness and other controllable factors affecting measurements.</p> <p>(c) Compensating corrections (if used) adequate.</p> <p>(d) Housekeeping/cleanliness.</p>					
5.4	<p>4. <u>Intervals of Calibration.</u></p> <p>(a) M&TE calibrated at established intervals based on stability, purpose, degree of usage.</p> <p>(b) Intervals adjusted based on results of previous calibrations.</p> <p>(c) Recall system established which is mandatory and in compliance with intervals.</p> <p>(d) Historical records maintained.</p> <p>(e) Calibration due notices.</p> <p>(f) Prompt release for calibration.</p> <p>(g) Overdue notices.</p>					

MIL-HDBK-52A
17 August 1984

APPENDIX (Cont'd)
CHECKLIST FOR EVALUATION OF CONTRACTOR'S CALIBRATION SYSTEM

MIL-STD REF. PARAGRAPH	TITLE AND REQUIREMENT	CONTRACTOR'S PROCEDURE REF.	ADEQUACY	
			PROCEDURE SAT	COMPLIANCE SAT
5.5	<p>5. Calibration Procedures.</p> <p>(a) Written procedures provided and utilized.</p> <p>(b) Procedures specify accuracy of instruments being calibrated.</p> <p>(c) Procedures specify either the measurement standard to be used or the required accuracy of the standard.</p> <p>(d) Procedures require that calibration be performed by comparison with higher accuracy level standards.</p>			
5.6	<p>6. Out of Tolerance Evaluators.</p> <p>(a) Procedure provides for using out of tolerance data to:</p> <p>(1) Adjust calibration intervals.</p> <p>(2) Determine adequacy of M&TE.</p> <p>(3) Determine adequacy of calibration, measuring, and test procedures.</p> <p>(b) M&TE which does not perform satisfactorily is identified and its use prevented.</p> <p>(c) Significant out of tolerance defined.</p> <p>(d) Reporting channels identified.</p>			

MIL-HDBK-52A
17 August 1984

APPENDIX (Cont'd)

CHECKLIST FOR EVALUATION OF CONTRACTOR'S CALIBRATION SYSTEM

MIL-STD REF. PARAGRAPH	TITLE AND REQUIREMENT	CONTRACTOR'S PROCEDURE REF.	ADEQUACY			
			PROCEDURE		COMPLIANCE	
			SAT	UNSAT	SAT	UNSAT
5.7	<p>7. Calibration Sources (Domestic & Foreign)</p> <p>(a) M&TE calibrated using standards traceable to National Standards, derived from natural physical constants or derived by ratio techniques.</p> <p>(b) Standards calibrated by commercial facility capable of performing service, a Government laboratory, the NBS, or a foreign national laboratory whose standards are compared to International or US National Standards.</p> <p>(c) Standards supported by certificates, reports or data sheets attesting to date, accuracy, and environmental conditions.</p> <p>(d) Subordinate standards supported by same as (c) when such is essential to achieving the accuracy control required by MIL-STD-45662.</p> <p>(e) Certificates from labs other than Govt. labs or NBS shall indicate the standards used have been compared at planned intervals with the National standard or indirectly thru (b), (c) and (d).</p>					

MIL-HDBK-52A
17 August 1984

APPENDIX (Cont'd)
CHECKLIST FOR EVALUATION OF CONTRACTOR'S CALIBRATION SYSTEM

MIL-STD REF. PARAGRAPH	TITLE AND REQUIREMENT	CONTRACTOR'S PROCEDURE REF.	ADEQUACY			
			PROCEDURE		COMPLIANCE	
			SAT	UNSAT	SAT	UNSAT
5.8	<p>(f) Contractor assures sources other than Govt. labs or NBS are capable of performing the service to the satisfaction of MIL-STD-45662.</p> <p>8. Application and Records.</p> <p>(a) Records support all requirements of MIL-STD-45662.</p> <p>(b) Schedules and procedures followed.</p> <p>(c) Records include identification of item, interval, date of last calibration, and calibration results of out of tolerance conditions.</p> <p>(d) If accuracy must be reported on a calibration report or certificate, the record will cite the report or certificate number or a copy be on a file.</p>					
5.9	<p>9. Calibration Status.</p> <p>(a) Label or other means provided to monitor equipment adherence to calibration schedules.</p> <p>(b) The system shall indicate date of last calibration, by whom calibrated and when next calibration is due.</p>					

MIL-HDBK-52A
17 August 1984

APPENDIX (Cont'd)
CHECKLIST FOR EVALUATION OF CONTRACTOR'S CALIBRATION SYSTEM

MIL-STD REF. PARAGRAPH	TITLE AND REQUIREMENT	CONTRACTOR'S PROCEDURE REF.	ADEQUACY			
			PROCEDURE		COMPLIANCE	
			SAT	UNSAT	SAT	UNSAT
5.10	<p>(c) Items not calibrated to their full capability or which require functional check only will be labeled to indicate condition.</p> <p>10. <u>Control of Subcontractor Calibration.</u></p> <p>(a) Contractor delegates through purchase agreements with subcontractors, MIL-STD-45662 requirements to the degree necessary.</p> <p>(b) Contractor assures subcontractor compliance with 10.(a) above.</p>					
5.11	<p>11. <u>Storage and Handling.</u></p> <p>(a) Storage, handling, transportation does not adversely affect calibration of measuring and test equipment.</p> <p>(b) Packaged properly when required.</p> <p>(c) Adequate storage conditions.</p> <p>(d) Improper storage, handling, and transportation reported.</p>					

MIL-HDBK-52A
17 August 1984

Custodians:

Army-MI
Navy-OS
Air Force-05
DLA-DB

Preparing Activity:

Army-MI

Project No. QCIC-0008

Review Activities:

Army-AR, AV
Navy-AS, EC, SH
AF-15, 23, 85
DLA-ES

User Activities:

Army-ME
DLA-SS

AREA: QCIC

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