

**TECHNICAL MANUAL**

**AIR FORCE METROLOGY AND  
CALIBRATION PROGRAM**

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Page No.	* Change No.	Page No.	* Change No.	Page No.	* Change No.
Title.....	0				
A .....	0				
i- iv.....	0				
1-1 - 1-8 .....	0				
2-1 - 2-4 .....	0				
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4-1 - 4-10 .....	0				
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6-1 .....	0				
6-2 Blank .....	0				
7-1 - 7-6 .....	0				
8-1 - 8-8 .....	0				
9-1 - 9-8 .....	0				
10-1 - 10-6 .....	0				

\*Zero in this column indicates an original page

## TABLE OF CONTENTS

<u>Section/Paragraph</u>	<u>Page</u>
1 INTRODUCTION.....	1-1
1.1 PURPOSE.....	1-1
1.2 GENERAL.....	1-1
1.3 SCOPE .....	1-2
1.4 DEFINITIONS.....	1-2
1.5 PROGRAM ACRONYMS .....	1-6
2 AFMETCAL PROGRAM ORGANIZATION AND INTERFACE.....	2-1
2.1 GENERAL.....	2-1
2.2 AFMETCAL PROGRAM.....	2-1
2.3 PROGRAM POLICY AND DIRECTION.....	2-2
2.4 PROGRAM REQUIREMENTS .....	2-3
2.5 PROGRAM MATERIAL.....	2-3
2.6 PERSONNEL .....	2-4
2.7 PROGRAM INTEGRATION.....	2-4
3 OPERATION.....	3-1
3.1 CALIBRATION OF STANDARDS AND OTHER TMDE .....	3-1
3.2 EXCEPTIONS FROM PERIODIC CALIBRATION.....	3-5
3.3 LIMITED OR SPECIAL CALIBRATION .....	3-7
3.4 CALIBRATION INTERVALS .....	3-8
3.5 PRECISE TIME SUPPORT.....	3-11
3.6 TMDE USER RESPONSIBILITIES .....	3-11
3.7 INPUT PRIORITY SYSTEM.....	3-15
3.8 CARE OF TMDE .....	3-15
3.9 PMEL MOBILE/ON-SITE MEASUREMENT CAPABILITIES.....	3-18
3.10 PMEL MANAGEMENT RESPONSIBILITIES .....	3-20
3.11 QUALITY SYSTEM.....	3-23
4 CALIBRATION ASSISTANCE AND SUPPORT AGREEMENTS .....	4-1
4.1 REQUESTS FOR CALIBRATION ASSISTANCE.....	4-1
4.2 TECHNICAL/ENGINEERING ASSISTANCE .....	4-2
4.3 CALIBRATION, REPAIR & RETURN, AND LOAN.....	4-2
4.4 PMEL SUPPORT AGREEMENTS .....	4-3
4.5 COMMERCIAL AND N49/59/64 CALIBRATION OF TMDE .....	4-5
4.6 CALIBRATION SUPPORT FOR SITE ACTIVATION TASK FORCE (SATAF), OPERATIONAL TEST AND EVALUATION (OT&E), and INITIAL OPERATIONAL TEST AND EVALUATION (IOT&E) .....	4-8
4.7 SECURITY ASSISTANCE (SA) PROGRAMS AND FOREIGN MILITARY SALES (FMS).....	4-9

## TABLE OF CONTENTS (Cont.)

4.8	TMDE WARRANTIES .....	4-9
4.9	LEASED/BORROWED EQUIPMENT .....	4-9
5	PREPARATION AND USE OF CALIBRATION FORMS AND LABELS .....	5-1
5.1	TMDE CERTIFICATION STAMP (K STAMP) .....	5-1
5.2	GENERAL INSTRUCTIONS .....	5-1
5.3	TMDE BAR CODE LABELS .....	5-2
5.4	CERTIFICATION LABELS .....	5-3
5.5	AFTO FORM 256, NO CALIBRATION REQUIRED LABEL .....	5-7
5.6	NIST REPORT OF MEASUREMENT .....	5-7
5.7	CALIBRATION CERTIFICATES OR CALIBRATION REPORTS .....	5-8
5.8	AFTO FORM 249, TMDE CALIBRATION DATA .....	5-9
5.9	AFTO FORM 250, TMDE CALIBRATION CORRECTION CHART .....	5-9
5.10	MEASUREMENT STANDARD DECALS .....	5-9
5.11	AFTO FORM 255, NOTICE CERTIFICATION VOID WHEN SEAL IS BROKEN .....	5-9
5.12	AFTO FORM 45, REQUEST FOR CALIBRATION RESPONSIBILITY DETERMINATION ....	5-10
5.13	AFTO FORM 57, PMEL TECHNICAL ORDER INFORMATION .....	5-14
5.14	AF FORM 537, PMEL SHIPPING LABEL .....	5-15
6	PMEL REPORTS: RCS HAF-ILM(SA) 7808 and RCS HAF-ILM(A) 9450 .....	6-1
6.1	PMELs USING PAMS .....	6-1
6.2	PMELs NOT USING PAMS .....	6-1
7	PMEL ASSESSMENT AND CERTIFICATION PROGRAM .....	7-1
7.1	GENERAL .....	7-1
7.2	ASSESSMENT INTERVALS .....	7-1
7.3	CERTIFICATION PROCESS .....	7-1
7.4	PROFICIENCY TESTING/MEASUREMENT ASSURANCE PROGRAM (PT/MAP) .....	7-4
7.5	CERTIFICATION STATUS .....	7-5
7.6	ASSESSMENT REPORTS .....	7-6
7.7	APPEAL PROCESS .....	7-6
8	PMEL FACILITY OPERATIONAL REQUIREMENTS .....	8-1
8.1	GENERAL REQUIREMENTS .....	8-1
8.2	PMEL ENVIRONMENT .....	8-2
8.3	TMDE ENVIRONMENTAL RESTRICTIONS .....	8-4
8.4	DUST LEVELS .....	8-4
8.5	NOISE .....	8-4
8.6	VIBRATION .....	8-4
8.7	ELECTROMAGNETIC INTERFERENCE (EMI)/RADIO FREQUENCY INTERFERENCE (RFI) .....	8-5
8.8	LIGHTING .....	8-5

## TABLE OF CONTENTS (Cont.)

8.9	DOORS & WINDOWS.....	8-6
8.10	AIR LOCKS.....	8-6
8.11	CONTROLLED AREAS.....	8-6
8.12	FLOORING.....	8-6
8.13	FURNITURE AND FIXTURES.....	8-7
8.14	FMS TYPE IV AND TYPE II ( ) PMEL FACILITY REQUIREMENTS .....	8-7
8.15	ENVIRONMENTAL LIMITS FOR USNS OBSERVATION ISLAND AND RASCAL .....	8-8
9	QUALITY PROGRAM (QP).....	9-1
9.1	QUALITY PROGRAM .....	9-1
9.2	TYPES OF REVIEW .....	9-1
9.3	QUALITY REVIEW .....	9-1
9.4	STANDARD REVIEW.....	9-2
9.5	SAMPLING RATES .....	9-2
9.6	PROCESS REVIEW .....	9-2
9.7	NONCONFORMITY (NC).....	9-3
9.8	ROOT CAUSE (RC) ANALYSIS.....	9-3
9.9	TREND ANALYSIS .....	9-3
9.10	PROCESS IMPROVEMENT MODEL.....	9-3
9.11	REPORTING REVIEWS.....	9-4
9.12	QP ACTIVITY SUMMARY .....	9-4
9.13	NONCONFORMITY AND ROOT CAUSE CODES .....	9-5
10	AIR FORCE METROLOGY AND CALIBRATION LABORATORIES .....	10-1
10.1	MAJOR COMMAND (MAJCOM) and AGENCY CODES .....	10-1
10.2	AIR FORCE PRIMARY STANDARDS LABORATORY (AFPSL) .....	10-1
10.3	PRECISION MEASUREMENT EQUIPMENT LABORATORIES (PMELs).....	10-2
10.4	AUTHORIZED USER TORQUE CALIBRATION AND REPAIR SITES. ....	10-4

## LIST OF FIGURES

<u>Number</u>	<u>Title</u>	<u>Page</u>
1-1	PMEL Support Matrix.....	1-3
1-2	Measurement Traceability Of The Air Force Metrology And Calibration Program.....	1-4
2-1	AFMETCAL Program Resources And Planning Interfaces .....	2-2
4-1	Air Logistic Type IIA CONUS Areas Of Responsibility .....	4-2
5-1	TMDE Certification Stamp (K Stamp).....	5-1
5-2	AFTO Form 65, TMDE Bar Code Label, Aluminum Stock .....	5-2
5-3	AFTO Form 66, TMDE Bar Code Label, Polyester Stock .....	5-3
5-4	AFTO Form 108, TMDE Certification Label .....	5-5

## LIST OF FIGURES (Cont.)

<u>Number</u>	<u>Title</u>	<u>Page</u>
5-5	AFTO Form 394, TMDE Certification Label .....	5-6
5-6	AFTO Form 99, Limited/Special TMDE Certification Label .....	5-6
5-7	AFTO Form 398, Limited TMDE Certification Label .....	5-7
5-8	AFTO Form 256, No Calibration Required Label .....	5-7
5-9	AFTO Form 255, Notice Certification Void When Seal Is Broken .....	5-9
5-10	AFTO Form 45, Request For Calibration Responsibility Determination .....	5-13
5-11	AFTO Form 57, PMEL Technical Order Information .....	5-15
6-1	AFTO Form 80, Precision Measurement Equipment Laboratory Report .....	6-1

## LIST OF TABLES

<u>Number</u>	<u>Title</u>	<u>Page</u>
3-1	Calibration Software Classes .....	3-3
9-1	Summary Of QP Codes.....	9-5
10-1	MAJCOM And Agency Codes .....	10-1
10-2	AFPSL Site Information .....	10-1
10-3	PMEL Site Information.....	10-2
10-4	Torque Site Information .....	10-4
10-5	List Of Acronyms In Table 10-4.....	10-6

## SECTION 1 INTRODUCTION

### 1.1 PURPOSE.

This Technical Order (TO) contains the methods and procedures for the management of the Air Force Metrology and Calibration (AFMETCAL) Program. This TO implements AFI 21-113, *Air Force Metrology and Calibration (AFMETCAL) Program*.

### 1.2 GENERAL.

The AFMETCAL Program is an Air Force program that provides measurement standards and equipment, professional and technical metrologists, performing work centers (PWCs), a system of worldwide Precision Measurement Equipment Laboratory (PMEL) facilities, measurement equipment users, calibration data and integrated planning. This program ensures the reliability and accuracy of systems, subsystems and equipment. The program provides for the calibration and repair of Test, Measurement and Diagnostic Equipment (TMDE). It also ensures measurement traceability of the TMDE through the Air Force Primary Standards Laboratory (AFPSL) to National Institute of Standards and Technology (NIST) or other 562d Combat Sustainment Group (562 CBSG) approved sources. To accomplish this traceability, the AFMETCAL program requires that Air Force users and Precision Measurement Equipment Laboratories (PMELs) obtain calibration service from Air Force PMELs or the AFPSL. The 562 CBSG must approve calibration service from other sources. The responsibilities of organizations in the AFMETCAL Program are identified in AFI 21-113.

**1.2.1 562d Combat Sustainment Group (562 CBSG).** The 562 CBSG serves as the Air Force technical authority on metrology issues and is the Air Force single point of contact for calibration services and traceability of measurements to NIST. The 562 CBSG makes TMDE calibration and repair responsibility determinations. The 562 CBSG publishes responsibility determinations in TO 33K-1-100-1 and TO 33K-1-100-2 (contained in TO 33K-1-100-CD-1) and Calibration and Measurement Summary (CMS) TOs. TO 33K-1-100-2 and the workload summary tables in the CMS TOs are electronic data tables displayable with the Air Force Calibration Authority Viewer (AFCAV) application included with these TOs. The PMEL Automated Management System (PAMS), Facility and Equipment Maintenance System (FEMS) and LABMET systems maintain authorized facsimiles of TO 33K-1-100-2 and certain CMS workload summary tables. All references to TO 33K-1-100-2 and CMS TOs apply equally to the corresponding authorized electronic facsimiles maintained in PAMS, FEMS and LABMET. If specifications are listed as "Table 1" in 33K-1-100-2, they must be used and can only be viewed using AFCAV.

#### 1.2.1.1 Key documents referenced above:

- a. TO 33K-1-100-1 (*Calibration Procedure for TMDE Calibration Notes, Maintenance Data Collection Codes, and Calibration Measurement Summaries*)
- b. TO 33K-1-100-2 (*TMDE Calibration Interval Technical Order and Work Unit Code Reference Guide*)
- c. TO 33K-1-100-CD-1 (*TMDE Calibration Notes, Maintenance Data Collection Codes, Calibration Measurement Summaries, Calibration Procedure, Calibration Interval and Work Unit Code Reference Manual*)

**1.2.2 Air Force Primary Standards Laboratory (AFPSL) Division.** The Air Force Primary Standards Laboratory (AFPSL) maintains the Air Force Measurement Standards. The standards are traceable to NIST or other sources as approved by the 562 CBSG. Air Force Measurement Standards are used to ensure the accuracy and traceability of Base Measurement Standards. Base Measurement Standards are provided to PMELs.

**1.2.3 Precision Measurement Equipment Laboratories (PMELs).** HAF/A4MM approves the establishment of PMELs at selected installations. The PMEL is the base-level AFMETCAL Program focal point. It is the activity authorized to possess and use base measurement standards. Operational details of the program are set forth in Section 3 of this TO and related command directives.

**1.2.4 Program Controls.** Commanders of the United States Air Force, Air Force Reserves and Air National Guard activities shall establish controls to ensure TMDE under their control is repaired, calibrated and certified. Commanders shall ensure PMEL facilities are built according to AFMAN 32-1094, *Criteria for Air Force Precision Measurement Equipment Laboratory Design and Construction*, and operated according to Section 8 of this TO.

AFI 21-113, along with this TO, applicable CMS TOs, TO 33K-1-100-1 and TO 33K-1-100-2, and command directives prescribe those controls. TMDE in use shall be calibrated at regularly scheduled intervals called out in CMS TOs, TO 33K-1-100-1 and TO 33K-1-100-2. Authorized exceptions to calibration are identified in Section 3 of this TO, any applicable CMSs, and TO 33K-1-100-2.

**1.2.5 Other DoD Services Calibration Laboratories.** The use of other DoD services calibration laboratories is authorized when approved by the applicable MAJCOM FAM and the 562 CBSG. The Army, Navy and Marine Corps operate calibration laboratories using similar measurement techniques and management concepts. These laboratories provide measurement traceability to NIST. This policy does not extend to other government calibration laboratories. Units requesting support from another service shall follow the guidance in Section 4, which includes the interservice support agreement guidance.

### **1.3 SCOPE.**

This TO applies to all activities that possess, use, calibrate, certify and maintain TMDE.

### **1.4 DEFINITIONS.**

The following definitions apply for the purpose of this TO.

**1.4.1 Absolute Measurement Standard.** Designated measurement standards based on the absolute value of natural physical constants whose values can be accurately repeated under controlled conditions. Examples are Laser Length Standards, Josephson Junction Voltage Standards and Hall Effect Magnetic Field Standards.

**1.4.2 Air Force Primary Standards Laboratory (AFPSL).** The highest-level laboratory in the AFMETCAL Program. It maintains Air Force measurement standards certified by the NIST, the US Naval Observatory (USNO), or other 562 CBSG approved sources.

**1.4.3 ANSI/NCSL Z540-1-1994.** The American National Standards Institute publication, "*Calibration Laboratories and Measuring and Test Equipment - General Requirements*". The AFMETCAL program does not accept this standard as the sole requirement for operating a USAF PMEL.

**1.4.4 Calibration.** Calibration is a comparison between equipment items, 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).

**1.4.5 Calibration, Limited.** Calibration of TMDE to less than the accuracy or functional capabilities specified in the authorized calibration procedure or data.

**1.4.6 Calibration, Special.** Calibration of TMDE to all specifications called for in the authorized calibration procedure plus additional requirements.

**1.4.7 Calibration and Measurement Summary (CMS).** A TO which identifies calibration support necessary to ensure the operational readiness of a specific weapon system, weapon subsystem or mission. The summary describes the calibration concept and is calibration authority for the applicable weapon system, weapon subsystem or mission. The CMS is printed as a weapon system or 33K series technical order. The 562 CBSG maintains Air Force CMSs.

**1.4.8 Calibration and Measurement Requirement Summary (CMRS).** This is a three category, in-line summary of measurement parameters. Normally, a Department of Defense (DoD) system contractor prepares the CMRS. A CMRS identifies all measurement requirements within a specific system or item of equipment. The CMRS further displays the proposed solutions for maintaining the system measurement requirements within stated limits. It is also used to identify the need for new calibration standards. This data is provided to 562 CBSG, 813 Irving-Wick Dr W, Bldg 2, Heath OH, 43056-1199. The 562 CBSG uses it for ensuring calibration supportability and planning for PMEL support for a particular weapon system/subsystem. The 562 CBSG maintains the CMRS.

**1.4.9 Calibration Certificate or Calibration Report.** Also referred to as, "Report of Measurement". It is a document containing data relevant to the calibration of a specific test instrument or standard. The AFMETCAL Program does not differentiate between a calibration certificate and a calibration report provided the document contains the required information to interpret the calibration results for the specific calibration.

**1.4.10 Calibration Chart.** A chart prepared for a specific item. It shows the difference between the nominal value and the actual value of a measurement or group of measurements.



**1.4.11 Centralized Intermediate Repair Facility (CIRF).** Centralized intermediate repair facilities (CIRFs) provide regional intermediate-level maintenance repair support for designated USAF units. This regional repair capability replaces the decentralized maintenance concept in which base-level units performed all intermediate-level maintenance for deployed aircraft.

**1.4.12 Certification.** The documented designation that standards and TMDE have been calibrated and meet established technical requirements. When used to refer to a calibration laboratory (PMEL or AFPSL), certification means the laboratory fulfills 562 CBSG assessment criteria.

**1.4.13 Commercial Calibration.** Calibration of TMDE obtained from a commercial source where the TMDE already has a published calibration determination but the calibrating activity (PMEL or USER) asks for an exception. This should be considered only after organic (Air Force) support options have been exhausted. 562 CBSG approval is required prior to obtaining the commercial calibration from a commercial source. Commercial calibrations will be funded by the user.

**1.4.14 Contingency Calibration Operation.** A deployed calibration capability that may include but is not limited to Rapid Assistance Support for Calibration (RASCAL), Transportable Field Calibration Unit (TFCU), mobile calibration teams, combined operations with a foreign military, etc. See Figure 1-1 for the PMEL support matrix.

	DEPLOYED TMDE THAT IS NOT RAINBOWED	DEPLOYED TMDE THAT IS RAINBOWED	TMDE PERMANENTLY ASSIGNED WITHIN AOR
STEADY-STATE / ROTATIONAL OPERATIONS	Customer Uses Reachback Support From Their Home Station	Customer Uses Steady State CIRF <sup>2,3,4</sup> OR Customer Uses Reachback Support From Their Home Station	Customer Uses Contingency State CIRF <sup>1,3,4</sup> OR Customer Uses Nearest USAF Activity with PMEL Capability <sup>3,4</sup>
CONTINGENCY / CRISIS OPERATIONS	Customer Uses Contingency State CIRF <sup>1,3,4</sup> OR Customer Uses Nearest USAF Activity With PMEL Capability <sup>3,4</sup>		
<b>NOTES:</b> 1. Contingency CIRFs provide regional intermediate repair to support small-scale rapid response deployments to multiple global locations. 2. Steady state CIRFs provide regional intermediate repair to support AEF/AEW rotations. 3. CIRF and PMEL as applicable shall request manning assistance from the LGM/A4 of the MAJCOM/AFFOR (Ref: AFI 21-101, <i>Aircraft and Equipment Maintenance Management</i> ). 4. CIRF and PMEL as applicable shall use the customer’s AF Form 616 Fund Cite Authorization to fund repair parts (Ref: AFI 21-101).			

**Figure 1-1. PMEL Support Matrix.**

**1.4.15 Contract Calibration.** Calibration obtained from a contracted source, funded by the user or an Item/Program Manager. Neither the PMEL nor the 562 CBSG centrally manages or funds these calibrations. These items are identified with a calibration responsibility of "CONTRACT".

**1.4.16 Correction Chart.** A chart prepared for a specific item. The chart shows corrections to apply to indicated values to obtain true value. In instances where an item is charted and the item's accuracy or uncertainty is applied, the charted values can be used through the item's calibration interval. However, in instances where a better accuracy or uncertainty of another standard is "transferred" and being used, the charted values may only be used to complete the immediate calibration requiring the transfer/charting. The AFPSL is authorized to assign an interval only after a documented engineering analysis is completed that supports the transfer of accuracy or uncertainty to the assigned interval.

**1.4.17 Equipment Types:**

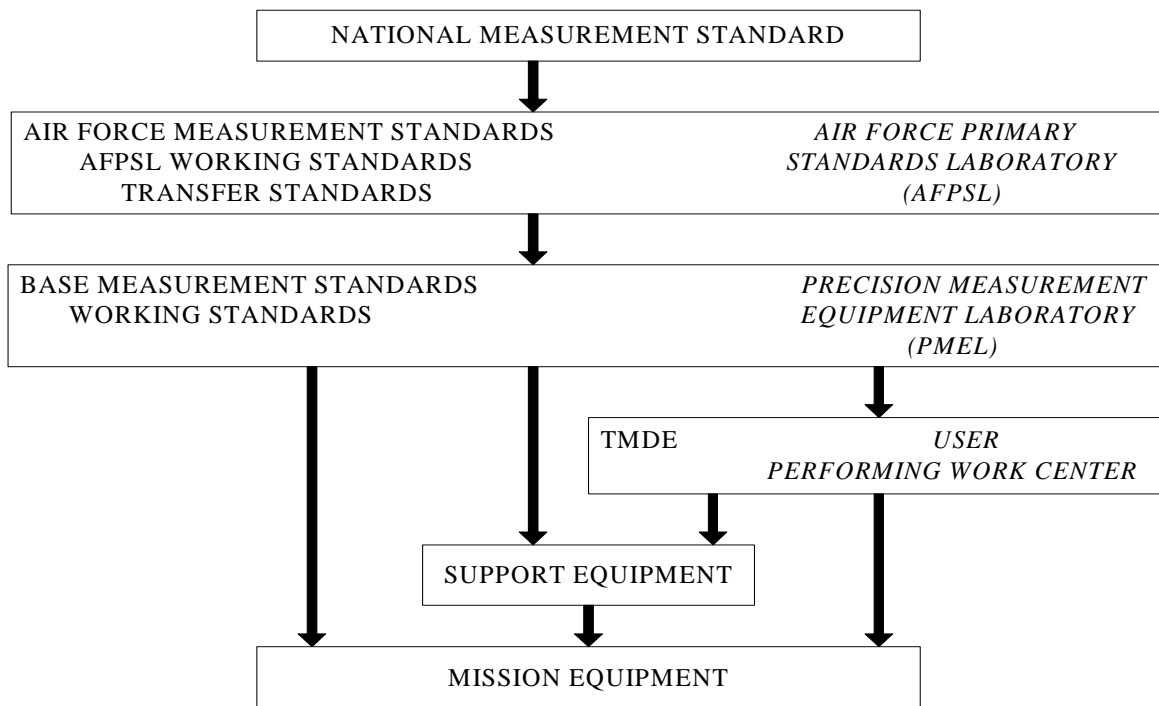
- a. Mission Equipment. Part of operational ground or airborne systems.

- b. Non-TMDE. SE not meeting the TMDE definition. This equipment does not require calibration and is the responsibility of the user
- c. Precision Measurement Equipment (PME). For purposes of this TO, PME is the same as TMDE. This is the former title for TMDE.
- d. Support Equipment (SE). A broad category of equipment and tools used to verify and maintain mission equipment. Support equipment can include equipment used to verify the operation of other support equipment. SE is categorized as either TMDE or Non-TMDE. The AFMETCAL Program is primarily concerned with TMDE support equipment.
- e. Test, Measurement and Diagnostic Equipment (TMDE). Devices used to maintain, evaluate, measure, calibrate, test, inspect, diagnose or otherwise examine materials, supplies, equipment and systems to identify or isolate actual or potential malfunction, or decide if they meet operational specifications established in technical documents. ANSI/NCSL Z540-1-1994 and ISO 17025 refer to this equipment as “measuring and test equipment.”

**1.4.18 ISO/IEC Standard 17025.** The international standard for commercial metrology, “General Requirements for the Competence of Calibration and Testing Laboratories.” It includes the relevant requirements of ISO 9000 series standards. The AFMETCAL program does not approve this standard as the sole requirement for operating a USAF PMEL.

**1.4.19 Manager.** The individual responsible for day-to-day management and operation of the PMEL and its associated work centers, such as production control, quality program and material control. Synonymous with PMEL superintendent, PMEL branch chief, TMDE branch chief, TMDE flight chief, TMDE section chief and Laboratory Manager.

**1.4.20 Measurement or Reference Standards.** Equipment by which the accuracy and traceability of a precision measurement is derived. The typical chain of measurement standards is shown in Figure 1-2. The following are types of standards:



**Figure 1-2. Measurement Traceability Of The Air Force Metrology And Calibration Program.**

- a. Air Force Measurement Standards. Equipment certified by NIST or other 562 CBSG approved sources. These standards are used by the AFPSL as a basic measurement reference for the Air Force.
- b. Air Force Primary Standards Laboratory (AFPSL) Working Standards. TMDE certified by the AFPSL and used to calibrate other TMDE.
- c. Base Measurement Standards. Equipment certified by the AFPSL or 562 CBSG approved sources. These standards are used by an Air Force PMEL as a measurement reference. Base Measurement Standards are designated in TO 33K-1-100-2.
- d. Exchange Standard. A calibration standard calibrated by the AFPSL through a calibrate and replace methodology to minimize PMEL down time. An exchange standard is calibrated by the AFPSL and sent to a PMEL to replace a like base measurement standard before its calibration has expired. The exchange standard whose calibration interval is expiring is returned to the AFPSL for calibration, then forwarded to another PMEL. The PMEL is responsible to fund shipping costs to return exchange standards to the AFPSL. TO 33K-2-11, *Detailed Instruction and Information Pertaining to Air Force Primary Standards , Laboratory Calibration Exchange Standards, and Artifact Proficiency Testing Standards, PMELs Only*, contains detailed instructions and information for Exchange Standards.
- e. National Measurement Standards. Equipment or physical constants identified and normally used by NIST. These standards serve as a basic measurement reference for use throughout the United States and at U.S. installations/activities overseas.
- f. Working Standards. TMDE certified by PMEL and used to calibrate other TMDE.
- g. Transfer Standard. A measurement standard calibrated by the AFPSL and circulated to multiple PMELs to calibrate base measurement standards or working standards. A transfer standard is calibrated by the AFPSL, forwarded to a PMEL, used by the PMEL to calibrate a base or working standard, and returned to the AFPSL or forwarded to the next PMEL as directed. PMELs are responsible to fund shipping costs to forward transfer standards to the AFPSL or the next PMEL. TO 33K-2-11 contains detailed instructions and information for Transfer Standards.

**1.4.21 Metrology.** The science or system of weights and measures used to determine conformance to technical requirements. This includes the development of standards and systems for absolute and relative measurements.

**1.4.22 Precision Measurement Equipment Laboratory (PMEL).** A laboratory authorized to own and use base measurement standards to maintain working standards. The working standards are used along with PMEL-owned TMDE to maintain (troubleshoot, align, repair, and calibrate) TMDE designated as PMEL responsibility. Authorizations for PMEL equipment and facility requirements are tailored to meet specific requirements for supported missions. PMELs are the base-level link for measurement transfer and maintenance self-sufficiency for all systems in the Air Force. PMEL types are:

- a. Type IIA. A base level PMEL with a 68°F room providing support to an Air Logistics Center (ALC) and/or a large geographical area. ALC PMELs are operated by AFMC. PACAF theater support command operates the type IIA PMELs at Kadena AB, JA and Elmendorf AFB, AK. USAFE theater support command operates the Type IIA PMEL at RAF Feltwell, UK.
- b. Type IIB. A base-level PMEL established to support aircraft, missiles, ground systems and/or other equipment on base or in the local area.
- c. Type IIC. A base level PMEL with a 68°F room supporting research, development, test or evaluation programs, as well as other operational and support functions.
- d. Type III. A PMEL supporting a specific mission. It normally receives calibration support from a Type II ( ) PMEL. With the exception of Rapid Assistance Support for Calibration (RASCAL) sets, a Type III PMEL is not authorized at an installation where a Type II PMEL exists.
- e. Type IV. A PMEL supporting a specific weapon system. It uses a transportable measurement system in fixed and deployed locations. A Type IV PMEL receives calibration support from a Type II ( ) PMEL. It may be located at an installation where a Type II ( ) PMEL exists. Type IV PMELs are no longer authorized in the USAF metrology program. They still exist, however, in FMS country metrology programs.

**1.4.23 PMEL Mobile and On-Site Measurement Capabilities.**

- a. Rapid Assistance Support for Calibration (RASCAL). A portable PMEL designed for rapid deployment to support emergency calibration needs. It consists of 5 environmentally controlled shelters containing measurement standards and other TMDE. The shelters are joined together when in use. They are taken apart and airlifted to the needed location.
- b. Jet Engine Test Stand Calibrator (JETSC). TMDE and accessories needed to perform on-site calibration of jet engine test stands, housed in a trailer or set of ruggedized cases.
- c. Portable Automatic Test Equipment Calibrator (PATEC). A PATEC is used to calibrate Automatic Test Equipment (ATE) on site. A PATEC consists of a set of portable standards. A Core PATEC meets the calibration needs of a variety of test stations.
- d. Transportable Field Calibration Unit (TFCU). The TFCU consists of working standards in hardened cases selected to function within given performance tolerances as long as the equipment is operated within the published environmental restrictions of the TFCU. The TFCU is used to calibrate TMDE located at remote sites or bases.

**1.4.24 PMEL Quality Assurance (POA) Evaluator.** Shall be a highly qualified 2P071 or equivalent when possible. POA evaluators are selected by PMEL management and appointed in writing. POA evaluators are the only personnel designated to perform Quality Reviews, Process Reviews and Standard Reviews applicable to the Quality Program.

**1.4.25 Proficiency Testing/Measurement Assurance Program (PT/MAP).** The PT/MAP is a process for assessing laboratory capability by means of inter-laboratory data comparisons and exchange standard intercomparisons. Results from PT/MAP are an indication of a laboratory's competence and are an integral part of the assessment process.

**1.4.26 Rainbowed Equipment.** Non-prepositioned equipment that is sourced from multiple units, left in place, and used by multiple units over time to enable the best support of vulnerable AEFs while minimizing home station impact on supporting units.

**1.4.27 Reachback.** The process of obtaining products, services and applications of forces, equipment or materiel from Air Force organizations not forward deployed. This capability allows commanders to obtain or coordinate support from units not physically located with the forward force. See AFI 21-101 for more information.

**1.4.28 Shall.** Shall is a directive statement. Reference TO 00-5-1, *AF Technical Order System*.

**1.4.29 Traceability.** The ability to relate individual measurement results to national standards or nationally accepted measurement systems through an unbroken chain of comparisons all having stated uncertainties. Mandatory USAF traceability is accomplished as shown in Figure 1-2 or as approved by the 562 CBSG.

**1.4.30 User.** User refers to the using activity or owning organization responsible for calibration and maintenance of items designated "USER" responsibility in a CMS or TO 33K-1-100-2. In most cases, the 'user' and the 'owner' are the same. In general, the 'user' is the activity that physically uses the item. The 'owner' is the organization that owns the item via a supply account. The 'user' performs USER calibrations or coordinates with the PMEL for assistance when resources are not available. The PMEL will assist to identify required equipment or approved sources of support. As a last resort, the PMEL may perform the calibration. The owner is responsible for all funding associated with these efforts.

**1.5 PROGRAM ACRONYMS.**

- |    |     |                             |
|----|-----|-----------------------------|
| a. | AEF | Air Expeditionary Force     |
| b. | ASC | Allowance Source Code       |
| c. | CAP | Corrective Action Plan      |
| d. | CBU | Calibrate Before Use        |
| e. | CFR | Code of Federal Regulations |

**PROGRAM ACRONYMS-Continued**

f.	CIRF	Centralized Intermediate Repair Facility
g.	CPIN	Computer Program Identification Number
h.	ECS	Environmental Control System
i.	EME	Equipment Management Element
j.	ESD	Electrostatic Discharge
k.	FMS	Foreign Military Sales
l.	GEOLOC	Geographic Location
m.	HIR	High Intensity RADIAC
n.	ICO	Initial Calibration Only
o.	IM	Item Manager
p.	ISA	Interservice Support Agreement
q.	JCN	Job Control Number
r.	JDD	Job Data Description
s.	JETSC	Jet Engine Test Stand Calibrator
t.	MAP	Measurement Assurance Program
u.	MCA	Measurement Capability Assessment
v.	MDC	Maintenance Data Collection
w.	<i>Reserved</i>	<i>Reserved</i>
x.	NC	Nonconformity
y.	NCR	No Calibration Required
z.	NEC	No End Item Calibration
aa.	NHA	Next Higher Assembly
bb.	NPC	No Periodic Calibration
cc.	NRC	Nuclear Regulatory Commission
dd.	OEM	Original Equipment Manufacturer
ee.	OWC	Owning Work Center
ff.	PAMS	PMEL Automated Management System
gg.	PM	Program Manager
hh.	PNC	Process Nonconformity
ii.	PT/MAP	Proficiency Testing/ Measurement Assurance Program
jj.	PQA	PMEL Quality Assurance
kk.	PR	Process Review
ll.	PTRS	Precise Time and Reference Station
mm.	PWC	Performing Work Center
nn.	QDR	Quality Deficiency Report

**PROGRAM ACRONYMS-Continued**

oo.	QNC	Quality Nonconformity
pp.	QP	Quality Program
qq.	QR	Quality Review
rr.	RC	Root Cause
ss.	SA	Security Assistance
tt.	SATAF	Site Activation Task Force
uu.	SBSS	Standard Base Supply System
vv.	SICL	See Individual Component Listing
ww.	SICW	See Item Calibrated With
xx.	SR	Standard Review
yy.	TCM	Technical Content Manager
zz.	TI	Test Instrument
aaa.	TRC	Technical Repair Center
bbb.	WRM	War Reserve Material
ccc.	WUC	Work Unit Code

## **SECTION 2**

### **AFMETCAL PROGRAM ORGANIZATION AND INTERFACE**

#### **2.1 GENERAL.**

The AFMETCAL Program includes the 562 CBSG, PMELs and their resources, and the TMDE in the Air Force. The directives that provide the policy and guidance are also part of the program. The purpose of the AFMETCAL Program is to ensure that all Air Force TMDE used to make measurements is accurate, reliable, provides standardized measurements, and is traceable through the AFPSL to NIST or other 562 CBSG approved sources. This TMDE is used to make sure that each system and subsystem is accurate and reliable and ensures that they properly interface with other systems.

#### **2.2 AFMETCAL PROGRAM.**

**2.2.1 Figure 2-1 Description.** Figure 2-1 depicts each element of the AFMETCAL Program and the interrelationship of major Air Force organizations. The center circle identifies the major elements of the AFMETCAL Program: AFMETCAL Director (562 CBSG/CC), the PMELs and TMDE users. The focus of the AFMETCAL Program is to ensure accuracy and traceability of TMDE. This TMDE is used to ensure the accuracy and reliability of all Air Force systems. The resources needed to operate the AFMETCAL Program are identified in the rectangles. In cooperation with the other elements, the 562 CBSG provides program guidance, PMEL standards, traceability of standards, calibration procedures, PMEL evaluations, metrology engineering support, and determines calibration requirements of systems. The PMELs are the performing work centers containing the personnel that calibrate, certify and repair the TMDE owned and used by Air Force organizations. The AFMETCAL program requires users and PMELs to obtain calibration service from Air Force PMELs or the AFPSL as appropriate. The 562 CBSG must approve obtaining calibration service from other sources. The users of TMDE utilize their PMEL calibrated items to verify their support equipment (test benches, simulators, etc.) as well as major systems or subsystems. Users of the TMDE are assigned owning work center (OWC) codes.

**2.2.2 Resources used by AFMETCAL Program.** There are four primary groups of resources used by the AFMETCAL Program to do its mission (personnel, equipment/material, documentation and facilities). A basic need is sufficient personnel, having the necessary education, training, technical knowledge and experience for their assigned functions. These personnel require directives/procedures, material, and facilities. Calibration procedures provide the calibration methods. The PMEL requires parts and material to perform calibration and repair of TMDE. They also need their own measurement standards. The PMEL facility has some special requirements based on the system(s) it supports. The requirements of the program are based upon the measurement needs, and the accuracy of the measurements required of all systems supported by the Air Force. The outer ring of Figure 2-1 identifies the organizations that interface with the AFMETCAL Program. They provide, or coordinate, in the provisioning of the resources for the program. The outer ring of Figure 2-1 also shows the planning required to ensure that the proper AFMETCAL Program support is available. That support is needed for all systems from the time a system is under development through its entire life cycle.

**2.2.3 Funding.** Material and personnel needs are satisfied according to the amount of funding available.

**2.2.3.1** Funds for daily operating expenses of the PMELs are provided by the owning command. They generally come from operation and maintenance (O&M) appropriations. Business operating funds are furnished for AFMC by the MAJCOMs for the depot-supported workloads. Air Force regional workload support is generally funded by O&M appropriations.

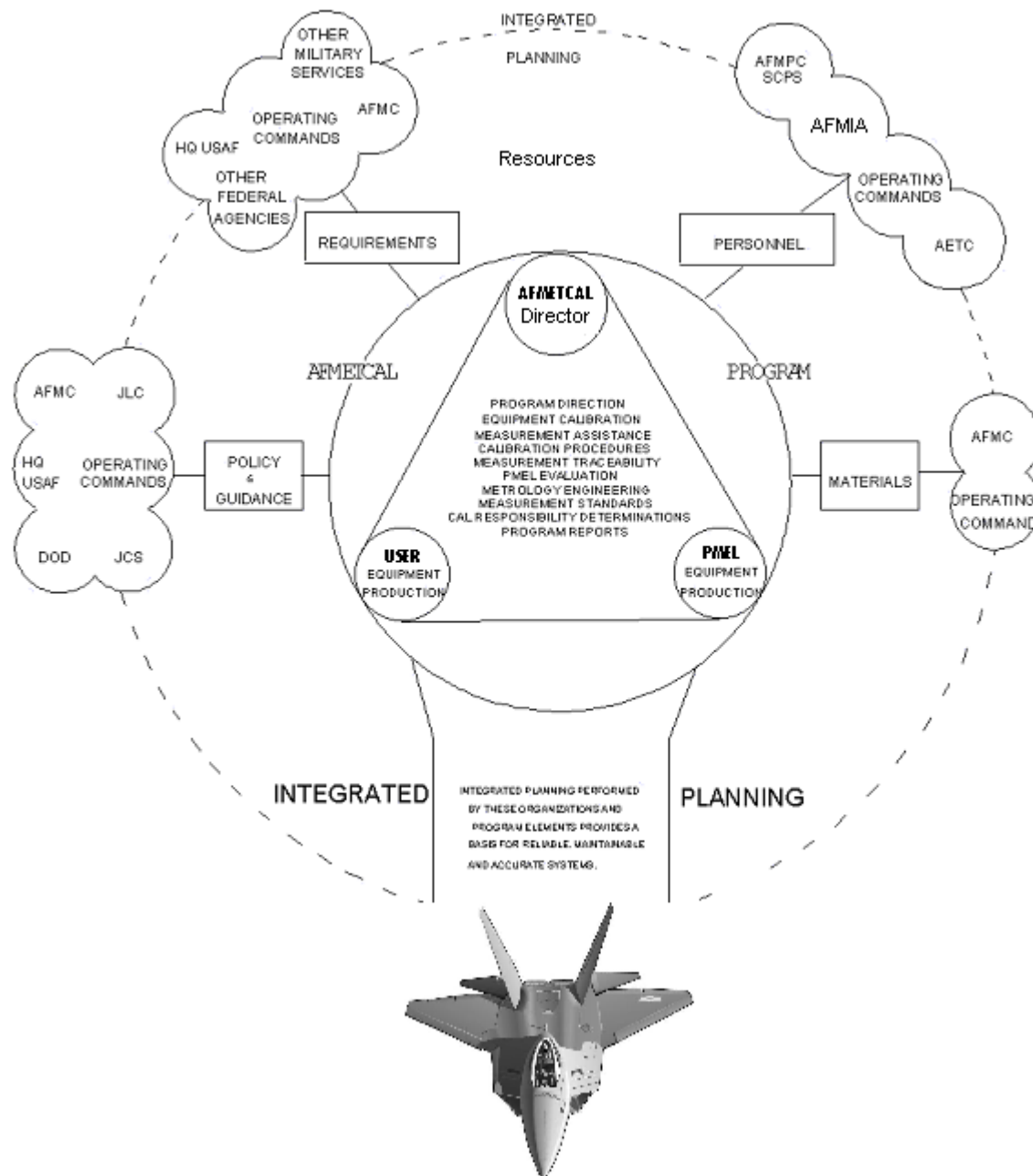
**2.2.3.2** Centrally procured investment equipment funding for equipment costing less than \$250K per item is provided to the AFMC procuring agency by MAJCOMs.

**2.2.3.3** Centrally procured expense (parts) item funding comes from the USAF Stock Fund.

**2.2.3.4** Operating command or base procured investment and expense items are generally funded from O&M and equipment funds.

**2.2.3.5** Facility funds are part of 3300 (Military Construction – Air Force) appropriations. This includes major and some minor construction projects as well as facility project planning efforts.

**2.2.3.6** AFMC is responsible for funding research and development projects. This includes support required for those projects turned over to other operating commands.



**Figure 2-1. AFMETCAL Program Resources And Planning Interfaces.**

## **2.3 PROGRAM POLICY AND DIRECTION.**

HQ USAF/A4MM provides program policy in AFI 21-113, *Air Force Metrology and Calibration (AFMETCAL) Program*.

**2.3.1 Requirements for TMDE Support from PMELs.** FAMS, PMELs and TMDE user organizations shall periodically review and update war plans related to their operations. The review shall consider where, who, what and how TMDE shall be supported. Of special concern shall be TMDE that is mission essential to systems and



subsystems required to meet Designed Operational Capability (DOC). This is necessary for mission capability and unit combat readiness reporting under AFI 10-201, *Status of Resources and Training System*.

**2.3.2 Periodic Reports Utilized.** The 562 CBSG and the PMEL functional area managers utilize periodic reports (see PMEL Reports, Section 6) submitted by each of the PMELs to assist in managing the program.

## **2.4 PROGRAM REQUIREMENTS.**

New systems or improvements in weapon system performance are major factors in upgrading the measurement capability of supporting PMELs. The 562 CBSG has the responsibility to review the measurement requirements of all Air Force systems. This normally happens through the review of Support Equipment Recommendation Data (SERD) and/or CMRS documents.

**2.4.1 Support Equipment Recommendation Data (SERD).** The SERD review process is used to justify the weapon system support equipment. SERDs are reviewed by Operating Commands, the acquisition agency, the item manager and the 562 CBSG. Calibration responsibility determinations are made for approved SERDs. Calibration procedure requirements are established when necessary.

**2.4.2 Calibration and Measurement Requirement Summary (CMRS).** The CMRS documents are only required on complex systems. The completed document identifies the measurement requirements. They extend from the weapon system through the support equipment to the PMEL measurement standards.

**2.4.3 Calibration and Measurement Summary (CMS).** The CMS is published as a TO and details the measurement accuracy requirements on a complex system. The 562 CBSG is responsible for the technical adequacy of the CMRS and the subsequently published CMS. The 562 CBSG is also responsible for ensuring that measurement traceability exists from the national level to the system measurement. This includes the AFPSL capability. If the system has no unique or complex support requirements, the applicable support equipment is added to TO 33K-1-100-2.

**2.4.4 Measurement Upgrade Identification.** Necessary improvements in PMEL measurement capability are identified early in the 562 CBSG review. This is done in the calibration responsibility determinations and the calibration procedure preparation process. If additional measurement capabilities are required, the measurement standard shall be acquired and distributed by the 562 CBSG to the appropriate PMELs following coordination with MAJCOM functionals. If only national stock listed test equipment is required; the equipment shall be added to the applicable Allowance Source Code (ASC). The equipment shall be requisitioned by the PMEL. Normally, workload summaries derived from the SERD and CMRS reviews, are distributed to the operating commands. They are distributed at various times during the life cycle of the system to allow for PMEL support planning. Since two PMELs rarely support the same type systems, very few PMELs have the exact same measurement capability. Most have the same basic capability.

## **2.5 PROGRAM MATERIAL.**

Material is a broad category. It includes facilities as well as equipment, parts, and other items. It is used to support the AFMETCAL Program mission at all levels.

**2.5.1 PMEL Establishment/Closing.** Commands shall coordinate any change in the status of any PMEL with the 562 CBSG and receive final approval from HQ USAF/A4MM. This includes requirements for new PMELs, elimination of any existing PMEL, or a PMEL location change.

**2.5.2 PMEL Facility Requirements Documentation.** The 562 CBSG specifies PMEL facility requirements and performs reviews of facility project documentation. Design and construction are an owning command responsibility. AFMAN 32-1094, *Criteria for Air Force Precision Measurement Equipment Laboratory Design and Construction* and AFI 32-1024, *Standard Facility Requirements*, are some of the major publications involved. TO 00-20-14 (Section 8, PMEL Facility Operational Requirements) contains facility operating parameters for PMELs.

**2.5.3 Equipment.** Equipment is obtained through the Air Force Equipment Management System (AFEMS) by ASC authorizations from ALC Commodity Management, 562 CBSG or local purchase.

**2.5.4 Expense Items.** Expense items (parts, tools, furnishings, etc) are obtained through the Standard Base Supply System (SBSS) from ALC Commodity Management, local purchase or local manufacture.

**2.5.5 Technical Data.** Technical data is obtained from the Air Force TO System, the 562 CBSG, other DoD Agencies or local purchase.

**2.5.6 Management Information System (MIS).** Software and hardware that provides inventory, processing, calibration scheduling, job data documentation and quality assurance functionality.

**2.6 PERSONNEL.**

PMELs shall have sufficient personnel, having the necessary education, training, technical knowledge and experience for their assigned functions. PMEL managers shall ensure that training of personnel is kept up-to-date and consistent with employee assignments and development.

**2.6.1 Qualification/Training Records.** Qualification, training, or certification records shall be maintained on the relevant qualifications, training, skills and experience of all technical personnel certifying/verifying TMDE. The documentation may be maintained in electronic or traditional format. Regardless of the format, records shall be available and periodically reviewed by the employee and PMEL management as specified in the PMEL quality manual. The term training in this context is defined as “records maintained in the PMEL that document management approval for specific technicians to perform specific tasks or types of tasks.” These records (however named) should be of sufficient detail to provide confidence in the task competence of assigned personnel. Military specialty training standards or similar documents are a convenient method to satisfy this requirement.

**2.7 PROGRAM INTEGRATION.**

TMDE requiring support drives all resource needs and normally comes from three sources. They are (A) centrally procured items resulting from a systems acquisition, (B) centrally procured replacement buys and (C) locally-procured TMDE.

**2.7.1 AFMC Centrally Procured TMDE.** Close working relationships among the System Program Directors (SPDs), the 562 CBSG's measurement area and systems planners, ALC Commodity Managers, Product Group Managers, Material Group Managers, AETC/TT, and the using commands are necessary to ensure proper planning, programming, budgeting, acquisition, training and distribution of resources needed to support this TMDE are provided.

**2.7.2 Centrally Procured Replacement TMDE.** Close working relationships among ALC Commodity Managers, 562 CBSG measurement area planners, Product Group Managers, Material Group Managers, AETC/TT, and the using commands are necessary to ensure planning, programming, budgeting, acquisition, training and distribution of resources needed to support this TMDE are provided.

**2.7.3 Locally Procured TMDE.** The local user/buyer funds support requirements. Before contracting for TMDE, the buyer shall coordinate support requirements with PMEL. See TMDE User Responsibilities in Section 3 for more information.

## SECTION 3 OPERATION

### **3.1 CALIBRATION OF STANDARDS AND OTHER TMDE.**

The PMELs, which are maintained, manned, and operated by the MAJCOMS, are responsible for calibrating and/or repairing standards and other TMDE specified in CMS TOs, TO 33K-1-100-1, and TO 33K-1-100-2. PMELs are also responsible for other workload that may be assigned by the MAJCOM. Policy, procedures, intervals, and responsibilities for the maintenance, calibration, and certification of standards and TMDE are identified in this TO, TO 33-1-27, TO 33K-1-100-1, TO 33K-1-100-2, other applicable command directives, and weapon or support system CMS TOs. These TOs and directives shall be used for all TMDE used to make qualitative/quantitative measurements on operational systems and equipment. All TMDE having an effect on the accuracy and validity of calibrations shall be calibrated. Any standard or TMDE that has exceeded its calibration due date or is otherwise judged unreliable shall be recalled or removed from service.

**3.1.1 Valid and Accurate Calibration Requirements.** To assure valid and accurate calibrations are performed, it is necessary to:

- a. Comply with appropriate calibration authority.
- b. Use technically qualified personnel.
- c. Use equipment called for in the calibration authority or substitute equipment with required functions, ranges and test uncertainty ratios.
- d. Perform calibrations in an environmentally controlled atmosphere.
- e. Utilize current technical data.

**3.1.2 Calibration Authority Precedence.** Calibration authority selection shall be made in accordance with the following precedence:

- First. CMS\* (Applicable to TMDE used solely to support a system referenced in the CMS). Where TMDE is applicable to more than one CMS and where different calibration intervals are listed, use the shortest interval listed and note in the special block which CMS was used for the interval.
- Second. TO 33K-1-100-2\*.
- Third. TO 33K-1-100-1 Section 3-1, if applicable.
- Fourth. Other official DoD calibration procedures.
- Fifth. Equipment maintenance TO.
- Sixth. Commercial Publications or Commercial Data.

\* NOTE for PAMS, FEMS, and LABMET users: TO 33K-1-100-2, and Calibration and Measurement Summary (CMS) TOs are distributed on CD and electronically updated via the AF Portal and the 562 CBSG public internet site. This information is also provided to the PAMS managers to automatically update the PAMS database. Thus, information contained in the PAMS system is current and calibrating organizations are authorized to use the calibration determination information contained in the PAMS system. FEMS and LABMET users must ensure that their calibration determination databases are current with those distributed via the CD and electronic updates. The corresponding precedence applies to these systems. If specifications are listed as "Table 1" in 33K-1-100-2, they must be used and can only be viewed using AFCAV.

**3.1.3 Local K100.** A locally managed addendum to TO 33K-1-100-2 that contains the following inventory items:

- a. Items that have an AFTO Form 45 being processed. These items must be purged when they become listed in a CMS or TO 33K-1-100-2.
- b. Items that have no identifiable part number or manufacture and have been calibrated under the provisions for "Special" calibrations.
- c. Items from FMS countries.

- d. Items that do not belong to the Air Force, ANG or AFRC. (Support agreements, NASA, DOE, etc.)
- e. Locally manufactured items determined to be TMDE. (Reference TO 33K-1-100-1, Section 1)
- f. Items with Responsibility Determination Exceptions as per 3.1.5.3.

**3.1.4 AFPSL Requirements.** The AFPSL evaluates many first-article items and is responsible for acceptance testing of certain new items entering the inventory. This requires some deviation from normal directives since formal 33K procedures may not exist for such items. The process for conducting first-article and acceptance testing shall be documented.

**3.1.5 Calibration Responsibility Determinations.** TMDE calibration and maintenance responsibility determinations are managed by the 562 CBSG and are published in CMS TOs and TO 33K-1-100-2.

**3.1.5.1 Request for Calibration Responsibility Determinations.** If the TMDE is not listed in the CMS or TO 33K-1-100-2 as prescribed in TO 33K-1-100-1, the PMEL shall submit an AFTO Form 45, *Request for Calibration Responsibility Determination*, to the 562 CBSG in accordance with instructions in Section 5 of this TO. The PMEL shall assist the user in maintenance and calibration; however, the maintenance and calibration of the equipment shall be the responsibility of the user and the procuring agency until the calibration responsibility decision is made. While awaiting the calibration responsibility determination, as published in the CMS or 33K-1-100-2, the item may be calibrated using other DoD procedures or commercial data per the calibration authority precedence in paragraph 3.1.2. If the item is new and was calibrated by the manufacturer, the PMEL may accept the initial commercial calibration IAW paragraph 4.5.1.2.2.

**3.1.5.2 Non-Air Force TMDE.** Ensure requests for calibration responsibility determinations, AFTO Form 45s, are not submitted for equipment owned and used by departments outside the Air Force. Such a customer is responsible to give the PMEL the capability to support new equipment, if the PMEL does not already have it.

**3.1.5.3 Responsibility Determination Exceptions.** There may be instances where individual MAJCOMS may require exceptions from the assigned determination because the capability exists in an organization other than a PMEL. Requests to deviate from the assigned calibration responsibility, by having the calibration performed in an organization other than a PMEL, shall be processed through the MAJCOM PMEL Functional Area Manager (FAM). If the FAM accepts the request, the request along with supporting comments shall be forwarded to the 562 CBSG for review. The 562 CBSG's concurrence or non-concurrence shall be forwarded to the FAM. If the 562 CBSG concurs, the FAM may authorize the PMEL to change their local -100 via message, letter or email. PMEL shall retain the authorization and make it available upon request. Calibration of a USER designated item by a PMEL is not considered an exception to responsibility determination.

**3.1.6 Calibration Equipment Traceability/Accuracy.** The overall program shall be designed and operated to ensure measurements are traceable through the AFPSL to NIST or other 562 CBSG approved sources. The equipment required to calibrate TMDE is listed in each calibration TO. Other equipment, which has the necessary functions, ranges and accuracies, may be substituted to perform the calibration even though they may not have all the characteristics of the listed item. Use TO 33K-1-100-CD-1 to assist in the identification of substitute items. If the uncertainty ratio of the equipment specified in the TO is better than the required uncertainty ratio, substitute equipment shall not lower the uncertainty ratio to less than the required uncertainty ratio. EXAMPLE: If the required accuracy is specified as 2 to 1, the accuracy of the substituted standard must be at least 2 to 1. If no uncertainty ratio is specified, the default required uncertainty ratio is 4 to 1. Round uncertainty ratios to one decimal place; (i.e. 3.94 rounds to 3.9; 3.95 rounds to 4.0). CAUTION: Care must be taken in determining the accuracy of a given measurement. In many instances, the accuracy of the measurement is not the sum of accuracies of the instruments used. Modification of procedural steps is authorized when substitute equipment is used. However, all parameters, ranges and accuracies in Table 1 of the calibration TO shall be met or exceeded. Questions regarding determination of accuracies shall be directed to the responsible engineer at the 562 CBSG. The 562 CBSG POC page is published at: <https://metweb.afmetcal.af.mil>. Air Force calibration procedures (33K series technical orders) are designed to ensure calibrations are traceable through the AFPSL to NIST or other 562 CBSG approved sources. Air Force calibration laboratories (both PMELs and the AFPSL) shall ensure that any substitution of equipment and subsequent modification of procedural steps does not adversely affect the traceability of the calibration being performed.

**3.1.6.1 Calibration Software.** When using calibration software, the calibration authority for the measurement shall be established using the order of precedence noted in Paragraph 3.1.2. Normally, the calibration authority is a 33K

Series calibration procedure. Calibration software provided by the 562 CBSG can be released either as CPIN software referenced in a manual 33K procedure, or a software package released as a 33Kx-x-xxxx-10 automated procedure. The 33K automated procedure carries the same calibration authority as the equivalent manual procedure and will be listed in the [Auto CTO] field of 33K-1-100-2 or the applicable CMS. The calibration authority is cited on the calibration certificate/label. Thus, the calibration of the end item shall satisfy the requirements contained in the calibration authority. Use of calibration software is viewed as a controlled substitution of equipment. The control is established through the documentation, validation and verification requirements noted in Table 3-1. Use of software that has not been properly documented, validated, and verified is prohibited and is grounds for audit failure by either the local PQA evaluator or by the visiting 562 CBSG certification team. Calibration software is divided into four classes as shown in Table 3-1.

**Table 3-1. Calibration Software Classes.**

Software Class	Developer	Maintainer	Distributor	Val & Ver	Calibration Authority	Documentation
562 CBSG CPIN or Technical Order (TO)	562 CBSG	562 CBSG	562 CBSG	562 CBSG	See para 3.1.2	562 CBSG Generated & Approved
PMEL/ AFPSL CPIN	PMEL/ AFPSL	562 CBSG	562 CBSG	PMEL/ AFPSL/ 562 CBSG	See para 3.1.2	PMEL/ AFPSL Generated - 562 CBSG Approved
PMEL/ AFPSL Local	PMEL/ AFPSL	PMEL/ AFPSL	Not Authorized.	PMEL/ AFPSL	See para 3.1.2	PMEL/ AFPSL Generated - PQA Approved - Copy of Val & Ver doc shall be kept on file - Notify 562 CBSG of usage
Commercial	Commercial	Acquirer	Acquirer	Acquirer	See para 3.1.2	Acquirer Responsibility - Copy of Val & Ver documentation shall be kept on file - Notify 562 CBSG of usage

#### 3.1.6.1.1 Definitions for Table:

- Developer: Authors software.
- Maintainer: Maintains software and is responsible for configuration control and software changes/updates. The Maintainer shall keep the calibration software in agreement with the Calibration Authority.
- Distributor: Distributes software to users. Updated copies of the calibration software shall be provided whenever the Maintainer accomplishes changes/updates.
- Validation & Verification: Organization responsible to validate and verify that software satisfies calibration requirements. Validation and verification shall demonstrate and document that the software operates correctly, produces the desired result, cannot be manipulated/changed during operation, and satisfies and is equivalent to the Calibration Authority.
- Calibration Authority: Calibration requirements as determined by the 562 CBSG shall be established using the order of precedence noted in Paragraph 3.1.2.
- Acquirer: Organization that procures the calibration software.

#### 3.1.6.1.2 Calibration software documentation levels shall be determined by the Maintainer, but shall include as a minimum:

- End items to be calibrated with the software.
- Software identification number.
- Software revision status/number.
- Calibration authority to be cited (including version date).
- Software Validation and Verification (Val & Ver) Plan.

- f. Validation and Verification results. This documentation shall be maintained throughout the software's life.

**NOTE**

Software Validation and Verification shall be re-accomplished and documentation updated if the Calibration Authority is changed and/or updated. Calibration software that has not undergone Validation and Verification against the published (official) version of the Calibration Authority or lacking current up to date documentation cannot be used.

**3.1.6.1.3** Additionally, the methods used to acquire, develop, maintain, validate and verify, distribute, document and control calibration software shall be addressed in the laboratory's Quality Manual. Copies of the software documentation and the laboratory quality manual shall be available for review by the 562 CBSG upon request. Upon review, the 562 CBSG reserves the right to disapprove use of the software, if it has not been adequately validated and verified, does not have current up to date documentation, does not satisfy or is not equivalent to the Calibration Authority.

**3.1.6.1.4** Software Verification and Validation Support. One or several PMELs may be tasked through the Command FAM to participate in software Verification and Validation tests for 562 CBSG managed CPIN or TO calibration software. Specific guidelines detailing the Validation and Verification process will be provided to the PMEL for each test.

**3.1.7** Calibration Procedures. The 562 CBSG shall prepare, maintain and control content, and issue 33K series technical orders and software for calibrating measurement standards, TMDE and automated test equipment defined as the responsibility of the PMEL. The 562 CBSG shall publish and maintain TO 33K-1-100-1, *Technical Manual TMDE Interval, Calibration, and Repair Technical Order Reference Guide and Work Unit Code Manual*. The 562 CBSG shall ensure:

- a. Calibration procedures contain the required range and tolerance or uncertainty of each item or unit parameter being calibrated or verified.
- b. The procedures contain a generic description of the measurement standards and equipment needed with the required parameter, range, tolerances or uncertainties, and specifications for performing the measurement, and/or representative types (manufacturer, model, option) that are capable of meeting the generic description for the measurement standards.
- c. The procedures are consistent with the accuracy required, and with any standard specifications relevant to the calibrations/verifications concerned.
- d. The calibration uncertainties are sufficiently small so that the adequacy of the measurement is not affected. Well-defined and documented measurement assurance techniques or uncertainty analyses may be used to verify the adequacy of a measurement process. If such techniques or analyses are not used, then the collective uncertainty of the measurement standards shall not exceed 25 percent (4:1) of the acceptable tolerance for each characteristic of the measuring and test equipment being calibrated or verified.

**3.1.7.1** Locally Developed Procedures. Locally developed procedures for items designated PMEL responsibility shall not be used to perform calibration until approved by the 562 CBSG and the using command (TO 00-5-1). Format of the procedures shall conform to MIL-PRF-38793B and MIL-STD-38784. The writing shall conform to the plain English standards and minimum editorial requirements listed in AFI 33-360V1. The local procedures shall be routed through the PMEL's FAM to the 562 CBSG. If a locally developed procedure must be changed or revised, the revised locally developed procedure shall be routed through the PMEL's FAM to the 562 CBSG for approval prior to use. Do not submit AFTO Forms 22 for locally developed procedures

**3.1.7.2** Procedure Specifications. 33K Series calibration procedures shall be written to meet manufacturer's specifications whenever possible. The procedure shall direct use of a Limited Certification Label if the parameters listed in Table 1 of the calibration procedure do not meet the manufacturer's specifications. This is to ensure the user of the TMDE is made aware of the deviations from manufacturer's specifications. Table 1 specifications of 33K Series TO take precedence over other specifications or tolerances listed throughout the TO. Individuals discovering contradictions between Table 1 and any other section of the TO shall comply with paragraph 3.1.8.

**3.1.7.3** TO Verification Process. Laboratories shall perform TO verification on all draft calibration procedures received from the 562 CBSG for review. Guidelines detailing the verification process are outlined on the TO Support page of METWEB under Verification of Calibration Technical Order (TO).

**3.1.7.4 Post-Publication Reviews.** The 562 CBSG will perform Post-Publication Reviews on TOs under any of the following conditions:

- a. The TO has not been changed for five years.
- b. The recommendation of the Technical Content Manager (TCM).
- c. The recommendation of the TO Manager due to the number of AFTO 22s received and at the request of the using command Functional Area Manager.

During a Post Publication Review, one or several PMELs may be tasked through the Command FAM to participate, either locally or at another site. This tasking shall be at the discretion of the TCM. Reference AFMCI 21-301, TO 00-5-1, and TO 00-5-3.

**3.1.8 Documenting and Reporting Procedure Problems.** PMEL technicians experiencing difficulty performing calibration procedures shall contact the appropriate 562 CBSG flight for assistance and submit an AFTO Form 22, *Technical Manual Change Recommendation and Reply*, if necessary. Recommendations for minor changes may be emailed to the address listed on the TO Support Home Page of the AF Portal. When a calibration procedure (33K) contains an error and an AFTO Form 22 is submitted, the technician shall select an alternate procedure for the affected parameter(s) in compliance with paragraph 3.1.2, and document the calibration authority for the affected parameter(s) in the Special block of the certification label. If commercial data is used, document its use in accordance with paragraphs 5.4.2.3.4 and 5.4.2.3.7.

### **3.2 EXCEPTIONS FROM PERIODIC CALIBRATION.**

Some types of TMDE do not require periodic calibration. They include items not used to make quantitative measurements, TMDE seldom used but must be calibrated before use, items designated as not requiring calibration and TMDE that requires initial calibration only.

**3.2.1 No Calibration Required (NCR) Items.** Certain types of TMDE identified as NCR do not require calibration because they do not provide important quantitative measurement information, and/or are accessories to other TMDE or function only as an interface device. Examples are RF receivers traceable to a frequency standard; some automotive test equipment; some pressure regulators, isolators, terminations, loads, adapters, tees, circulators and waveguide components. Exception may occur when such items present an actual workload for the PMEL. Examples: NCR items may require calibration in specific applications, or the user may request calibration of an NCR item. The user shall supply justification for the need. Bar code labels shall not be applied on NCR items that cannot be repaired unless the item requires periodic calibration by the PMEL. An AFTO Form 256, *No Calibration Required*, label or a 'white dot' shall be affixed in accordance with Section 5.

**3.2.2 Calibrate Before Use (CBU).** There are two criteria for CBU:

- a. TMDE identified by the 562 CBSG as CBU in a CMS or TO 33K-1-100-2. These items require calibration or operational verification prior to every use rather than periodical calibration. Generally, the CMS or TO 33K-1-100-2 entry for CBU items will reference a specific 'Note Code' instruction in TO 33K-1-100-1 Section 3.
- b. TMDE that normally is not used at least once during its calibration interval need not be periodically calibrated and may be designated as CBU. Calibration of TMDE designated CBU need not be recalibrated until the TMDE is to be used even though the calibration due date has passed. CBU items shall be calibrated at least once before being designated as CBU. New TMDE shall require an initial calibration to ensure it meets requirements before being designated CBU. Previously calibrated TMDE shall not require a recalibration before being designated CBU unless requested by the user. After notifying the PMEL to update the master inventory, the user may enter "CBU" following the DATE DUE date on the AFTO Form 99, 108, 394, or 398 as applicable and hold the item until they require it to be calibrated. After calibration of a CBU designated item, an AFTO Form 99 or 398, whichever is applicable, shall be completed and marked CBU in accordance with Section 5. The CBU designation shall be entered in the PMEL Master Inventory listing in place of the calibration interval.

#### **NOTE**

PMEL cannot make an item CBU without the user's direction or permission.

**3.2.3 No End-Item Calibration (NEC).** NEC in the calibration interval denotes TMDE designated SICL (See Individual Component Listing) in a CMS or TO 33K-1-100-2, that does not have an end-item-calibration requirement. NEC only applies to the end-item; not components listed with separate calibration intervals.

**NOTE**

For scheduling systems that have not been updated to process NEC, load as NCR.

**3.2.4 Next Higher Assembly (NHA).** NHA in the calibration interval field of a CMS or TO 33K-1-100-2 denotes components that are calibrated as part of a next higher assembly. The calibration interval and calibration TO of the next higher assembly apply unless otherwise noted. NHA items shall not generate a separate “due calibration” in addition to the end item. The next higher assembly calibration sticker applies to all components designated NHA.

**NOTE**

For scheduling systems that have not been updated to process NHA, load as NPC so only the next higher assembly is scheduled for calibration.

**3.2.5 No Periodic Calibration Required (NPC) Items.** There are two criteria for NPC:

- a. TMDE which are components of a higher assembly that are identified by the 562 CBSG as NPC in a CMS or TO 33K-1-100-2 do not require periodic calibration. These items shall require an initial calibration to ensure it meets requirements of the applicable calibration authority. This TMDE shall require calibration after repair is accomplished. An AFTO Form 99 or 398 shall be completed and affixed to the TMDE. TMDE designated NPC shall be identified in the PMEL Master Inventory Listing as NPC where the frequency is normally entered.
- b. Based on user applications (see below), an individual unit of TMDE may not require periodic calibration. Even though it belongs to a part number group that normally requires calibration per a CMS or TO 33K-1-100-2, it may be locally designated as NPC by the user. The TMDE user exercises the option of designating an item NPC by contacting the PMEL with the request that a specific item be made NPC for one of the reasons listed below. This TMDE shall require an initial calibration to ensure it meets requirements of the applicable calibration authority. The unit shall not require another calibration if the user wants to designate the item NPC at a later date. This TMDE shall require calibration after repair is accomplished. AFTO Form 99 or 398 shall be completed and affixed to the TMDE. TMDE designated as NPC shall be identified in the PMEL Master Inventory Listing as NPC where the frequency is normally entered. The TMDE user may designate an item NPC if either:
  - (1) Its performance is verified, checked or monitored by other certified TMDE.
  - (2) It does not affect safety and is not used to verify equipment performance factors or make absolute measurements.

**NOTE**

PMEL cannot make an item NPC without the user's direction or permission.

**3.2.6 Training Equipment.** TMDE used solely for training and not used to verify specifications or performance factors of operational weapon/support systems or does not affect safety may be identified as NPC. Calibration shall be performed if the TMDE is required for contingency purposes. Calibration after repair of TMDE used for training and designated NPC is optional based on agreement between user and the PMEL flight chief. Instructors shall remove, or annotate malfunctions implanted for training purposes prior to processing any TMDE for repair or calibration. Instructors shall ensure TMDE coded NPC with inoperative functions or ranges is processed for repair before the item becomes totally inoperative. TMDE requiring calibration shall use the interval specified in the applicable CMS, if appropriate or TO 33K-1-100-2. TMDE used for training and identified as NPC shall have an AFTO Form 99 or 398 attached. The Standard Reporting Designator (SRD) for resident training TMDE is "HTE". All other TMDE shall use normal SRD reporting codes.

**3.2.7 Initial Calibration Only (ICO).** Due to its inherent design features, TMDE designated ICO does not require periodic calibration. This TMDE shall be calibrated when initially entering service, or if necessary to meet required specifications after repair. An exception is an absolute standard, which does not require any calibration. Retain



report of measurement or certificate of calibration from NIST, AFPSL, PMEL (if applicable) or original equipment manufacturer (OEM) on file in the PMEL until the TMDE is no longer needed. A properly completed certification label (and any supporting data referenced on said label) is sufficient for ICO items certified by the PMEL. The ICO category also includes certified reference materials or samples which might be obtained from NIST or other sources.

**3.2.8 Depot or Base Supply Stocks.** Except for the following situations, items in depot or base supply stocks do not require periodic calibration. Items of TMDE that are an integral part of an automatic test station and are maintained as spares in a forward supply point shall be calibrated prior to turn-in to supply and thereafter at their designated calibration interval unless another interval is prescribed in the applicable weapon CMS. The items shall be tested in the station if possible.

### **3.3 LIMITED OR SPECIAL CALIBRATION.**

A Limited or Special calibration requires the use of an AFTO Form 99 or 398 Limited TMDE Certification label. The authorization for a limited or special calibration shall be documented in the USER APPROVAL block of the AFTO Form 99 or in the INI block of the AFTO Form 398 in accordance with Section 5.

**3.3.1 Limited.** There are several situations where the PMEL may be authorized to perform a limited calibration.

**3.3.1.1 TO Directed Limited Calibration.** The procedure can contain a statement such as "The Test Instrument accuracy has been downgraded from the manufacturer's specifications due to a lack of adequate standards" and shall direct use of the limited calibration certificate.

**3.3.1.2 Limited PMEL Capability.** When a PMEL does not have the capability to calibrate the full range of specifications contained in the calibration procedure or maintenance TO, the PMEL supervisor shall advise the using activity of the extent of services available. The using activity shall decide if the available service meets the mission requirements. If the limited calibration service does not meet their needs, the using activities shall advise the PMEL, and action shall be taken in accordance with paragraph 4.1.

**3.3.1.3 Limited User Requirement.** When a user requires less than the full capability of the TMDE, the user shall specify the desired calibration points or ranges to the PMEL. The PMEL shall clearly identify the certified points or ranges (or the limitations) on the instrument's certification label (AFTO Form 99 or AFTO Form 398 or the form that accompanies them).

**3.3.1.4 Instrument Limitation.** When a function, range or specification on a multi-function instrument cannot be economically restored to original design specifications, the PMEL supervisor shall advise the using activity of the condition. The user shall then decide if the missing function is necessary to support the mission or if a replacement item is needed. If a limited calibration can permit proper mission support, the PMEL can perform the limited calibration. If not, the item shall be returned to the user, with the appropriate condition tag affixed in compliance with TO 00-20-3.

**3.3.1.5 AFPSL Limitation.** If the AFPSL cannot perform a complete calibration because the capability does not exist to calibrate the item to full manufacturer's specifications, the AFPSL may perform a limited calibration. Document all such limitations on an AFTO Form 99.

**3.3.2 Special.** When a special calibration is performed, the ability of the test instrument to maintain accuracy through the calibration interval is questionable and the user shall be notified of the inherent risk. A typical special calibration includes an extra data point(s) such as a special frequency or reading that is not in the calibration procedure. They may also be:

- a. Calibration of an item designated as NCR.
- b. Calibration of a unit to a higher accuracy than specified in the calibration procedure. In this case, the unit must be capable of providing the higher accuracy within manufacturer's specifications. Whenever possible, performance specifications shall be consistent with the manufacturer's specifications (MIL-PRF-38793B, paragraph 3.2.2.2). If they are not, the calibration procedure shall identify any deviations from manufacturer's specifications.
- c. Calibration of an item that has no identifiable manufacturer or part number. In this case the user shall submit, in writing, a special calibration request that includes range and accuracy required and a documented reference (TO, Test Program Set, test plan, etc.). Laboratory personnel shall determine if the test instrument is capable of supporting the required measurement. If there is reasonable doubt of Test

Instrument capability, the item shall not be calibrated. When calibrated, the Test Uncertainty Ratio shall be at least 4:1. The certified accuracy must not exceed the Table 1 specifications of the general calibration procedure used as per TO 33K-1-100-1. The certified accuracy shall be annotated on the certification label.

**3.3.2.1 PMEL Special Calibration.** The PMEL shall contact the 562 CBSG for direction when there is a 33K-series calibration procedure written with uncertainties downgraded from the manufacturers stated uncertainties and there is a need to certify TMDE to the manufacturer specifications.

**3.3.2.2 AFPSL Extended Calibration.** To meet Air Force requirements, the AFPSL may perform special calibrations that exceed manufacturer's ranges and/or specifications. In such cases, specific details of the extended calibration shall be documented and published in the calibration procedure if the extended calibration is an ongoing occurrence. An AFTO Form 108 shall be used by the AFPSL in these instances. An AFTO Form 99 shall be used if it also has a limited parameter. An uncertainty analysis shall be performed and documented to substantiate the uncertainties published.

### **3.4 CALIBRATION INTERVALS.**

The Air Force calibration interval (calibration cycle) listed in a CMS or TO 33K-1-100-2 is the period of time over which the equipment shall perform its mission (or function) with a statistically derived end-of-period reliability (shall be within tolerance) of 85% or better. These intervals are established and modified as necessary from data collected on the total TMDE population through the maintenance data collection system. TMDE that has exceeded the prescribed calibration interval shall not be used. The date due, however, can be extended in certain cases. Paragraphs 3.4.10 through 3.4.16 identify those cases.

**3.4.1 Precedence for Calibration Intervals.** Calibration interval selection shall be made in accordance with the following precedence:

- a. CMS (Applicable to TMDE used solely to support a system referenced in the CMS). Where TMDE is applicable to more than one CMS and where different calibration intervals are listed, use the shortest interval listed and note in the special block which CMS for the interval was used.
- b. TO 33K-1-100-2.
- c. General procedure interval listed in TO 33K-1-100-1 Section 3-1, if applicable.
- d. Individual maintenance TOs.
- e. Commercial data.

**3.4.2 Intervals for New Items and Items Listed without a Calibration Interval.** The maximum calibration interval for TMDE is 12 months when an interval is not prescribed by a TO.

**3.4.3 Published Calibration Interval Changes.** It is not mandatory that TMDE be rescheduled or recalled for calibration or update of certification solely because a change to a calibration interval is published. Items changed from NCR, ICO, or CBU to a periodic calibration interval shall be removed from service and recalled to the PMEL and calibrated. When large quantities are involved, the recall should be staggered to maintain an even flow of workload into the PMEL.

**3.4.4 Other Reasons for Calibration Interval Changes.** TMDE users may request recalibration of their TMDE any time there is reason to question the accuracy of the instrument. Items exposed to rough handling, overload, or other severe conditions shall be removed from service and recalibrated regardless of the calibration due date. TMDE users may request shorter calibration intervals to meet mission requirements. Users may also request special calibration of NCR items if they are used to accept or reject items. PMEL may shorten a calibration interval based on calibration mobility team schedules, PMEL workload or excessive unscheduled maintenance.

**3.4.5 Recommending Changes to Calibration Intervals.** Air Force activities that have accumulated data to substantiate a change in calibration intervals may submit this data and the recommended changes to the 562 CBSG. Interval changes must be approved by the 562 CBSG.

**3.4.6 War Reserve Material (WRM) TMDE Calibration Intervals.** A WRM kit package or container shall be labeled with a calibration due date equal to 18 months from the earliest date calibrated item packed in accordance with Section 5. TMDE to be placed in WRM kits shall be calibrated prior to packaging. Calibration intervals for TMDE in WRM kits do not start until they are unpacked for use. Once removed from the package, all items shall

revert to their normal interval. TMDE that is not removed from the package and whose accuracy is not in question need not be calibrated until the 18-month period marked on the package has expired. Any obvious damage to the equipment package would be cause to recalibrate the TMDE. Due to the many unforeseen circumstances that could arise from storing equipment in relatively uncontrolled areas, 18 months has been determined as the maximum time WRM equipment could be stored with a reasonable expectation that the equipment will operate within the specifications of the calibration procedure. In lieu of storing TMDE in WRM kits, TMDE may be individually tagged and placed in a stringently controlled, limited-access area(s). When an item of TMDE is removed from this controlled area, calibration interval reverts to the interval specified in the CMS or TO 33K-1-100-2. The following paragraph identifies items that cannot be stored in WRM kits, or require special precautions.

**3.4.6.1** Items that either can't be stored in WRM kits or require special precautions:

- a. GAS DETECTORS CONTAINING SENSORS WITH A SHORT SERVICE LIFE – Ensure the Sensor service life covers the maximum possible projected storage period.
- b. RADIAC DOSIMETERS - Those that need to be recharged periodically (usually 30 days) shall not be placed in long time storage.
- c. STANDARD CELLS - A period of weeks is required to obtain accurate voltage readings.
- d. CESIUM BEAM FREQUENCY STANDARD - Cesium Beam Tube would be ruined if it were turned off more than 90 days. The ion pump could not keep the tube evacuated.
- e. NI-CAD BATTERIES - Shall require recharging after 18 months in storage.
- f. TEMPERATURE BATH - Drain oil before storing.
- g. DEADWEIGHT TESTER - Drain oil before storing.
- h. VACUUM SYSTEM - Drain oil before storing.
- i. HYDRAULIC FORCE PRESS - Drain oil before storing.
- j. HOOK GAGE - Drain water before storing.
- k. PNEUMATIC PRESSURE STANDARDS AND LO PRESS GAGES - Require dry nitrogen source to use.
- l. BATTERIES - Remove from equipment prior to storage. See TO 33-1-35 for further guidance.

**3.4.7** Special Purpose Recoverable Authorized Maintenance Set (SPRAMS). Spare Tester Replaceable Units (TRUs) stored in SPRAMS require a DD Form 1574 Serviceable Label and an AFTO Form 99/108/394/398 Certification Label attached in accordance with Section 5. For scheduling purposes, the calibration interval of TRUs in SPRAMS shall be 18 months. TRUs to be placed in SPRAMS shall be calibrated prior to being stored. Calibration intervals for TMDE in SPRAMS do not start until they are removed from storage. Once removed from storage, the TRU shall revert to the normal interval. SPRAMS assets that are calibrated as part of an end-item (e.g., a system calibration) that are NOT installed back into the same end-item they were originally calibrated in, shall be re-calibrated at the time of installation to establish system integrity.

**3.4.8** Foreign Military Sales (FMS) TMDE Interval Adjustments. FMS TMDE calibration dates may be adjusted in the following manners:

- a. The 562 CBSG may delay the start of (post date) calibration intervals for FMS items (except for those items specified by Metrology engineers) being assembled to meet foreign country PMEL activation dates to agree with the activation date or other milestones.
- b. FMS customers may adjust calibration intervals if shipping time to country is in excess of fifteen days. The following rules apply:
  - (1) Receipt in-country must be recorded and filed.
  - (2) The number of shipping days consumed will advance calibration Due Dates when:
    - (a) Interval is equal to or less than 90 days. May be adjusted up to 45 days.
    - (b) Interval is more than 90 days. May be adjusted up to 60 days.

(c) No interval may be adjusted by more than 60 days.

**3.4.9 Coding of WRM.** TMDE subject to deployment as WRM assets shall be identified as WRM in the master inventory. This shall be accomplished by checking the WRM block of the PAMS scheduling screen. For non-PAMS users, accomplish this coding as specified in the applicable MIS documentation.

**3.4.10 Exchange Standard Intervals.** The calibration interval for Exchange Standards sent to PMEL in exchange for base measurement standards due for certification may be up to 60 days longer than the calibration interval listed in TO 33K-1-100-2 to account for administrative and transit time. The date calibrated on Exchange Standards shall reflect the actual date of calibration. The date due shall be established as the 28<sup>th</sup> day of the month in which the item is due for recertification. These dates shall not be changed by the PMEL.

**3.4.11 AFPSL Equipment Due Date Extensions.** The 562 CBSG is responsible for authorizing the extension of calibration due dates of Air Force Measurement Standards used by the AFPSL.

**3.4.12 Test Project TMDE Due Date Extensions (excluding RADIAC equipment).** Test project TMDE that is assigned a periodic calibration interval may have its due date extended by mutual agreement between the test director and the PMEL Manager, if calibration of the TMDE would adversely affect a test. The due date may be extended to the end of the test or an additional 50 percent of the assigned interval, whichever is less. The test director must verify that the extension is at their request, and the PMEL is no longer responsible for the accuracy of the TMDE in the test setup.

**3.4.13 Critical TMDE Due Date Extensions (excluding RADIAC equipment).** MAJCOMs are authorized to extend the calibration due date if the loss of the TMDE will delay or prevent critical mission accomplishment. Requests for extensions shall be forwarded to the command PMEL Functional Area Manager (FAM). The request shall describe the TMDE involved, the calibration due date, the specific reasons calibration cannot be accomplished as scheduled, the estimated date calibration action can be initiated, actions taken to locate a suitable alternative or substitute item, and the calibration history of the TMDE. Also include a statement from the OWC Maintenance Superintendent indicating the understanding that calibration interval is the period of time over which TMDE maintains a statistically derived end-of-period reliability of 85% or better and that extending the interval may jeopardize TMDE accuracy and reliability. The calibration activity manager will maintain a file copy of all approved calibration extensions and ensure a new TMDE certification label is placed on all TMDE that has been extended. Cite the e-mail/message from the approving functional manager in the "Special" block, along with the words "Calibration Extension". Enter the date the item was originally calibrated in the "Date Calibrated" block of the certification label. Enter the new date due calibration in the "Date Due" block. The new TMDE certification label should cite the same calibration authority as the old TMDE certification label. The calibration activity manager or designated representative will enter his/her initials in the "Certified By" block of the certification label.

**3.4.14 Base Measurement Standard Due Date Extension.** The command PMEL Functional Area Manager (FAM) is authorized to extend the calibration due date of Base Measurement Standards provided by the 562 CBSG to the PMELs. Information copies of extensions shall be sent to the 562 CBSG. This authorization does not apply to Exchange Standards.

**3.4.15 On-Site Off-Base TMDE Due Date Extensions.** The PMEL Manager is authorized to extend the calibration due date up to 30 days for off-base TMDE calibrated on-site to facilitate scheduling.

**3.4.16 Return Transportation Time and TFCU Visit Due Date Adjustment.** PMEL Managers have the authority to adjust calibration due dates up to 30 days to offset return transportation time, scheduled monthly pickup and delivery, or scheduled TFCU visits. The date calibrated shall reflect the actual date of calibration. The PMEL is authorized to extend the date due up to 30 days if one of the following cases applies:

- a. TMDE is picked up by or delivered to the customer at intervals less often than weekly.
- b. TMDE is used to equip maintenance teams that are deployed to support off-base customers.
- c. To coincide with the scheduled arrival date at the deployed location for TMDE with calibration intervals of 5 months or less that are deploying in support of Air Expeditionary Force (AEF) operations.
- d. To account for return transportation time for TMDE coded N49/N59/N64.
- e. To coincide with the arrival of the on-site TFCU.

### **3.5 PRECISE TIME SUPPORT.**

Precise time support is now accomplished using the GPS system through the local PMEL. Repair and replacement actions for cesium standards used for frequency or time standard should be accomplished through the appropriate item manager at WR-ALC.

### **3.6 TMDE USER RESPONSIBILITIES.**

The user shall:

- a. Appoint a TMDE coordinator. A TMDE coordinator is not required at locations where the PMEL supports only one organization. The TMDE coordinator shall attend training and maintain a TMDE coordinator file that includes:
  - (1) Name of primary TMDE coordinator and alternate.
  - (2) TMDE Master ID Listing.
  - (3) TMDE Monthly Master Equipment Schedule.
  - (4) Test equipment hand receipts from PMEL.
  - (5) A copy of the base instruction, if applicable.
  - (6) Any customer handout(s) that might be provided by PMEL.

#### **NOTE**

Customers (or at least the TMDE coordinators) shall have access to and be familiar with contents of TO 33K-1-100-1; TO 33K-1-100-2; TO 00-20-14; any applicable CMS TOs; TO 00-25-234 *General Shop Practice Requirements for the Repair, Maintenance, and Test of Electrical Equipment*; TO 33-1-27, *Logistic Support of Test, Measurement and Diagnostic Equipment*; TO 33-1-32, *General Instructions for Input Power Wiring of Electrical/Electronic Support Equipment*; and the Special Certification Roster (SCR) or equivalent document identifying persons designated as calibration limitation approval authority. Preferably, coordinators of large accounts shall maintain their own copies of these TOs.

#### **NOTE**

A TMDE coordinator file is not required for the PMEL's TMDE coordinator.

- b. Calibrate, certify and repair TMDE specified in any applicable CMS TOs or TO 33K-1-100-2 as USER at the specified interval. If the USER organization (same as performing work center) does not have the capability, obtain calibration and maintenance support from the lowest echelon organization having the capability. If no other organization has the capability, the PMEL may assist by providing training, workspace, technical assistance or support, as resources allow. Organizations owning/using TMDE designated USER shall:
  - (1) Document that all personnel performing USER calibrations are properly trained and qualified on the tasks they are performing.
  - (2) Perform calibrations using authorized technical data IAW paragraph 3.1.2.
  - (3) Document maintenance actions in applicable MIS using assigned work unit code (WUC) from CMS TOs or TO 33K-1-100-2.
  - (4) Comply with local Maintenance Group (MXG) or equivalent quality program.
  - (5) Ensure calibrations are completed in an environment (temperature/humidity) that supports the specifications of standards and devices under test.
  - (6) Track due dates of TMDE designated USER and requiring re-calibration. Use appropriate MIS. USERS will ensure TMDE is not used unless calibrated. USERS will remove the TMDE from service once the calibration due date has expired. Exceptions are listed in Paragraphs 3.4.10-3.4.15.

- (7) Use TMDE calibrated and certified IAW Section 3 of this TO to maintain equipment designated as USER responsibility.
- c. Request approval from the 562 CBSG through local PMEL prior to obtaining calibration of Air Force TMDE from non-Air Force sources (see Section 4).
  - d. Accomplish and use applicable forms, labels and alternate methods of certification IAW Section 5 of this TO.
  - e. Return all TMDE specified as PMEL ( ) or AFPSL responsibility in any applicable CMS TOs or TO 33K-1-100-2 to the PMEL when scheduled for calibration or for unscheduled maintenance. Identify TMDE not listed in any applicable CMS TOs or TO 33K-1-100-2 to the PMEL for calibration determination action. Commanders and supervisors of all activities owning and using TMDE requiring calibration are responsible to ensure this TMDE is not used unless it has been calibrated and that it is removed from service once the calibration due date has expired. Exception to this statement only as covered by paragraphs 3.4.10 through 3.4.16.
  - f. Consider alternative of limited calibration, CBU, or NPC status, where possible. Calibration limitations shall be approved by the User's shop chief or designated seven level craftsman/civilian equivalents. Users shall identify individuals authorized to approve limitations and sign or initial certification labels on the Special Certification Roster or equivalent document. TMDE coordinator and calibration limitation approving official are two distinctly separate duties.
  - g. Deliver TMDE to the PMEL with all ancillary equipment (e.g., preamps, power supplies, adapters, cables or probes) needed for the calibration. PMEL personnel shall advise the user when an item is not sufficiently complete to allow full calibration and may return the item without action if the ancillary equipment and/or technical data are not readily available.
  - h. Provide proper care, handling, cleanliness and transportation of TMDE (see paragraph 3.8).
  - i. Ensure that notes contained in the SPECIAL block of the certification labels are read and understood.
  - j. Refer measurement standards authorized for use by activities other than the PMEL to the base PMEL for calibration. The base PMEL shall either calibrate these items or request assistance in accordance with paragraph 4.1. Measurement standards owned by research and development laboratories and used to support measurement areas peculiar to a specific PMEL may be used to calibrate TMDE that cannot be supported by the PMEL. The PMEL is responsible for ensuring these standards meet certification requirements.
  - k. Maintain technical data file for equipment owned. Provide technical data with the TMDE when requested by the PMEL. The TMDE User shall ensure adequate maintenance and technical data for each item of TMDE are available and that the technical data accompany their TMDE whenever they are deployed.
  - l. Request assistance from the base PMEL for calibration of individual items of TMDE that require equipment and technical skills normally in the PMEL. Also request PMEL help when specified in the applicable weapon system or equipment CMS TO. Ensure that TMDE used as component parts of systems or subsystems (e.g., B-52, AN/FPS-27, etc.) are not removed for calibration unless the system, subsystem, maintenance or CMS TO requires it.
  - m. Identify and/or coordinate any requirements for limited or special calibrations with the base PMEL. Comply with procedures for exceptions from periodic calibration as specified in paragraph 3.2. Place authorizing signature or initials on AFTO Form 99 or AFTO Form 398 in accordance with Section 5. This is to be done for TMDE that has received limited or special calibration when returned from the PMEL, or for TMDE that is to be exempted from periodic calibration.
  - n. Request calibration assistance as outlined in paragraph 4.1 when assistance is required.
  - o. Perform organizational maintenance on assigned TMDE in accordance with TO 33-1-27. This responsibility applies to stock listed and nonstock listed TMDE in all federal supply classes.
  - p. Remove AFTO Forms (108, 394, 99 or 398) from units being returned to supply stocks and notify PMEL of the turn-in. AFTO Forms 108, 394, 99, or 398 on items withdrawn from supply are invalid except for those on Redistribution Order actions. AFTO forms 65 and 66 stay on equipment.

- q. Leave all condition tags and other documentation including warranty tags (except the receipt) on TMDE being forwarded to the PMEL for initial calibration or acceptance testing and retain shipping containers. The initial calibration is a serviceability check on items from a vendor, technical repair center, or other base. Discrepancies found by the PMEL during initial calibration shall be reported to the users so they can submit deficiency reports back to the source of supply. A calibration procedure can serve as a guideline for an acceptance check.
- r. Provide facilities meeting temperature, humidity, and power requirements IAW this TO for TFCU or other PMEL mobile calibration operations.
- s. Ensure that torque-indicating devices, specified as PMEL responsibility in TO 33K-1-100-1/-2 or any applicable CMS TO, are sent to the PMEL for scheduled calibration or unscheduled maintenance. Torque indicating devices are considered TMDE and PMELs are assigned the primary responsibility for calibration and repair. If not collocated on an installation with a PMEL, an approved User Torque Calibration and Repair Site may calibrate the organization's torque indicating devices. Approved User Torque Calibration and Repair Sites (TCS) are listed in Section 10. User Torque Calibration and Repair Sites shall:

**NOTE**

Authority to use User Torque Calibration and Repair Sites expires when user organizations are redesignated, inactivated, reassigned, or on 30 September 2011, whichever comes first. Newly activated user organizations are not authorized to use this paragraph. User organizations affected by this note shall use AFI 25-201, *Support Agreements Procedures*, to acquire support for their total torque-indicating device workload (workload currently on hand and, when applicable, transferred workload).

- (1) Ensure torque devices are calibrated per any applicable weapon system Calibration and Measurement Summary (CMS) or TO 33K-1-100-1/-2.
- (2) Ensure torque devices NOT covered by the exemption, and NOT owned by the organization are sent to an AFMETCAL Program PMEL for calibration and repair support.
- (3) Ensure all personnel that perform torque calibration and repair are properly trained.
- (4) Ensure only 562 CBSG approved calibration standards are used, that they are properly maintained, and that they are calibrated by an AFMETCAL Program PMEL.
- (5) Collect and report maintenance data to the 562 CBSG, as requested.
- (6) Participate in 562 CBSG proficiency testing, as required.
- (7) Implement a quality program, and participate (as required) in the 562 CBSG evaluation program.
- (8) Report the inventory of torque devices supported to the 562 CBSG, as requested.
- (9) Ensure a bar code label, AFTO Form 65 or 66, is affixed to each item in inventory.
- t. Return special weapons test equipment designated as PMEL responsibility to the base PMEL for calibration and repair. The PMEL has the responsibility to repair and calibrate Air Force and Nuclear Regulatory Commission (NRC) designated nuclear ordinance commodity managed test equipment. This is meant to include all test equipment that contains radioactive material.
- u. Ensure that medical equipment is referred to the appropriate support activity in accordance with AFMAN 23-110, *USAF Supply Manual*, and TO 33K-1-100-1. TMDE locally purchased by the hospital requiring PMEL support shall be coordinated with the PMEL prior to purchase to ensure supportability.
- v. Ensure that Skydrol fluid pressure gages are calibrated using a Skydrol fluid pressure standard. The gage user is responsible for calibrating these gages.
- w. Ensure users do not reset adjustments/potentiometers that are sealed with an AFTO Form 255, "Notice Certification Void When Seal is Broken." Any unit discovered with a broken AFTO Form 255 shall be removed from service and submitted for recalibration.

- x. Ensure that components of complex TMDE (test stands, checkout consoles, etc.) are not removed for calibration merely because the components are listed individually in TO 33K-1-100-2. Removal of these components for calibration shall be accomplished only as specified in the calibration authority. Complex TMDE components that require calibration shall be calibrated in place, if feasible. Components that require calibration by the PMEL shall be calibrated in accordance with the provisions of a CMS or TO 33K-1-100-2. Typical items are pressure gages, panel meters, power supplies, frequency meters, etc. To preclude excessive down time, each component shall be calibrated at the shortest interval listed for any of the components, or at a multiple of the shortest interval, if this multiple does not exceed its own listed interval. For example, if the shortest interval is 4 months, an item with a 9 month interval may be checked every 4 months or it may be shortened to 8 months and checked every other time.
- y. Prior to the 'local purchase' of TMDE:
  - (1) Coordinate with PMEL to verify there is no existing TMDE that can be used to satisfy the requirement as soon as a part number or model number is available.
  - (2) Coordinate with PMEL to determine if the item is already listed in a CMS or TO 33K-1-100-2. Perform action in next paragraph if it is not listed.
  - (3) Assist PMEL in completing the Request for Calibration Responsibility Determination per Section 5 and provide the necessary commercial data.
  - (4) Provide funding for resources needed to support locally procured TMDE. This includes funding for repair and calibration when locally procured TMDE is beyond the support of the local PMEL.
  - (5) Follow the guidance in AFI 64-117, *AF Government-Wide Purchase Card Program*, when using a Government Purchase Card to local purchase TMDE.
- z. Provide PMEL with mission impact statements for AWP follow-ups.
- aa. Perform all periodic maintenance or inspections as directed by maintenance TOs.
- bb. Notify PMEL of the date items are removed from WRM packages and placed into use. Complete the date due block of the certification label using the calibration interval listed in TO 33K-1-100-2 or applicable CMS at the time the item is removed from the WRM package. PMEL may be contacted for assistance in calculating the date due. Date due shall be dependent upon calibration interval stated in the TO 33K-1-100-2 or applicable CMS.
- cc. Ensure all forms, labels, and calibration correction charts received with the TMDE from the PMEL are complete. Notify the supporting PMEL of errors encountered.
- dd. Identify all TMDE that is designated as WRM or subject to deployment. This information shall be provided to servicing PMEL to be included on master inventory.
- ee. Provide PMEL information regarding the use made of RADIAC equipment to permit PMEL to determine calibration interval. To be precise, is it NDI equipment, disaster preparedness, or medical equipment?
- ff. Remove batteries from FSC 6665 RADIAC equipment being sent to a PMEL that does not affect the calibration of the unit.
- gg. Maintain warranty information on all TMDE and document start and stop dates and other warranty conditions.
- hh. Coordinate with PMEL (or organization identified as having calibration responsibility for the TMDE) prior to upgrading TMDE firmware or operational software\*. Firmware/software upgrades may impact TMDE calibration thereby voiding the usability of the previous calibration.
 

\*Operational software refers to software provided by the TMDE manufacturer required for basic instrument control, or to provide basic software utility functions.
- ii. When notified by the PMEL of an "out-of-tolerance" TMDE item, the owning work center should determine the impact of the "out-of-tolerance" condition on shop production and what steps, if any, they should take (customer notification, recall of production items, etc.).
- jj. Prior to the 'lease/borrow' of TMDE:



- (1) Coordinate with PMEL to verify there is no existing TMDE that can be used to satisfy the requirement.
- (2) Provide the PMEL with the expected duration of the 'lease/borrow' arrangement.
- (3) If TMDE will be 'lease/borrowed', comply with the requirements of paragraph 4.9, *Leased/Borrowed Equipment* (and sub-paragraphs) of this TO.

kk. Coordinate with the organization responsible for calibration prior to replacing SICL test stand NHA components with spares. A recalibration may be required.

### 3.7 INPUT PRIORITY SYSTEM.

Items submitted to a PMEL or the AFPSL shall use the following priority system based on category and first-in, first-out within each category. The PMEL management information system allows internal use of additional priority codes to meet mission requirements. All priority codes used in the PMEL shall be defined in the quality manual with EMERGENCY defined as the highest possible priority. Customers may request the following priorities:

- a. EMERGENCY Calibration or Repair. One-of-a-kind TMDE that is inoperable or due calibration and for which a critical job is at a work stoppage. A letter of justification signed by the OWC maintenance supervision or equivalent shall accompany the TMDE. The letter may be handwritten to prevent delay, and telephone coordination between the OWC and PMEL is encouraged. The PMEL or AFPSL shall accept emergency TMDE any time and immediately place it into work, with calibration or repair action continuous until repair or calibration is completed or status of the item changes (e.g., AWP, deferred for lack of standards or technical data, etc.). The PMEL Manager may require an OWC technician familiar with the TMDE to accompany the TMDE to and remain at the PMEL to provide technical assistance until the work is completed or placed in an interim-complete status. The owning or using organization picks up the TMDE immediately upon notification of completion. For AFPSL items, the item shall be shipped to the Air Force Primary Standards Laboratory (AFPSL), Heath, Ohio, by priority means; and the supporting PMEL shall alert the AFPSL scheduler and 562 CBSG/GBHA with a telephone call or by message of the impending arrival of the priority; and the PMEL Manager shall sign a cover letter (suggest a form letter) requesting and justifying the priority.
- b. MISSION ESSENTIAL Calibration or Repair. One-of-a-kind or one-deep TMDE that is part of a unit's deployment package, or is critical to daily peacetime operations, or TMDE assets falling below critical availability levels. A letter of justification signed by the OWC flight chief or equivalent shall accompany the TMDE. The OWC flight chief or equivalent may pre-identify, by letter, TMDE which meets the mission essential definition as approved by the PMEL Manager or delegated approval authority. The PMEL or AFPSL shall accept mission essential TMDE any time during duty hours and schedule it with sufficient priority to ensure the calibration/repair is complete, or the maintenance status changes (e.g., from INW to AWP, DEF, etc.), by the date and time specified by the customer. The OWC or using organization picks up the TMDE immediately upon notification of completion. For AFPSL items, the supporting base PMEL shall alert the AFPSL scheduler and 562 CBSG/GBHA with a telephone call or by message of the impending arrival of the priority; and the PMEL Manager shall sign a cover letter (suggest a form letter) requesting and justifying the priority.
- c. ROUTINE Calibration or Repair. TMDE not categorized as emergency or mission essential. The PMEL or AFPSL shall accept routine TMDE during normal turn-in and pick-up hours. This is equivalent to the normal processing of TMDE in the PMEL or AFPSL.

### 3.8 CARE OF TMDE.

Activities owning and using TMDE are responsible for its proper handling, transportation to and from designated drop off points, care, use and cleanliness. These are important factors in ensuring that TMDE performs reliably within specified tolerances for the duration of the established calibration interval.

**3.8.1 Physical characteristics of TMDE.** Physical characteristics of TMDE range from sturdy to fragile. The sturdy can be outer cases with shock suppression mountings. The fragile can be components that can be damaged by a slight jolt, scratch or static electricity. Special handling instructions for specific items are prescribed in maintenance TOs when handling requirements exceed normal practice. Electrostatic Discharge (ESD) control procedures are described in MIL-HDBK-263B *Electrostatic Discharge Control Handbook for Protection of*

*Electrical and Electronic Parts, Assemblies, and Equipment, MIL-STD-1686C, Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies, and Equipment, and TO 00-25-234.*

**3.8.1.1** Items of TMDE shall be handled as "delicate instruments" regardless of outer physical appearance.

**3.8.1.2** TMDE that is too heavy or awkward to be carried by one person may require team lifting or mechanical assistance (AFOSHSTD 91-501, *Air Force Consolidated Occupational Safety Standard*).

**3.8.1.3** Items of TMDE shall be handled individually unless the item's size and physical characteristics allow it to be held in one hand.

**3.8.1.4** External cords, cables, accessories and special connectors shall be secured to the case before movement.

**3.8.1.5** All unmated connectors shall be kept covered with moisture-proof and vapor-proof caps. Exceptions are when stored in environmentally controlled areas or if subject to use on a daily basis. Unmated connectors on units that contain circuitry susceptible to ESD damage shall be covered with conductive caps (Reference TO 00-25-234, paragraph 7.5d(12)(d)). Do not substitute the use of tape for the caps.

**3.8.1.6** Metal-to-metal contact with TMDE items shall be avoided unless the total instrument is contained in a protective case.

**3.8.1.7** Only TMDE awaiting work, in delay status or delivery to the customer shall be stored in the PMEL receiving and shipping areas. If a portion of the area is used for other purpose(s), the area shall be well marked as to status or purpose of use.

**3.8.1.8** All TMDE shall be stored on shelves or racks unless the physical characteristics prevent this type storage. Items of TMDE constructed so that the instrument is completely contained in a case may be stored on metal or wooden shelving without further protection. Care must be taken to protect protruding dials, knobs, or meter faces. TMDE not constructed in cases shall be protected from damage by use of suitable containers and appropriate padding. Containers, protective caps and coverings, and padding are not required for equipment in work or subject to use on a daily basis. Items of TMDE completely contained in packing cases may be stored on the floor.

**3.8.1.9** TMDE shall be removed from service if it has been subjected to overloading, mishandling, gives suspect results, or otherwise determined to be defective. Properly tag and store the TMDE to prevent further use until it can be scheduled for repair or calibration.

**3.8.2** Transportation of TMDE. Transportation of TMDE by trained personnel using a regularly assigned and specially configured vehicle will provide the maximum degree of protection to the equipment. Physical characteristics of individual TMDE shall dictate the extent of protection required during transportation. In general, protection from the elements and excessive shock and vibration is all that is required for TMDE in a protective case. Padding protection between items on the same vehicle may be required to protect knobs, dials, and meter faces from damage if the load shifts.

**3.8.3** Cleaning TMDE. The user shall clean the exterior of all TMDE immediately before transporting to the PMEL. TMDE may be returned to the user for cleaning. When an item is disassembled in the calibration area of the PMEL and found to be dirty internally, the calibrating technician shall return the item to the cleaning room. Dust removal may be done in the calibration area by vacuuming only. Use ESD approved systems when vacuuming ESD sensitive internal circuitry/equipment to remove dust. Techniques for cleaning electronic equipment are provided in TO 00-25-234. These techniques may also be applied for electromechanical and physical standards when applicable. Oxygen TMDE shall be certified as clean by the user prior to shipment to the PMEL.

#### NOTE

Oxygen gages shall contain the warning OXYGEN-USE NO OIL printed on the face of the gage by the manufacturer or by use of the OXYGEN- USE NO OIL decal part number 69A52267 (TO 15X-1-102, *General Care and Cleaning of Oxygen Gauges and Oxygen Device Related Test Equipment*) or an equivalent statement of oxygen service. If the gage does not have the OXYGEN-USE NO OIL warning or decal or equivalent statement of oxygen service printed on the face or affixed to the gage, the PMEL shall not include the "Not Oxygen Clean" statement on the certification label.

**3.8.4 PMEL Tracking of TMDE.** Each item of equipment shall be labeled, marked or otherwise identified to indicate its calibration status. Records shall be maintained for each item of equipment and all materials significant to the calibrations or verifications performed. All items having PAMS ID numbers that require calibration when used to accomplish the calibration shall be entered into the PAMS or alternate management information system traceability listing (calibration detail listing in PAMS). TMDE used for preliminary steps, but not listed as a standard in the calibration procedure, does not require listing. The records shall be stored and held secure and in confidence to the customer for a minimum period of one year or the length of one calibration interval if the calibration interval exceeds one year. The intent is to have at least the last record in the file. The records shall include as a minimum:

- a. Nomenclature
- b. Manufacturer, type identification and serial number or other unique identification
- c. Current location, where appropriate
- d. Where applicable, date calibrated, results of calibration and/or verifications, and date due calibration
- e. Details of maintenance carried out to date and planned for the future
- f. History of any damage, malfunction, modification or repair
- g. The identity of the certifying technician

**3.8.5 PMEL Handling of TMDE.**

- a. The PMEL shall have a documented system for uniquely identifying the items to be calibrated, to ensure there can be no confusion regarding the identity of such items at any time.
- b. Upon receipt of the TMDE for calibration, any abnormalities or departures from standard condition as prescribed in the relevant calibration method shall be recorded on an AFTO Form 350 or equivalent document. Where there is any doubt as to the item's suitability for calibration, where the item does not conform to the description provided, or where any limited or special calibration required is not fully specified, the PMEL shall consult the customer for further instruction before proceeding. The PMEL shall establish whether the item has received all necessary preparation, or whether the customer requires preparation to be undertaken or arranged by the PMEL.
- c. The PMEL shall have documented procedures and appropriate facilities to avoid deterioration or damage to the calibration item during storage, handling, preparation and calibration. Any relevant instructions provided with the item shall be followed. Where items have to be stored or conditioned under specific environmental conditions, these conditions shall be maintained, monitored and recorded where necessary. Where a calibration item or portion of an item is to be held secure (for example: for reasons of record, safety or value, or to enable check calibrations to be performed later), the PMEL shall have storage and security arrangements that protect the condition and integrity of the secured items or portions concerned.
- d. The PMEL shall have documented procedures for the receipt, retention or safe disposal of calibration items, including all provisions necessary to protect the integrity of the PMEL.

**3.8.6 Computers and Automated Equipment.** Where computers and automated equipment are used for the capture, processing, manipulation, recording, reporting, storage or retrieval of calibration data, the PMEL shall ensure that:

- a. Computer software is documented and adequate for use.
- b. Procedures are established and implemented for protecting the integrity of data. Such procedures shall include, but not be limited to, integrity of data entry or capture, data storage, data transmission and data processing.
- c. Computer and automated equipment is maintained to ensure proper functioning and provided with the environmental and operating conditions necessary to maintain integrity of the calibration data.
- d. Appropriate procedures for the maintenance and security of data, including the prevention of unauthorized access to and amendment of computer records are established and implemented.

NOTE: Spreadsheets or programmable calculator programs must be verified prior to use to ensure desired/accurate results. This may be accomplished by the calibrating technician prior to use, or if desired, by PQA personnel who may then protect/lock the product for use by all laboratory technicians.

### **3.9 PMEL MOBILE/ON-SITE MEASUREMENT CAPABILITIES.**

**3.9.1 Transportable Field Calibration Unit (TFCU).** The TFCU consists of working standards, TMDE and accessories. These items are mounted in shockproof transportable cases. The cases serve as equipment racks during operation and provide protection during transit. The TFCU is used to augment a PMEL to provide on-site calibration support. The PMELs that possess and operate TFCUs are identified in Section 10.

**3.9.1.1** TFCU working standards will operate satisfactorily within temperature ranges of 18°C (64.4°F) to 28°C (82.4°F) with humidity up to 70% RH. Depending on the TFCU working standard(s) used, calibrations performed outside of these ranges may result in a degradation of accuracy. Specific details on TFCU operating environment are available on the 562 CBSG PMEL website 'METWEB'.

**3.9.1.2** TMDE with accuracy requirements beyond the capability of the TFCU shall be returned to the host PMEL. TMDE that needs more than minor maintenance shall normally be returned to the host PMEL.

**3.9.1.3** A TFCU shall be considered for assignment to specific PMELs on a case-by-case basis to accomplish the following:

- a. Provide calibration support to established Air Force and DoD agencies remotely located from a host-base PMEL.
- b. Provide interim or emergency TMDE support at remote sites and bases where operating units have been deployed and where no support PMEL exists.
- c. Permit PMELs to maintain and operate calibration support capabilities within prescribed geographic areas.
- d. Provide calibration support at a location where an operation does not justify the establishment of a PMEL because of its limited size and workload.
- e. Provide temporary support to augment a base PMEL during facility renovations, construction, natural disasters or loss of environmental systems.

**3.9.1.4** Requests for authorization for a TFCU or redistribution of a PATEC shall be submitted through the PMEL FAM to the 562 CBSG with an information copy to HQ USAF/A4MM. The requests shall include the following:

- a. Identify the proposed owning activity, the purpose for which the TFCU (or PATEC) shall be used, and how it shall be supported.
- b. Model or part number, manufacturer, nomenclature, and quantity of TMDE that requires on-site support.
- c. The official military designation, squadron or unit, and major command for each activity that shall receive TFCU support.
- d. The geographic location of each customer and distance from the host PMEL.
- e. Alternate course(s) of action to provide support if the TFCU (or PATEC) is not authorized.
- f. Statement of mission impact if a TFCU (or PATEC) is not obtained.

**3.9.1.5** PMELs that have lost the on-site customers that justified their need for a TFCU (or PATEC) shall contact the 562 CBSG and the command PMEL Functional Area Manager for disposition instructions.

**3.9.1.6** Any calibration support requirements that cannot be met within the above guidelines shall be returned to the main operating base for support.

**3.9.2 Portable Automatic Test Equipment Calibrator (PATEC).** The PATEC is normally used to calibrate ATE on-site. The PATEC consists of a set of portable standards designed to calibrate a specific ATE system. The PATEC standards are housed in portable cases. See paragraphs 3.9.1.4 and 3.9.1.5 for redistribution or turn-in process.

**3.9.2.1** When used on-site, environmental requirements are determined by the requirements of the ATE being calibrated and the operational specifications of the standards in the PATEC.

**3.9.2.2** Calibration of ATE using the PATEC shall be in accordance with 33K- or 33D- series TO, as applicable.

**3.9.2.3** The PATEC is normally assigned to a designated PMEL. There are cases where the PATEC is owned by the organization owning the ATE because of mission security, geographic, or deployment considerations. When a PATEC is built to support specific ATE, the activity owning the ATE shall have priority use, even though the PATEC may be held by the PMEL. The PATEC shall be available at all times for scheduled or unscheduled calibration of the specified ATE.

**3.9.2.4** Supply procedures of AFMAN 23-110 shall be followed for transfer and receipt of the equipment when the PATEC is intended to be used in the deployment mode.

**3.9.3** Rapid Assistance Support for Calibration (RASCAL). RASCAL is a deployable PMEL with a downsized measurement capability designed for rapid deployment to support emergency calibration needs. It is comprised of five NAVAIR shelters, each measuring 8 ft wide and 20 ft long. These units are put together to form four measurement area shelters and one scheduling/receiving shelter. The four measurement area shelters provide calibration capability in the DC and Low Frequency, Microwave, Dimensional, and Electro-Mechanical areas.

**3.9.3.1** RASCAL can be deployed using aircraft, air-ride trailers or ships. Once deployed, RASCAL requires a 20,000 to 25,000 pound crane or forklift to complex the units. Based on various conditions, complexing time is approximately half a day.

**3.9.3.2** RASCAL is equipped with Environmental Control Units (ECUs) designed to maintain interior temperature at  $73 \pm 6^\circ\text{F}$  and relative humidity at less than 50 percent.

**3.9.3.3** RASCAL has the ability to be powered by either a commercial or a mobile generator type source.

**3.9.3.4** Requests for RASCAL support shall be processed through MAJCOM PMEL Functional Area Managers.

**3.9.4** Jet Engine Test Stand Calibrator (JETSC). TMDE and accessories needed to perform on-site calibration of jet engine test stands. They are housed in ruggedized cases, or in a trailer which has both a work and a storage area. Environmental requirements are determined by the requirements of the items being calibrated and the standards being used.

**3.9.5** Other On-Site. At times it is not possible to return TMDE to the PMEL and calibrations must be performed on-site. When performing a calibration of TMDE designated PMEL responsibility outside of the controlled environment of the PMEL, additional care must be taken.

**3.9.5.1** The temperature and humidity ranges of all standards and test items must be considered. Generally, base measurement standards should not be taken outside of the PMEL. Before taking a base measurement standard out of the PMEL, consult with 562 CBSG/GBEBA or /GBEBB.

**3.9.5.2** Items assigned a calibration responsibility of 'PMEL (68Deg)' are calibrated at a nominal  $20^\circ\text{C}$  ( $68^\circ\text{F}$ ) and should not be calibrated outside of a controlled environment. If you have a specific need to make this type of measurement on-site, consult with the 562 CBSG/GBEBA.

**3.9.5.3** Other measurements are performed at a nominal  $23^\circ\text{C}$  ( $73.4^\circ\text{F}$ ). On-site calibration should be held to an environment of  $23 \pm 5^\circ\text{C}$  ( $73.4 \pm 9^\circ\text{F}$ ) and  $<70\%$  RH. If you have a need to perform an on-site calibration outside these environmental conditions, review the following:

- a. End-item to be calibrated, manufacturer's stated operating environment and applicable temperature coefficients.
- b. Any limited calibrations noted on the calibration label or certificate of the TI and/or standards used.
- c. All equipment to be used in the calibration, the manufacturer's stated operating environment, and applicable temperature coefficients for each piece of equipment.
- d. Any environmental conditions detailed in the calibration authority.
- e. When calibrating in extreme environmental conditions, care should be taken to ensure the test uncertainty ratio for each measurement performed in the calibration (including the effects of any temperature coefficients) is equal to or better than the test uncertainty ratio in the calibration authority.

**3.9.5.4** Environmental conditions must be monitored for the calibration. The calibration technician must determine how frequently the calibration environment should be monitored/checked based on the stability of the calibration environment, the length (time) of the calibration, and the sensitivity of the equipment involved in the calibration to fluctuations in the calibration environment. The calibration environment should be monitored/checked frequently enough to provide assurance that the calibration environment does not adversely impact the calibration process/results. Record the worst observed temperature/humidity in the PMEL MIS.

**3.9.5.5** In all cases, PMELs shall conform to the maintenance TO or manufacturer's data regarding any environmental limitations or temperature coefficients of any item used in a measurement setup. The calibration authority may state specific environmental conditions, which shall be met, for the calibration.

### **3.10 PMEL MANAGEMENT RESPONSIBILITIES.**

The PMEL shall be organized and shall operate in such a way that permanent, temporary and mobile facilities meet the requirements of this TO.

**3.10.1** Responsibilities of PMEL Commanders and Senior Level Management. Commanders and Managers in the PMEL chain of command shall ensure that:

- a. The PMEL is maintained in a condition that facilitates effective mission performance. This includes an adequate environmental system.
- b. TMDE requiring calibration is not used unless it has been calibrated and that it is removed from service once the calibration due date has expired.
- c. Special attention is placed on personnel proficiency, PMEL manning, environmental control, quality assurance, materiel resources and use of technical directives.
- d. The PMEL provides maximum support to Air Force activities, other federal agencies, contractors (authorized to receive such support) and security assistance programs under the guidelines of AFI 25-201, AFI 21-113 and AFI 99-103 (*Capabilities Based Test and Evaluation*).
- e. TMDE is calibrated and certified as prescribed in this TO, AFI 21-113, applicable CMSs, and TO 33K-1-100-1/-2.
- f. Vehicles used to transport TMDE are equipped to provide full protection to TMDE from damage that may occur from weather, vibration or shock.
- g. When PMEL measurement standards are not maintained or authorized at an installation or on an instrumentation ship, affected TMDE shall be calibrated by a PMEL possessing the required capability. Support agreements may be negotiated between the site or base and the supporting activity as needed. Reference DoDI 4000.19 (*Interservice and Intragovernmental Support*) and AFI 25-201.
- h. Continuing problems with PMEL customers regarding timely delivery of TMDE for scheduled calibration shall be elevated for resolution if the supervisor responsible for the OWC quality control cannot obtain results.
- i. PMEL intermediate off-equipment TMDE maintenance production requirements are identified in operations plans when applicable.
- j. The PMEL shall have managerial staff with the authority and resources needed to discharge their duties.

**3.10.2** Responsibilities of PMEL Managers. The PMEL Manager is the senior on-site manager responsible for the overall PMEL, quality and production control functions. The PMEL manager shall:

- a. Ensure management procedures conform to the requirements specified in this TO, command directives and applicable contractual requirements.
- b. Organize the PMEL in such a way that confidence in its independence of judgment and integrity is maintained at all times. When there is a possibility of PMEL personnel being placed under pressure by customers or other sections of the organization, reporting relationships shall be established to isolate personnel from this pressure. The boundaries, expectations and responsibilities of the employee in dealing with the customer may need to be specified in order to maintain independence of judgment and integrity.

- c. Specify and document the responsibility, authority and interrelation of all personnel who manage, perform or verify work affecting the quality of calibration.
- d. Provide supervision by persons familiar with the calibration methods and procedures, the objective of the calibration and the assessment of the results. Management practices shall be such as to ensure adequate supervision.
- e. Designate a technical manager (however named) who has the overall responsibility for the technical operations.
- f. Designate a quality manager (however named) who has the overall responsibility for the quality system and its implementation. The quality manager shall have direct access to the highest level of management at which decisions are taken on PMEL policy or resources, and to the technical manager.
- g. Designate alternates in case of absence of the technical or quality manager.
- h. Where relevant, have documented policy and procedures to ensure the protection of customer's confidential and proprietary rights.
- i. Participate in inter-PMEL comparisons and proficiency testing programs as required.
- j. Establish and maintain a quality system in accordance with this TO, and document quality policies and objectives in the PMEL quality manual in accordance with this TO.
- k. Use appropriate methods and procedures for all calibrations/verifications and related activities within its responsibility (including, but not limited to, sampling, handling, transport and storage, preparation of items, estimation of uncertainty of measurement and analysis of calibration data). TMDE shall be calibrated and certified in accordance with the requirements of this TO, AFI 21-113, CMS TOs, TO 33K-1-100-1, and TO 33K-1-100-2.
- l. Ensure documented procedures exist for the purchase, reception and storage of consumable materials used for the technical operations of the PMEL that can affect the results of calibrations.
- m. Document policies and procedures for the resolution of complaints received from customers or other parties about PMEL activities. Specifically, records shall be maintained of all complaints and the actions taken to resolve those complaints. Complaints or other circumstance regarding compliance with PMEL policies, procedures, quality or the requirements of this TO shall be promptly resolved.
- n. For non-PAMS PMELs, submit the PMEL Report, RCS: HAF-ILM(SA) 7808, and the PMEL Inventory Listing, RCS: HAF-ILM(A) 9450, as specified in Section 6, ensuring accurate data and on-time submission.
- o. Establish a Quality Program (QP) in accordance with this TO and any applicable command directives.
- p. Ensure all levels of management are aware of the importance PMEL environmental conditions play in timely and accurate mission support. Procedures shall be developed and documented to ensure calibrations are not accomplished when environmental conditions are outside prescribed specifications. Outages must be logged when the facility environment deviates from prescribed tolerances. It is incumbent upon PMEL managers to be aware of PMEL environmental outages that may impact the PMEL ability to successfully support mission requirements.
- q. Ensure technicians who certify TMDE are appropriately qualified/trained.
  - (1) Annual calls and out of cycle requests for technical training course quotas through the Pipeline Management System (PMS).
  - (2) Submission of Graduate Assessment Survey (GAS) or Field Evaluation Questionnaire (FEQ) IAW AFI 36-2201 (Volume 1), *Air Force Training Program- Training Development, Delivery, and Evaluation*.
  - (3) Submission of AF Form 403, Request for Special Training.
  - (4) Career Development Course reviews.

- r. Initiate and maintain an effective safety program that includes a fire safety program per the applicable safety standards (AFOSHSTD 91-501 and AFOSHSTD 91-90, *Precision Measurement Equipment Laboratory [PMEL]*).
- s. Process items of TMDE identified as being beyond the PMEL capability to repair or calibrate in accordance with this TO, TO 00-25-107 (*Maintenance Assistance*), TO 33-1-27, and AFMAN 23-110.
- t. Minimize the use of PMEL personnel for the performance of clerical, supply and equipment cleaning duties. Personnel trained in these skills should perform these duties.
- u. Deliver and return items of TMDE that are fragile or subject to environmental damage and require support from other laboratories by courier. PMEL technicians shall not be used for courier duty unless they are to receive specialized TMDE training at the other PMEL.
- v. Coordinate calibration support with medical equipment personnel in accordance with AFMAN 23-110.
- w. Ensure measures are taken to ensure good housekeeping in the PMEL. Optimum cleanliness shall be maintained. No eating, drinking, smoking or use of other tobacco products shall be permitted in the calibration and repair areas unless specifically authorized in Section 8.
- x. Minimize the location of purely administrative functions within the calibration and repair area of the PMEL. Completion of the necessary forms used for certification is not considered an administrative function.
- y. Establish a TMDE Coordinator training program.
- z. Establish a system to control test fixtures. The system shall provide for:
  - (1) An identity on the test fixture that can be related to the equipment/calibration procedure for which the test fixture was fabricated.
  - (2) A storage area for test fixtures not permanently used in measurement setups.
  - (3) An index or reference file that identifies the test fixture and its storage location.
- aa. Take necessary actions to minimize the late delivery of TMDE for scheduled calibration.
- bb. Notify the OWC if a deficiency is discovered with the physical condition or documentation that affects the ability to calibrate or repair the item. Notify the customer when customer-owned TMDE is found out of tolerance or improperly functioning, IAW the decision process outlined in 3.11.1.k.
- cc. Maintain a TO File on the use and operation of PMEL-owned equipment, on the handling and preparation of PMEL-owned items, and for calibrations/verifications. All instruction, standards, manuals and reference data relevant to the work of the PMEL shall be maintained up-to-date and readily available to the staff. TOs will be filed in any type of binder which will protect and facilitate the use of the TO (TO 00-5-1, paragraph 4.10.1). Individual 33K TOs can be filed in individual file folders that can be color-coded to indicate the 33K series (such as K6 - Dimensional - blue). The file sequence shall be alphanumeric. AFTO Form 57, described in Section 5.13, can be used in the folder to document data peculiar to each TO.
- dd. Take all actions necessary to ensure the TMDE Availability rate for the total TMDE inventory supported, as tracked and reported by PAMS (or alternate MIS), exceeds 93 percent while simultaneously meeting the customers' expectations. (TMDE Availability is a measure of the percentage of total TMDE inventory operationally capable of performing its designed function based on the TMDE condition (serviceability). It is expressed mathematically as the total number of serviceable TMDE end items divided by the total TMDE inventory.)
- ee. Ensure Requests for Calibration Responsibility Determination are not submitted for equipment owned and used by departments outside the Air Force. Such a customer is responsible to give the PMEL the capability to support new equipment, if the PMEL does not already have it.
- ff. Perform initial testing on new items when the PMEL has the capability, a calibration procedure exists, or adequate commercial data or maintenance TO data is available to permit testing. May accept commercial calibration if the conditions of paragraph 4.5.1.2.2 are met.



- gg. Identify non-PMEL TMDE, identical in part number or model to PMEL standards, to any off-base organization to which they are sent for calibration. This permits the certifying technician to determine the correct calibration procedure.
- hh. Maintain the security of the information in PAMS by exercising proper control of the access codes, and administer, maintain, and operate the PAMS in accordance with applicable regulations, manuals and command instructions. Reference AFCSM 21-303 Vol 2.
- ii. When requested by the OWC prior to the local purchase or “lease/borrow” of new TMDE, verify there is no available existing TMDE that can be used to satisfy the requirement, and determine if the item is already listed in TO 33K-1-100-2.

### **3.11 QUALITY SYSTEM.**

A quality system is defined as the organizational structure, responsibilities, procedures, processes and resources for implementing quality management. A quality system includes everything a PMEL does that affects the quality of the services provided. The elements of a PMEL's quality system shall be documented in a quality manual. The quality manual shall define and document the PMEL policies and objectives for, and commitment to, good PMEL practices and quality calibration services. The quality manual shall be issued under authority of the PMEL Manager and made available for use by all personnel.

**3.11.1 Quality Manual.** The purpose of the Quality Manual is twofold. First, it provides an organized way of communicating how the PMEL's quality is managed both to personnel working in the PMEL and to external parties such as base and corporate management, customers, and auditors. Second, it provides a basis for orienting new personnel on their roles and responsibilities under the PMEL quality system and how the quality system is implemented in the PMEL. The Quality Manual shall be reviewed annually by PMEL management to ensure the objectives of the quality system are being met and to introduce improvements. This review shall be documented. The quality manager shall maintain the Quality Manual in status, and as a minimum, it shall include or reference the location of the following information:

- a. Management Policy Statements. This section shall contain management's quality policy statement, including objectives for, and commitment to, good PMEL practices and quality of calibration services.
- b. Organization and Management. This section shall contain a chart showing the organization and management structure of the PMEL, including its place in any parent organization and related organization charts.
- c. Records. This section shall contain the procedures, responsibilities and authorities for drafting, changing, approving and issuing quality system documents. This includes the Quality Manual, related quality documentation such as local procedures and forms (e.g., PR, SR and QR review forms), internal audits, management reviews, customer complaints, etc.
- d. Personnel. This section shall contain a description of the responsibilities and key duties of the PMEL Manager, Technical Manager and Quality Manager.
- e. Training. This section shall identify the PMEL training requirements, methods used to obtain the required training, who shall review the records, and the interval between qualification/training records review.
- f. Signatories. This section shall identify the signatures required and specific personnel authorized to sign or approve PMEL documents. Signatories shall be selected based on their qualifications to make the required decision. Signatories of calibration results shall be responsible for the adequacy of the results.
- g. Accepting New Work. This section shall contain the procedures for reviewing new work, such as local procedures for completing AFTO Forms 45. This process shall ensure the PMEL has the appropriate support agreements, facilities, equipment, standards and technical expertise necessary to support the new work.
- h. Calibration Procedures. This section shall contain or reference local procedures for requesting, posting, controlling, and using calibration and maintenance procedures.
- i. PMEL TMDE. This section shall outline local procedures to ensure calibration, verification, and maintenance (including preventive maintenance) of equipment owned, rented or leased by the PMEL.

- j. Quality Programs. This section shall contain local quality assurance objectives and practices. This includes specific management policies for meeting requirements of the QP. Also include the local guidance for participating in applicable 562 CMSG proficiency testing programs.
- k. Recall and Notification. This section shall contain the decision process used to determine 1) if TMDE should be subject to recall and 2) if notification of the customer/user is necessary when a PMEL standard or customer-owned TMDE is found to be out of tolerance or when a faulty process (that may result in an out-of-tolerance condition) is identified. This shall also include nonconformities discovered during QP reviews, internal audits, and management reviews.
- l. Exceptions and Limitations. This section shall contain PMEL management's policy and process for permitting departures from calibration procedures, such as, permitting limited and special calibrations. Include the local process for permitting exceptions to published calibration determinations, such as calibration interval, calibration responsibility and those adjustments granted IAW Para 3.4.16.
- m. Submitting Changes. This section shall contain local procedures for submitting changes to calibration procedures, calibration intervals, technical orders and any other documents affecting quality of work produced. Include local procedures for completing AFTO Forms 22.
- n. Measurement Uncertainty. This section shall contain the PMEL's process for determining measurement uncertainty and calibration accuracy when substituting equipment or when using a calibration authority other than 33K series procedures.

### **3.11.2 Internal Audits And Management Reviews.**

**3.11.2.1 Internal Audits.** The PMEL shall have documented procedures to perform internal audits. PMELs shall perform and document internal audits at least once every 12 months, or within 12 months from contract start date for new contractor or MEO operated PMELs. The purpose of this audit is to verify that operations continue to comply with the requirements of the quality system. An internal audit is not just a mini-562 CMSG assessment; rather, it is an in-depth review of all laboratory processes within the PMEL quality system to ensure that the PMEL is operating in accordance with the policies and procedures specified in the Quality Manual, this TO and any other contractual or directive quality documents. A measurement capability assessment does not fully assess the quality system but may be used as part of an internal audit at management's discretion. Persons possessing the knowledge and skills necessary to understand the process being audited as well as the process of auditing shall conduct the audit. If possible, auditors should be selected from personnel independent of the area being audited. For scheduling purposes, management may elect to complete portions of the audit throughout the year, providing the entire quality system is covered within a 12-month period. At a minimum, internal audit documentation shall include: areas or processes audited, audit findings, corrective actions, and a follow-up schedule with subsequent results. Where the audit findings and root cause analysis conclude there is reason to doubt the correctness or validity of calibration results, the PMEL shall take immediate corrective action and initiate established recall procedures as necessary.

#### **NOTE**

Management should consider timing the conclusion of the internal audit to allow sufficient time (2-3 months recommended) for implementation and follow-up of required corrective actions resulting from internal audit findings prior to conducting the laboratory Management Review (see paragraph 3.11.2.2). This will enable management to assess effectiveness of implemented corrective actions as part of the management review process."

**3.11.2.2 Management Reviews.** PMEL Management shall review the quality system at least once a year to ensure its continuing suitability and effectiveness and to introduce any necessary changes or improvements. A management review begins with an appraisal of all internal and external conditions and requirements, and then continues with an evaluation that all existing policy, processes and procedures effectively function to meet current (and possibly future) requirements. Documentation of management review actions shall include the date(s) conducted, names of review participants and a thorough analysis of all topics considered. Resulting action items from these reviews shall be assigned to responsible individuals with completion dates established by management. Documented follow-up of resulting action items, with details of resolution, shall be attached to/filed with management review meeting documentation. Management review documentation shall include review and evaluation of (as a minimum):

- a. Effectiveness of existing processes and procedures.
- b. Reports from managerial and supervisory personnel.
- c. The outcome of recent internal audits.
- d. Corrective and preventive actions.
- e. Assessments by external bodies.
- f. Results of inter-laboratory comparisons or proficiency tests.
- g. Changes in the volume and type of the work.
- h. Customer feedback and complaints.
- i. Quality program activity.
- j. Training program and qualification records.



## **SECTION 4**

### **CALIBRATION ASSISTANCE AND SUPPORT AGREEMENTS**

#### **4.1 REQUESTS FOR CALIBRATION ASSISTANCE.**

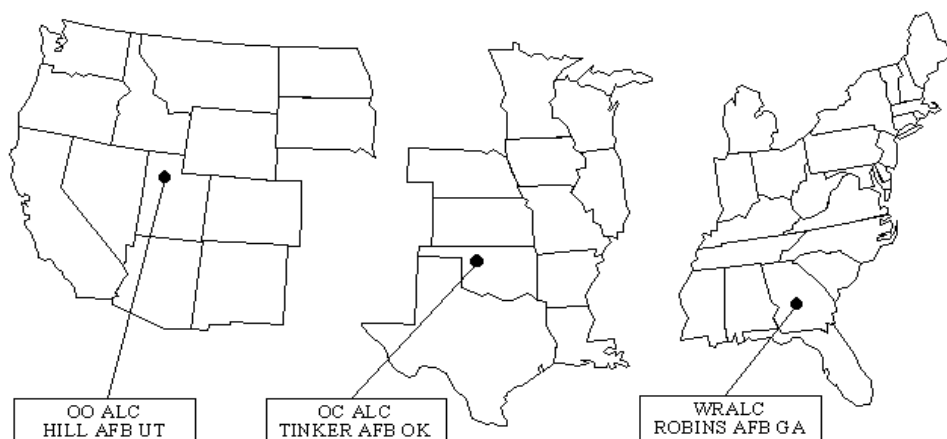
Calibration assistance from another PMEL or the 562 CBSG may be requested when a PMEL lacks the capability to calibrate assigned TMDE. The PMEL requiring support shall notify their respective PMEL FAM of the part number(s) requiring calibration and the reason they cannot support the item(s). Request assistance as follows:

- a. Request assistance from Type IIB or IIC PMEL. If not available, proceed to paragraph b.
- b. Request assistance from geographic supporting Type IIA PMEL (see Figure 4-1).
  - (1) Theater Type IIA (PACAF and USAFE) shall forward a request to the ALC Type IIA and inform the customer if they lack the capability.
  - (2) If the Type IIA normally has the capability but is temporarily out of service (temporarily down, etc.), it is the Type IIA's responsibility to seek lateral support before contacting the 562 CBSG, as necessary.
  - (3) If the Type IIA does not have the capability and has never had it, they shall forward the request to the 562 CBSG.
  - (4) Requests for documentation of the Type IIA PMEL assistance shall be required at the request of the servicing Type IIA PMEL. The request shall contain the following information for each item:
    - (a) National Stock Number.
    - (b) Model/Part Number.
    - (c) Manufacturer.
    - (d) Serial Number/ Bar Code.
    - (e) Nomenclature/Noun.
    - (f) Quantity.
    - (g) Ranges/Parameters/Accuracy or specific points/values/accuracy requiring calibration.
    - (h) WUC/Calibration Authority Source (K100-2, CMS, etc.).
    - (i) The calibration procedure, or commercial data if no TO has been published (Data shall be returned to customer).
    - (j) Priority (Per paragraph 3.7).
    - (k) Date Required.
    - (l) Location of Item.
    - (m) Specific reason why item cannot be calibrated.
    - (n) Permanent or temporary support.
- c. Request assistance from the 562 CBSG.
  - (1) Technical assistance from the 562 CBSG consists of:
    - (a) Identifying Air Force support locations.
    - (b) Obtaining support from NIST or USNO when required.
    - (c) Identifying interservice or contractual support.
  - (2) The 562 CBSG shall advise how calibration support shall be provided and provide instructions for delivery of the equipment.

- (3) No equipment shall be forwarded to AFPSL without prior coordination with the AFPSL scheduling section (DSN 366-5472/5473).

**4.1.1 Unscheduled AFPSL Items.** Unscheduled calibration support of items designated AFPSL responsibility shall be coordinated with the AFPSL scheduling section (DSN 366-5472/5473).

**4.1.2 Maintenance Support Assistance** (other than Calibration Assistance described in this section). Maintenance support assistance required by the PMEL over and above their capability shall be obtained using the instructions contained in TO 00-25-107.



**Figure 4-1. Air Logistic Type IIA CONUS Areas Of Responsibility.**

- \* USAFE obtains support from RAF Feltwell UK, IIA PMEL
- \* Elmendorf AFB AK, IIA support area includes Alaska
- \* WR-ALC PMEL also supports USAFE including the Azores
- \* Western and central pacific areas obtain support from Kadena AB JA, IIA PMEL
- \* OO-ALC PMEL also supports Elmendorf AFB AK and Kadena AB JA

## **4.2 TECHNICAL/ENGINEERING ASSISTANCE.**

Requests for technical and/or engineering assistance on specific metrology problems that cannot be resolved by the PMEL or TO 00-5-1 shall be submitted to the 562 CBSG. PMELs requesting assistance shall furnish a comprehensive description of each problem and advise if on-site assistance is recommended.

## **4.3 CALIBRATION, REPAIR & RETURN, AND LOAN.**

TMDE may be processed between PMELs on a repair and return; calibrate and return; or repair, calibrate, and return basis. Loan of TMDE between PMELs is authorized IAW procedures outlined in AFMAN 23-110. This maintenance concept is used when it is necessary for a PMEL to obtain maintenance assistance from an off-base PMEL. These transactions shall be coordinated between the PMELs involved. If the equipment is not to be sent to the PMEL, but to the depot or TRC, it shall be necessary to follow the procedures in TO 00-25-107 prior to movement of the equipment. After notification from the off-base PMEL that the required support can be given, the TMDE shall be delivered by courier or shipment. TMDE delivered and returned by courier shall not be processed through supply channels at either the supported or supporting PMELs location. Items of TMDE shipped through transportation channels shall be processed in accordance with established directives. In the event the TMDE is placed in awaiting parts status, the supporting PMEL shall notify the supported PMEL immediately and provide an estimated delivery date for parts and an anticipated completion date. If the Type IIA PMEL cannot perform the required maintenance, the procedures outlined in TO 33-1-27 shall apply. TO 00-25-115 identifies the ALC responsible for management of each stock class and for specific weapon systems/subsystems.

#### **4.4 PMEL SUPPORT AGREEMENTS.**

##### **4.4.1 Definitions.**

**4.4.1.1 Interservice Support.** Action by one military service or element to provide logistic support to a different military service or element.

**4.4.1.2 Interdepartmental/Agency Support.** Provision of logistics support by the military services to departments or agencies or the United States government (other than military) with or without reimbursement.

**4.4.1.3 Host-Tenant Support Agreement.** An intraservice agreement recorded on an DD Form 1144 (IAW AFI 25-201) between active Air Force, ANG or AFRC units (as required).

**4.4.1.4 Unique Support Equipment.** Equipment required solely to support the customer's equipment shall be provided by that customer if the customer is not Air Force, ANG or AFRC. The Air Force is not required and shall not be tasked to build up a capability at Air Force expense that is used only to support another military service or federal department.

**4.4.2 Generating Agreements.** Regional support requirement external to a PMELs parent unit may require a wide variety of documented agreements. The intent of this paragraph is to assist the PMEL manager in performing their task in generating an agreement if AFI 25-201 specifies a requirement or there is a need to generate an interservice agreement per DoDI 4000.19. PMEL managers require a working knowledge of support agreements and financial procedures to ensure resources are available and adequate to provide customer support. They also generate procedures to maintain communications to ensure mission support needs within a PMEL's area of responsibility are met. PMEL managers (or PMEL contract managers) shall also be aware of how and when to charge customers for services rendered. AFMC Type IIA calibration laboratories typically are not required to generate Host Tenant support agreements when servicing other PMELS. Agreements that could be encountered are:

- a. Host-tenant (AFI 25-201, AFI 65-601, Vol 1)
- b. Interservice/Interdepartmental/Agency (DoDI 4000.19).

**4.4.2.1** The following policies shall apply when generating support agreements:

- a. Support of other Air Force Units. Consider:
  - (1) Facility Requirements.
  - (2) Cost, Reimbursement.
  - (3) Manpower Authorizations Required and Source of Spaces and Funding.
  - (4) Effect on PMEL parent unit's Operations Plan. Consider what shall be PMELs role.
  - (5) Training Requirements, User and PMEL.
  - (6) Equipment, Parts and Technical Data Requirements. Customers are responsible to provide any material needed to support locally purchased items.
  - (7) Priority of Work, Customer's FAD and Precedence Rating. [USAF Programming Directive - (PD)].
  - (8) Customer's Wartime Requirements, Priorities, Exercises or Mobility support.
  - (9) Overdue Procedures.
  - (10) PMEL Assistance to Customer.
  - (11) Deficiency Reporting Procedures.
  - (12) Contract Maintenance and Calibration.
  - (13) Off-base Shipping and Transportation.
  - (14) Organizational Maintenance.
  - (15) Scheduling File Maintenance.
  - (16) Exercise or Mobility Support.

- (17) Mission Changes.
- (18) Unique Equipment Maintenance Cost.
- (19) Support Requirements for Locally Procured TMDE.
- (20) Workload.
- b. Support of non-Air Force units: Agreement is required on: all items listed in 4.4.2.1a and the following:
  - (1) Forms and Labels to Use.
  - (2) Calibration Intervals to Use.
  - (3) Scheduling and Management Procedures.
  - (4) Calibration Procedures to Use.
  - (5) Responsibilities.
- c. Support from non-Air Force sources: Agreement is required on all items listed in 4.4.2.1a and the following:
  - (1) Forms and Labels to use.
  - (2) USAF CMS and TO 33K-1-100-2 Intervals shall be used.
  - (3) Scheduling and Management Procedures.
  - (4) USAF Calibration Authorities shall be used.
  - (5) Responsibilities.
- d. Agreements can be simplified if PMELs have a base instruction established that contains policy, assigns responsibilities, directs actions, and prescribes procedures tailored to meet local needs and is referenced in the agreement. Base regulations apply to all organizations assigned or attached to the base or tenant organizations. They also apply to off-base and remote-site organizations of the same or different parent command if the subject matter relates directly to support and services furnished them by the issuing base.

**NOTE**

Do not submit a Request for Calibration Responsibility Determination for non-Air Force customer assets. Other agency customers are responsible for providing the calibration procedure to be used, or the specifications and accuracies required. Do not ask the 562 CBSG to write a calibration procedure or provide special equipment. It is the customer's responsibility to provide material resources the PMEL needs to assist them unless the PMEL already has the capability.

- e. Policy, information and procedures may be prescribed in a letter or message when there isn't time to process a publication. Letters or messages have to be replaced by a formal publication as soon as possible (AFI 33-360 Vol 1).
- f. Financial Administration. Information on financial matters, budgeting reimbursement, etc., is found in AFI 65-601 Vol 1 and DFAS-DER7010-1.
- g. Support Agreement Assistance. Assistance for development of support agreements and resolution of problems can be obtained from:
  - (1) Base Level Office Primary Responsibility (OPR) for support agreement.
  - (2) Parent Command PMEL Functional Area Manager (AFI 21-113), or Command Support Agreement Functional Area Manager.
  - (3) Air Force Material Command (AFMC), 562 CBSG is the Air Force point of contact for International Calibration Support.
  - (4) HQ USAF.
    - (a) Directorate of International Programs.



- (b) International Logistics Planning and Policy.
- (5) Support Agreement References.
  - (a) AFI 25-201, Support Agreement Procedures.
  - (b) AFI 38-201, Determining Manpower Requirements.
  - (c) AFI 21-113, Air Force Metrology and Calibration Program.
  - (d) Federal Acquisition Regulation (FAR).
  - (e) DoDI 4000.19, Interservice and Intragovernmental Support.
  - (f) DFAS-DER7070-3, Financial Management and Accounting for Security Assistance and International Programs.
  - (g) COMMAND 21-XX, Maintenance Management.
  - (h) AFI 65-601V1, Budget Guidance and Procedures.

**4.4.3 Negotiation, Administration and Review.** Each military service is responsible for providing or arranging for support of its own forces. Maximum practical use of support agreements shall be made when overall economies can be realized without impairing military effectiveness.

**4.4.3.1** Support agreements shall be generated only when necessary. Support agreements shall be negotiated at the lowest possible organizational level; customer to PMEL, for instance. This is with the concurrence of the base OPR for the agreement. PMEL managers shall coordinate on all agreements that include provisions of PMEL support.

#### **4.5 COMMERCIAL AND N49/59/64 CALIBRATION OF TMDE.**

**4.5.1 Commercial Calibration of TMDE.** Commercial calibration of TMDE represents a deviation from the published AF calibration determination. Therefore, the following policies pertain to commercial calibration of TMDE.

**4.5.1.1 General.** **The 562 CBSG is the only authority for approving commercial calibration service, unless authorized in paragraph 4.5.1.2.2 or 4.5.1.4.** An Air Force PMEL shall calibrate TMDE in accordance with the applicable CMS or T.O. 33K-1-100-2. When organic (Air Force) capability exists, commercial calibration shall not be purchased and support shall be obtained from another PMEL IAW Section 4.1 of this TO. If organic capability does not exist or calibration requirements exceed the AFMETCAL program capabilities, then supporting PMELs may submit a Request for Authorization of Commercial Calibration Services. When authorized to contract any part of the calibration, the work shall be placed with a calibration source that provides a calibration certificate/report containing the information required by Data Item Description DI-QCIC-80798B as a minimum (see paragraph 4.5.1.4). Also, the calibration should meet the same performance specifications of the Air Force calibration authority; if not, any deviation shall be documented and coordinated with the owner.

**4.5.1.2 Requests for Commercial Calibration Service.** OWCs and PWCs shall obtain 562 CBSG approval prior to procuring any calibration services from commercial sources except as noted below in paragraphs 4.5.1.2.1 and 4.5.1.2.2. The OWC and PWC shall accomplish each of the following:

- a. Verify that the part number is listed in TO 33K-1-100-2 or an applicable CMS, and:
  - (1) If not listed, assist the supporting PMEL in preparing and submitting an AFTO Form 45 in accordance with Section 5 of this TO.
  - (2) If listed, deliver the TMDE to the supporting Air Force PMEL for calibration. If the supporting PMEL lacks the capability (e.g., trained personnel or equipment) to accomplish the calibration, then the supporting PMEL shall seek lateral support from another PMEL IAW paragraph 4.1 of this TO. If no lateral support source can be located, the supporting PMEL shall contact the MAJCOM PMEL FAM for approval to submit the request.
- b. When approved to submit a request for commercial calibration services:

- (1) Prepare a Request for Authorization of Commercial Calibration Services; a form letter is available on METWEB on the Customer Support/Commercial Calibration Support page. FAX or EMAIL the request to the 562 CBSG office indicated on METWEB.
- (2) The requestor shall ensure and be able to provide documentation that the contractor is able to perform a calibration that meets the same performance specifications of the Air Force calibration authority, or that any deviation from the calibration authority was coordinated with the owner.

The 562 CBSG shall, at its discretion, determine if additional data or a site visit is required. The calibration results shall be reported in a calibration certificate/report containing the information required by Data Item Description DI-QCIC-80798B as a minimum (see paragraph 4.5.1.4)

**4.5.1.2.1 Exception for Items Designated CONTRACT.** Items listed in TO 33K-1-100-2 or an applicable CMS with a calibration responsibility of "CONTRACT" do not require a Request for Authorization of Commercial Calibration Services (see CONTRACT definition in TO 33K-1-100-1).

**4.5.1.2.2 Exception for New TMDE.** PMELs may accept the initial commercial calibration of newly procured TMDE without requesting authorization from the 562 CBSG if it includes a calibration certificate/report containing the same information required by Data Item Description DI-QCIC-80798B as a minimum (see paragraph 4.5.1.4), and by verifying that the commercial calibration meets the AF calibration authority performance specifications or owner requirements. Any deviation from the AF calibration authority shall be documented and coordinated with the owner. If the PMEL does not accept the commercial calibration, calibration of the TMDE shall be IAW the applicable CMS or TO 33K-1-100-2.

**4.5.1.3 Intervals for Commercially Calibrated Items.** The intervals for commercially calibrated TMDE shall be in accordance with any applicable CMS or TO 33K-1-100-2, regardless of calibration interval assigned by the calibration laboratory. The appropriate Air Force certification label shall be affixed to the TMDE IAW Paragraph 4.5.3. The calibration interval on commercially calibrated TMDE starts the date the contractor calibrated the item.

**4.5.1.4 Commercial Repair of TMDE.** Commercial repairs performed on customer TMDE shall be verified by the PMEL when the PMEL has the capability and the responsibility to calibrate the item. PMELs may accept commercial calibrations performed in conjunction with commercial repairs by verifying that the commercial calibration satisfies the User's specific calibration requirements and includes a calibration report containing the information required by Data Item Description DI-QCIC-80798B as a minimum. If the PMEL does not accept the commercial calibration, calibration of the TMDE shall be performed by the PMEL when possible. Data Item Description DI-QCIC-80798B requires the calibration certificate to include (NOTES shown below are to assist the PMEL's interpretation and verification of the requirement):

- a. Title, e.g. "Calibration Report" or "Calibration Certificate".
- b. Name and address of laboratory, and the location where the calibrations were carried out, if different from the address of the laboratory.
- c. Unique identification of the calibration report or certificate (e.g., the serial number), and on each page an identification in order to ensure that the page is recognized as a part of the calibration report or certificate, and a clear identification of the end of the calibration report or certificate.
- d. Name and address of customer.

NOTE: A requirement for the name and address of customer may be waived with customer coordination/concurrence.

- e. Identification of the method used.

NOTE: The calibration report or certificate may identify the method used in a manner similar to the following examples: a calibration procedure number; an ASTM, IEC, or other standard specification; or a narrative description of the method used (i.e. compared with laboratory standard X at 10 points between 10% and 100% of full scale).

- f. A description of, the condition of, and unambiguous identification of the item(s) calibrated.
- g. Date of receipt of the calibration item(s) where this is critical to the validity and application of the results, and the date(s) of performance of the calibration.

- h. Reference to the sampling plan and procedures used by the laboratory or other bodies where these are relevant to the validity or application of the results.

NOTE: The calibration report or certificate might not reference a sampling plan as sampling plans rarely apply to calibration; sampling plans normally are used in testing laboratories.

- i. The calibration results with, where appropriate, the units of measurement.
- j. The name(s), function(s) and signature(s) or equivalent identification of person(s) authorizing the calibration report or certificate.
- k. Where relevant, a statement to the effect that the results relate only to the items calibrated.
- l. The conditions (e.g., environmental) under which the calibrations were made that have an influence on the measurement results.
- m. The uncertainty of measurement or a statement of compliance with an identified metrological specification or clauses thereof.

NOTE: A calibration report or certificate that contains a statement of compliance to original manufacturer's specifications (with any exceptions or limitations noted) may satisfy this requirement.

- n. Evidence that the measurements are traceable.

**4.5.1.5 Procuring TMDE Involving Commercial Calibration.** Item and program managers procuring TMDE involving commercial calibration shall submit a data call to the 562 CBSG prior to contract award. The 562 CBSG will review the technical specifications contained within the data call and determine if organic capability currently exists. The 562 CBSG will work with the item manager/SPO office to determine the most efficient and cost effective means to ensure calibration support while complying with 562 CBSG policy. If commercial calibration is approved, the 562 CBSG will provide the necessary data requirements and appropriate quality statements to the item manager/SPO to be included within the contract. Data calls shall include the following information:

- a. Nomenclature and description of the item being procured.
- b. Weapon system (if applicable).
- c. Specifications contained within a purchase description (PD), commercial item description (CID) or other statement of work.
- d. Purpose for obtaining commercial calibration.
- e. Name, office symbol, phone number and address of the requesting organization.
- f. List of possible commercial vendors that may provide commercial calibration services.
- g. Time line in which the procurement is to be accomplished and equipment fielded.
- h. Submit data calls to the 562 CBSG/GBNA electronically or by FAX.

**4.5.2 Calibration of TMDE under N49/59/64.** Calibrations of TMDE under N49/59/64 are in accordance with published AF calibration determinations and are approved by the 562 CBSG. The following policies pertain to items listed within CMS TOs and TO 33K-1-100-2 with a calibration responsibility identified as N49, N59 or N64.

**4.5.2.1 General.** The 562 CBSG has responsibility for management of calibration services for Air Force TMDE listed as N49, N59 or N64, except for equipment requiring calibration under Depot Maintenance Activity Group (DMAG) or Stock Funded programs, which shall not be serviced or funded under this process unless a reimbursement agreement has been established. The PMEL shall not accept or process non-AF N49, N59 or N64 calibration workload.

**4.5.2.2 N49/N59 Calibration Support.** PMELs shall notify their customers that Air Force N49/59/64 calibration management has been centralized at the 562 CBSG. To be eligible for centrally funded calibration, all items must be operational. Any requests for short cycling must have a valid reason and must be approved by the 562 CBSG. N49/59 items will be scheduled by the local PMEL through PAMS. The PMEL scheduler will contact the appropriate service provider listed on METWEB's Customer Support Page. The PAMS shipping module will be used to log and track the item status and location. Equipment shall be shipped from the PMEL's location directly to

the service provider. Prior to shipment, maintenance data shall be entered into the PAMS system utilizing action taken code "D" 'Transferred to Another Base or Unit' and disposition code "5" 'Shipping'. Upon return of the calibrated N49 or N59 item, contact the responsible workload scheduler if the unit does not conform in any way or documentation is insufficient. If the item is determined to be unserviceable, the PMEL shall prepare and submit SF Form 368, Product Quality Deficiency Report and complete the appropriate Deficiency Report actions in PAMS. For serviceable TMDE, complete maintenance data actions in PAMS utilizing action taken code "X" 'Test-Inspect-Service'.

**4.5.2.3 N64 Calibration Support.** Calibration support may be obtained by either the owner or supporting PMEL by contacting the AFPSL scheduler directly. For owners shipping TMDE directly, after contacting the AFPSL for ship-to instructions: To ship the item, deliver the TMDE, a completed DD Form 1149 and an appropriate reusable shipping container to the local Traffic Management office. The DD Form 1149 shall be completed according to AFI 24-201, attachment 7 and AFI 21-101 to include applicable MAJCOM supplements. Ensure instructions are enclosed in the shipment to direct the shipping destination to return a signed copy of the packing slip. Mark one copy of the DD Form 1149 "ADVANCE COPY" and send (mail, FAX, e-mail, etc.) it to the calibration destination. Upon return of the calibrated equipment, the owning work center shall perform an incoming acceptance inspection (conformance assessment for physical condition, safety, documentation and cleanliness). Contact the AFPSL scheduler if the unit does not conform in any way or documentation is insufficient.

**4.5.2.4 Intervals for N49, N59, and N64 Calibrated Items.** The intervals for N49, N59 and N64 calibrated TMDE shall be in accordance with any applicable CMS or TO 33K-1-100-2, regardless of calibration interval assigned by the calibration laboratory. The appropriate Air Force certification label shall be affixed to the TMDE in accordance with paragraph 4.5.3. The Air Force calibration interval starts the date the contractor or DoD agency calibrated the item.

**4.5.2.5 Repair During N49/59/64 Calibration.** Incidental repair during calibration shall be accomplished and funded by the 562 CBSG. Funding shall be provided for incidental repair only. If a unit is shipped which is in need of major repair, the owning organization will be contacted by the 562 CBSG for a fund cite and/or disposition instructions. The 562 CBSG must grant approval for major repair actions.

**4.5.3 Certification Label.** The non-AF source certification label shall remain on the unit. An AF certification label shall be attached to the TMDE citing "TO 00-20-14" in the authority block. If the non-AF calibration deviates from the Air Force calibration authority performance specifications, a limited/special AF certification label shall be attached. Enter an annotation in the special block, referencing the non-AF certification label or certificate, and any additional certification data associated with that calibration. The PMEL or owning work center shall retain a copy of the non-AF certificate of calibration, and warranty document on file until warranty expiration. If data contained within the certification label, calibration certificate, or certificate of traceability is incorrect, notify the appropriate workload scheduler for instructions.

#### **4.6 CALIBRATION SUPPORT FOR SITE ACTIVATION TASK FORCE (SATAF), OPERATIONAL TEST AND EVALUATION (OT&E), and INITIAL OPERATIONAL TEST AND EVALUATION (IOT&E).**

**4.6.1 General.** (Reference DoDI 5000.2 AF SUP 1 and AFI 63-111.) Calibration support for activation of new sites or upgrading of operational site equipment by Air Force contractors shall be provided in accordance with host-tenant agreements established under the provisions of AFI 25-201. The 562 CBSG, in coordination with the program manager and the commands involved, shall develop the necessary calibration support plans and alert the selected PMEL of the projected workload and responsibility to support the installation and checkout contractor. The responsible PMEL shall initiate action in accordance with the plan to obtain equipment and manning to support TMDE to be utilized by the installation, checkout and acceptance teams and during the subsequent operational phase. This support is normally limited to:

- a. TMDE listed in any applicable CMS or TO 33K1-100-2 as PMEL responsibility.
- b. TMDE that is scheduled to remain on-site for use during the operational phase.
- c. The PMELs existing capability.

#### **NOTE**

Equipment, which will not be used during the operational phase, shall be identified by the PMEL as equipment requiring alternate support.

**4.6.2 Requests.** Requests for support of contractor-owned TMDE shall normally be received from one of the following sources:

- a. The administrative contracting officer.
- b. The SATAF or project officer.
- c. The local base procurement officer.
- d. The 562 CBSG through one or more of the above.

**4.6.3 Application.** These provisions also apply for tests on new or improved systems at system or subsystem sites.

#### **4.7 SECURITY ASSISTANCE (SA) PROGRAMS AND FOREIGN MILITARY SALES (FMS).**

FMS cases for the sale of systems to friendly nations often involve the necessity of establishing or augmenting a metrology program for that system. The 562 CBSG develops specific metrology programs providing for the repair and calibration of TMDE and follow-on calibration support. All queries for FMS cases or SA Programs shall be directed to 562 CBSG/GBIA, 813 Irving-Wick Dr W, Heath, OH 43056-1199.

#### **4.8 TMDE WARRANTIES.**

TMDE initially issued to using activities is frequently covered by a provisional warranty from the manufacturer. These warranties vary in degree of coverage, specific service/maintenance performed, and correction of design, material and workmanship deficiencies, which result in the item of TMDE performing below specification and contractual requirements. Detailed information on specific warranty provisions is explained in AFMAN 23-110, Volume 1, Part 1, Chapter 1, Section 10j.

**4.8.1 New Equipment Receipt.** Upon receipt of new equipment PMEL shall:

- a. Determine warranty expiration date. Complete and mail any warranty cards for PMEL-owned equipment.
- b. Calibrate the equipment, or, if repair is required and is covered by warranty, return to user with appropriate information required to promptly send the item through Base Procurement and contracting office IAW applicable regulations.
- c. After calibration, whenever reasonable and conditions permit, short cycle the next date due calibration so the item is due back in the PMEL no later than 30 days prior to warranty expiration date.
- d. Consider centrally procured items with warranties that fail calibration as subjects for Product or Quality Deficiency Reports.

**4.8.2 Warranty Processing.** Processing of a warranty action is at the discretion of the local contracting office. If the local contracting office requires an AF Form 9, it shall be submitted.

#### **4.9 LEASED/BORROWED EQUIPMENT.**

**4.9.1 Leased/Borrowed Equipment.** The following policies pertain to calibration requirements for Leased/Borrowed TMDE that is not owned by the Air Force, but is used to support an Air Force mission.

NOTE: TMDE owned and used by contractors performing under an AF contract on an AF installation to support an AF mission shall be considered leased/borrowed equipment when determining calibration requirements.

**4.9.1.1 General.** Leased and/or Borrowed equipment is equipment used to accomplish maintenance within the Air Force in accordance with prescribed Air Force instructions. Such equipment may be used by organic (Air Force) personnel or contractors. As such, requirements for accuracy and performance are identical to Air Force owned equipment.

**4.9.1.2 Definition of Leased versus Borrowed.** Leased equipment is obtained under contract and payment is made for its use. Borrowed equipment is obtained without financial consideration for its use. There is no difference in their application in support of the mission.

**4.9.2 Calibration Requirements for Leased/Borrowed Equipment.** The User may use the equipment without an AF PMEL calibration if all of the following conditions are met:

- a. The equipment has a valid calibration label and the Certificate (or Report) of Calibration provides the information required by TO 00-20-14, Paragraph 4.5.1.4.
- b. The User will lease/borrow the equipment for a period of less than 12 months and will not lease/borrow the item in the future.

**4.9.2.1** If the equipment does not meet the requirements of Paragraph 4.9.2, and **is listed** in TO 33K-1-100-2 (or an appropriate CMS), the User shall obtain calibration services IAW 33K-1-100-2 (or the appropriate CMS). An AF PMEL may calibrate Leased/Borrowed equipment without adjustment to avert voiding the warranty, unless adjustment action is included within the support agreement. Equipment that is found out of specification will be returned to the User for shipment to the owner for adjustment.

**4.9.2.2** If the equipment does not meet the requirements of Paragraph 4.9.2 and **is not listed** in TO 33K-1-100-2 (or an appropriate CMS), then the User shall deliver it to the supporting AF PMEL and assist the PMEL to prepare and submit an AFTO Form 45 in accordance with Section 5 of TO 00-20-14. Identify in the Remarks block of the AFTO 45 that the equipment is leased/borrowed, and the terms (length) of the lease. The User may have to reimburse the Air Force for costs of calibration procedure development, additional calibration equipment required to calibrate the item, or calibration of the item itself.

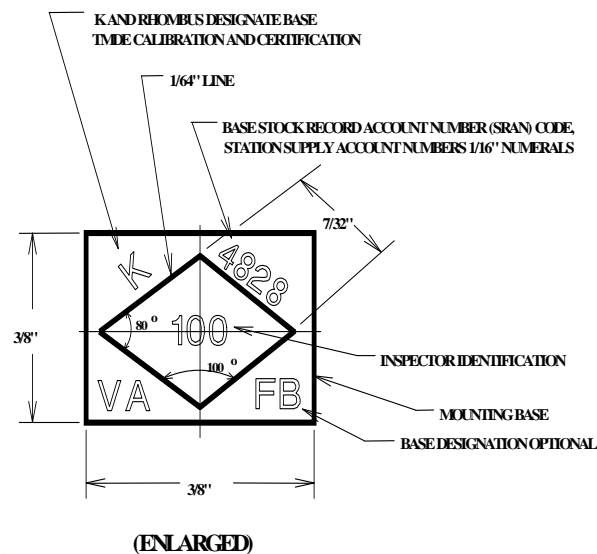
**4.9.2.3** If the equipment referenced in Paragraph 4.9.2.2 will be leased/borrowed for a period of less than 12 months, the certificate (or report) of calibration does not provide the information required by TO 00-20-14, Paragraph 4.5.1.4, the item is not listed in TO 33K-1-100-2 (or an appropriate CMS), and the item will not be leased/borrowed in the future, a request for commercial calibration may be submitted IAW Paragraph 4.5.1.2.b instead of submitting an AFTO Form 45. Any request for commercial calibration should identify that the item is leased/borrowed and the term (length) of use by the Air Force. The User will be responsible for the cost of the commercial calibration if the request is approved.

## SECTION 5

### PREPARATION AND USE OF CALIBRATION FORMS AND LABELS

#### 5.1 TMDE CERTIFICATION STAMP (K STAMP).

The K Stamp is a PMEL technician's official signature on those forms, tags, or labels described in this TO and applicable command directives. It shall be used only on these forms. Only PMEL technicians in officially designated TMDE calibration laboratories are authorized to use a TMDE Certification stamp (K-stamp as described in figure 5-1). In addition, technicians designated by the site manager at authorized torque calibration sites may use certification stamps to certify torque devices. Using an electronic version of the K stamp is authorized. The use of K stamps by PMEL technicians is mandatory on all certification labels. The PMEL manager shall designate who will be issued stamps. Stamps shall be serially numbered to identify the technician or supervisor and the activity to which he or she is assigned. The K stamp shall be as illustrated in Figure 5.1. The use of a stamp with smaller or larger dimensions is optional, provided it is dimensionally proportional and does not exceed the space available on forms. The K stamps shall be obtained through local purchase.



**Figure 5-1. TMDE Certification Stamp (K Stamp).**

#### 5.2 GENERAL INSTRUCTIONS.

The forms and labels in this section are mandatory unless otherwise noted. All written entries on labels and forms shall be in non-smearing permanent black or dark blue ink. Approval to use computer generated forms and labels controlled by this section can only be obtained by the 562 CBSG IAW AFI 33-360, V2.

#### NOTE

Anyone having trouble with one of the following labels or forms, due to their manufacture, shall report it to the 562 CBSG.

##### 5.2.1 Affixing Labels.

5.2.1.1 Only authorized personnel shall affix labels.

5.2.1.2 When affixing labels, do not cover TMDE identification data (part or serial number, etc). Also, do not affix labels where they would prevent use of TMDE (e.g., covering controls or control markings).

5.2.1.3 Always affix Bar Code Labels and certification labels where the user will see them during normal handling and use of the TMDE. Affix labels to a clean surface on the TMDE mainframe if possible, not on removable parts or panels. In the following instances, it may not be possible to affix labels to the TMDE:

- a. The TMDE is too small to affix a label or its nature will not allow affixing of a label (optical flats and gage blocks). In these cases, the label may be placed on a removable shoe tag, or if the TMDE has a container, the label may be affixed to it.
- b. The TMDE is used in an environment that might damage the labels (e.g., oil or fuels could destroy labels). Labels may be affixed away from the instruments.
- c. On complex TMDE such as test stands or checkout consoles, certification labels for components may be grouped on the end-item.

#### **NOTE**

When a label is not affixed to its TMDE, there shall be some definite marking or annotation (preferably part number/serial number) on either the label or TMDE that links the two together. This requirement also applies to individual TMDE items that are part of a set or kit. Individual weights, such as the MMS Weight Set, are an exception to this requirement. They shall have no part number, serial number or color markings on them other than their size because marking would physically alter the certified parameters and damage the TMDE. A process for positively identifying the instrument to the label, however, shall be outlined in the PMEL quality manual. For example: Identify the quantity and describe the items of the kit on the certification label (use as much detail as necessary to ensure the proper identification of these items). Identify the way the items will be used, e.g., only one set of Class 3 weights will be used at a time, etc.

**5.2.2 Removing Labels.** Only authorized personnel shall remove labels when the item is being returned to supply. Prior to returning TMDE to supply, all labels shall be removed except the Bar Code Label. (Exception: At the depot TRC, Cesium Beam Standards designated ABSOLUTE and used for frequency only, may retain the certification label for items being shipped to a known customer.) The PMEL shall be notified the item has been turned in so they can remove it from their master inventory. Document the condition tags IAW TO 00-20-3.

### **5.3 TMDE BAR CODE LABELS.**

The PMEL shall ensure an original TMDE bar code label, AFTO Form 65 or 66, is initially affixed to each item of Air Force TMDE (that physically exists) in the PMEL inventory; Exception: if item fits definition of paragraph 3.2.1. Ensure after cleaning TMDE surfaces that they are dry before applying these labels because wet solvent will remove the adhesive. Ensure there is at least one-eighth inch on both ends of the label beyond the bar code marks; this allows the bar code scanner to properly read the label. Preferred location for the bar code labels is on the upper right corner of the front panel. Damaged labels shall be replaced by a new AFTO Form 65 or 66 or an equivalent computer generated bar code using the original AFTO Form 65 or 66 bar code number. Computer generated bar codes are only authorized as a replacement.

**5.3.1 AFTO FORM 65 Aluminum Stock.** The TMDE aluminum label, AFTO Form 65 (see Figure 5-2), is optionally available for use where its durability is an advantage and it poses no safety hazard. There may be instances, however, due to safety or TMDE function, where the polyester AFTO Form 66 shall be used instead. See the instructions for the AFTO Form 66.



**Figure 5-2. AFTO FORM 65, TMDE Bar Code Label, Aluminum Stock.**

**5.3.2 AFTO FORM 66 Polyester Stock.** The TMDE polyester label, AFTO Form 66 (see Figure 5-3), may be used wherever practical. It shall be used when using the aluminum AFTO Form 65 could be a safety hazard or prevent proper TMDE function or calibration.





**Figure 5-3. AFTO FORM 66, TMDE Bar Code Label, Polyester Stock.**

Examples include:

- a. Small RADIAC dosimeters.
- b. Small torque indicating devices.
- c. TMDE that is inserted into mainframes or incorporated into other types of equipment where the label could become a conductive foreign object damage (FOD) hazard if it came loose.
- d. TMDE used on a flightline or anywhere a dislodged label could be ingested into an aircraft engine.

#### **5.4 CERTIFICATION LABELS.**

**5.4.1 General.** All equipment that requires calibration shall have a certification label attached by the calibrating work center prior to use by the Owning Work Center (OWC). The full-sized certification label (AFTO Form 108, 99) shall be used whenever possible and practical. Electronic (computer-generated) versions of certification labels that are printed on blank label stock are authorized for use provided the electronic (computer-generated) form maintains the same general information and dimensions of the pre-printed form. Only one certification label shall be used for each item; all unapproved or expired labels shall be removed.

##### **5.4.1.1 Exceptions.**

**5.4.1.1.1 Approved Non-Air Force Source Calibrated the TMDE.** In this instance, the TMDE shall have both the non-AF certification label and an Air Force certification label with the additional required information affixed. The authority in this situation is "TO 00-20-14". Also, enter an annotation in the Air Force certification label special block, referencing the non-AF certification label or certificate, and any additional certification data associated with that calibration.

**5.4.1.1.2 Non Existent NEC End Items.** Certification labels are not required for SICL end-item part numbers designated NEC that do not physically exist (e.g., the AN/APM-427).

**5.4.1.2 Use of Condition Tags.** When a certification label is affixed to TMDE, Air Force supply system condition tags, such as DD Forms 1574, Serviceable Label - Material, are not required unless the item is being returned to supply.

**5.4.1.3 Unauthorized Changes.** Unless authorized, any changes to certification labels shall void the certification. Only two changes are currently authorized. Owning organizations may change the OWC in the IDENTIFICATION NO. block IAW paragraph 5.4.2.1.1 or 5.4.2.1.2, and CBU may be added to the DATE DUE block IAW paragraph 3.2.2b.

**5.4.2 Common Entry Instructions.** The following requirements apply to all certification labels, unless otherwise indicated. For additional requirements see specific entries under the individual labels. For War Reserve Material (WRM) packages, see the specific instructions for the AFTO Form 108.

**5.4.2.1 IDENTIFICATION NUMBER Block.** Enter the OWC code, and the bar code number from the AFTO Form 65 or 66 if PMEL supported, or serial number if USER, of the equipment being certified.

**5.4.2.1.1 Changes to OWC.** Users may change the OWC code on a certification label. When this change is made, the user shall notify the PMEL.

**5.4.2.1.2 Differing MIS Databases.** This block may be filled in by the TMDE user if an off base PMEL calibrates the TMDE, and the customer does not use the same database as the PMEL.

**5.4.2.1.3 WRM.** In addition, also enter WRM if the TMDE will be packed and stored as war readiness material.

**5.4.2.2 AUTHORITY Block.** This block applies to AFTO Forms 99 and 108 only. For those items with an AFTO Form 394 or 398, the TO listed in the PMEL master ID listing is the authority, if included; otherwise the authority is the TO listed in the applicable CMS, TO 33K-1-100-1 or TO 33K-1-100-2.

**5.4.2.2.1 Absolute Standard.** Enter ABSOLUTE STANDARD in this block when applicable.

**5.4.2.2.2 AF Calibration Procedure.** Enter the calibration procedure identified in the CMS or TO 33K-1-100-2.

**5.4.2.2.3 No AF Calibration Procedure.** If there is no calibration procedure identified, or if the AF calibration procedure has not yet been published, enter either the DoD calibration procedure, the maintenance TO number, "COM DATA" (list the actual commercial data that was used in the SPECIAL block).

**5.4.2.2.4 CPIN.** Also enter the Computer Program Identification Number (CPIN), if it is used to perform part of the procedure and is not listed in the calibration procedure. If an automated calibration TO is used as the calibration authority, enter the content of the [Auto CTO] field, as formatted in the applicable CMS or 33K-1-100-2, including any sub procedure identified. If space is insufficient, the special block may be used.

**5.4.2.2.5 Calibrated by Non-AF Source.** Identify it as being calibrated by a non-AF source by entering "TO 00-20-14", as applicable.

**5.4.2.2.6 NCR.** For items designated NCR that require a Special calibration, enter "TO 00-20-14" and list the procedure used in the special block.

**5.4.2.2.7 NEC End Item.** For See Individual Component Listing (SICL) end-items designated NEC, leave blank.

**5.4.2.2.8 NHA Components.** For items designated NHA, enter "NHA".

**5.4.2.2.9 SICW.** For items designated SICW, enter "SICW".

**5.4.2.3 SPECIAL Block.** Enter any combination of the following as necessary.

**5.4.2.3.1 Additional Calibration Data.** Indicate if there is additional calibration data. Specifically identify the additional data by a minimum of part number, bar code or serial number, calibration date, and initial or K stamp of certifying technician.

**5.4.2.3.2 Calibration Using TO or Other Data.** Identify why the item was fully or partially calibrated by the maintenance TO or commercial data, if not the authority listed in the CMS or TO 33K-1-100-2. If this was a result of an inadequacy in the calibration procedure, submit an AFTO Form 22 to correct the calibration TO. If commercial data is used, also comply with paragraph 5.4.2.3.7.

**5.4.2.3.2.1 Com Data.** If the calibration authority is COM DATA, and the TMDE specifications are available in the CMS or TO 33K-1-100-2, annotate the special block with TO 33K-1-100-2 or the appropriate CMS reference. If the calibration authority is COM DATA, and the TMDE specifications are not available in the CMS or TO 33K-1-100-2, list the actual commercial data and publication/revision date that was used. If thorough research does not reveal a date of publication/revision, assign the date the research was accomplished to the data and retain on file.

**5.4.2.3.3 General Calibration TO.** If the TMDE was calibrated using one of the general calibration TOs listed in TO 33K-1-100-1 Section 3, and no accuracy is assigned in either the appropriate CMS or TO 33K-1-100-2 as displayed in the Air Force Calibration Authority Viewer (AFCAV) or the general calibration TO, enter the accuracy to which it was certified and the source data description (e.g., +/- 0.001 inch. See 'Manufacturer' catalog #29 pg 53, model 436).

**5.4.2.3.4 Contract Calibration.** Make entries per paragraph 5.4.1 if this was a contract calibration, which resulted in calibration meeting all specifications of Air Force or requirements.

**5.4.2.3.5 Multiple CMSs.** For common TMDE being used to support more than one system, the TMDE must be calibrated to all applicable system requirements. This may involve multiple CMSs and/or T.O. 33K-1-100-2, depending on the systems being supported. If different calibration intervals or specifications are listed, use the shortest interval and *tightest specification* and note which CMS was used for the interval/specification.

**5.4.2.3.6 NHA and SICL Components.** For SICL components, use this block to denote the component is "Part of" SICL end item part number (e.g., "P/O 12345-1"). If the component is calibrated as part of the end-item (generally designated NHA) and is not attached to the end-item or is to be removed from the end-item after calibration, also include the end-item bar code number or serial number.

**5.4.2.3.7 Insufficient Space.** If there is insufficient space on the label for all entries, recommend affixing the label to a plain manila shoe tag. The rest of the limitations shall go on the manila tag. The certification label serves as the authority for the data written on the manila tag. The manila tag shall be attached to the TMDE item. A second alternative is to enter additional data on a calibration data sheet when the plain manila tag interferes with use of the instrument. In either of these cases, reference the additional data in the special block of the certification label.

**5.4.2.3.8 SICL End Item.** For SICL end items, enter "SICL end item" in this block.

**5.4.2.3.9 SICW.** For SICW items, enter either the Bar Code Number or the part number and serial number of the end item it is calibrated with. The SPECIAL block of the end item will list either the bar code numbers or part numbers and serial numbers of all items calibrated with the end item.

**5.4.2.4 CERTIFIED BY Block.** The K stamp of the PMEL calibration technician, or the inspection/production stamp or initials of the calibration technician of other PWCs shall be entered in the block.

**5.4.2.5 DATE CALIBRATED Block.** Enter the date the TMDE was calibrated. Enter date as YYYYMMDD.

**5.4.2.5.1 Non-AF Certification.** When authorized to use manufacturer's certification, use date on manufacturer's certificate when provided, rather than date unit was received or placed into service.

**5.4.2.5.2 Absolute Standard.** For an absolute standard, enter the date the certification label is completed.

**5.4.2.5.3 SICL End Item.** For SICL end item, complete if the SICL end item has a calibration interval. If there is no SICL end item calibration, enter NEC.

**5.4.2.6 DATE DUE Block.** Enter the date the equipment is due for calibration. Enter date as YYYYMMDD. The equipment is overdue at the start of the following day. For example, an item due calibration on 13 June becomes overdue at 0001 hours, 14 June. Calibration due dates may be extended under certain circumstances as defined in paragraph 3.4.

**5.4.2.6.1 AFPSL Extensions.** The AFPSL is authorized to extend the due date to agree with a schedule or need date for special project TMDE being assembled for a PATEC, TFCU or RASCAL.

**5.4.2.6.2 Interval with Operating Hours.** In cases where the calibration interval is based on both a specified interval and a number of operating hours, enter the date the item would be due for recalibration under the specified interval and the operation hours.

**5.4.2.6.3 ICO.** Enter ICO instead of a date, if applicable.

**5.4.2.6.4 WRM.** Leave this block blank if the TMDE will be packed or stored as WRM. Once the item is removed from the WRM package or storage, the user shall annotate their TMDE inventory listing and the certification label with the new due date. User shall also notify the PMEL of the new date due. The calibration due date shall be computed using the assigned calibration interval starting from the date the TMDE is removed from the WRM status.

**5.4.2.6.5 SICW.** For SICW items, this block will match the Date Due block of the end item sticker.

**5.4.3 AFTO FORM 108, TMDE Certification Label.** An AFTO Form 108 (see Figure 5-4) can only be used if all specifications of the calibration authority are met. The calibrating technician or other authorized person shall fill out this label as described in the general instructions or in the following manner, as applicable.

IDENTIFICATION NO.		AUTHORITY (T O., ETC)	
SPECIAL			
CERTIFIED BY	DATE CALIBRATED	CERTIFIED BY	DATE CALIBRATED
	DATE DUE		DATE DUE

PREVIOUS EDITION WILL BE USED  
AFTO FORM 108 Nov 84

TMDE CERTIFICATION

**Figure 5-4. AFTO FORM 108, TMDE Certification Label (White).**

**5.4.3.1 Certification Labels for SPRAMS.** AFTO Forms 99/108/394/398 (as applicable) shall be used on individual TRUs for SPRAMS. The certificates shall be completed per the general instructions except as follows:

**5.4.3.1.1 IDENTIFICATION NO Block.** Also enter "SPRAMS".

**5.4.3.1.2 SPECIAL Block.** Once the item is removed from SPRAMS, the user shall enter the date the item was removed.

**5.4.3.1.3 DATE CALIBRATED Block.** Enter the original calibration date.

**5.4.3.1.4 DATE DUE Block.** Leave this block blank. Once the item is removed from SPRAMS, the user shall enter the new due date or NHA then notify the scheduler of the new date due. The calibration due date shall be computed using the assigned calibration interval starting from the date the TMDE is removed from SPRAMS.

**5.4.4 AFTO FORM 394, TMDE Certification Label.** AFTO Form 394 (see Figure 5-5) can only be used if all specifications of the calibration authority are met. The calibrating technician or other authorized person shall fill out this label as described in the general instructions.

CERTIFIED BY	TMDE CERTIFICATION	
	ID.NO. _____	
	SPECIAL _____	
	DATE CAL _____	DATE DUE _____
AFTO FORM 394, MAR 86 PREVIOUS EDITION WILL BE USED		

**Figure 5-5. AFTO FORM 394, TMDE Certification Label.**

**5.4.5 AFTO FORM 99, Limited/Special TMDE Certification Label.** The yellow AFTO Form 99 (see Figure 5-6) is used for standards and TMDE certified with a limited or special calibration as defined in Section 3 of this TO. Also, certain 33K TOs may direct use of this label because they do not verify all, or portions of, main functions and ranges. It is the responsibility of the user to read and apply whatever is in the SPECIAL block. This label shall also be used for equipment designated as NHA, NPC or CBU. The calibrating technician or other authorized person shall fill out this label in the following manner and as described in the general instruction, as applicable.

AFTO FORM 99, JUN 07 PREVIOUS EDITION WILL BE USED	IDENTIFICATION NUMBER		AUTHORITY (T.O. ETC.)
	SPECIAL		
	CERTIFIED BY	DATE CALIBRATED	USER APPROVAL
		DATE DUE	
LIMITED/SPECIAL TMDE CERTIFICATION			

**Figure 5-6. AFTO FORM 99, Limited/Special TMDE Certification Label (Yellow).**

**5.4.5.1 SPECIAL Block.** In addition to the information listed in the General Entry Instruction in this Section, this block shall be used for the following purposes:

- To indicate the accuracy to which the item was calibrated.
- To identify the basic function that was measured and the ranges or parameters certified (e.g., FUNCTION: 0-50 VAC). If it is more convenient, the exceptions may be entered (e.g., FUNCTION: Except 0-500V DC). In general cite the 33K Table 1 specification that is being limited (e.g., VDC, VAC, etc.)
- To identify special accuracy, ranges, points calibrated, or other information of value to user.

**5.4.5.2 DATE CALIBRATED Block.** Enter date calibrated, NHA or leave blank as applicable.

**5.4.5.3 DATE DUE Block.** Enter date due, NHA, NPC, date due/CBU or leave blank as applicable.

**5.4.5.4 USER APPROVAL Block.** The representative designated IAW paragraph 3.6f above shall sign or initial this block to indicate that the user agrees with the limited or special calibration performed.

**5.4.6 AFTO FORM 398, Limited TMDE Certification Label.** The yellow AFTO Form 398 (see Figure 5-7) is used for standards and TMDE certified with a limited or special calibration as defined in Section 3 of this TO. Also, certain 33K TOs may direct use of this label because they do not verify all, or portions of, main functions and ranges. It is the responsibility of the user to read and apply whatever is in the SPECIAL block. This label shall also be used for equipment designated as NHA, NPC or CBU. The calibrating technician or other authorized person shall fill out this label in the following manner and as described in the general instruction, as applicable.

CERTIFIED BY	LIMITED TMDE CERTIFICATION		INI
	ID.NO.		
	SPECIAL		
	DATE CAL	DATE DUE	
AFTO FORM 398, MAR 88 PREVIOUS EDITION WILL BE USED			

**Figure 5-7. AFTO FORM 398, Limited TMDE Certification Label (Yellow).**

**5.4.6.1 SPECIAL Block.** This block shall contain specific limitations or special calibration data. It will normally be used to direct the reader to see an AFTO Form 249 or other data sheet, since it is unlikely that all the instrument limitations (or special data) can be documented on the AFTO Form 398.

**5.4.6.2 DATE CAL Block.** Enter date calibrated, NHA or leave blank as applicable.

**5.4.6.3 DATE DUE Block.** Enter date due, NHA, NPC, date due/CBU as applicable.

**5.4.6.4 INI Block.** The representative designated IAW Paragraph 3.6.f above shall initial this block to indicate that the user agrees with the limited or special calibration performed by the PMEL. Note: On versions of this label without an INI block, initial in the label border adjacent to the Date Due block.

## **5.5 AFTO FORM 256, NO CALIBRATION REQUIRED LABEL.**

The AFTO Form 256 (see Figure 5-8) shall be affixed to those items of TMDE listed as NCR in a CMS or TO 33K-1-100-2.



**Figure 5-8. AFTO FORM 256 No Calibration Required Label.**

**5.5.1 Affixing and Validation Responsibility.** Organizations that possess NCR TMDE are responsible for affixing and validating the AFTO Form 256 for these items.

**5.5.2 Validation.** This label shall be validated with a PMEL K stamp, or the inspection/ production stamp or initials of the user of the TMDE

**5.5.3 PMEL NCR TMDE.** On NCR TMDE designated PMEL or AFPSL responsibility in the CMS or TO 33K-1-100-2, annotate the OWC and bar code label number (if assigned) on the AFTO Form 256.

**5.5.4 Small NCR TMDE.** On NCR TMDE too small to affix the label, a white dot can be used in place of the AFTO Form 256.

## **5.6 NIST REPORT OF MEASUREMENT.**

This report is completed by NIST on all Air Force measurement standards calibrated by NIST. A copy of the report shall remain with the standard.

## **5.7 CALIBRATION CERTIFICATES OR CALIBRATION REPORTS.**

**5.7.1 AFPSL Calibration Certificate or Report.** The AFPSL completes this certificate or report when a formal certificate/report is required or requested for base measurement standards, Air Force measurement standards and TMDE. When issued, the certificate or report shall contain the required information in paragraph 5.7.3.

**5.7.2 PMEL Calibration Certificate or Report.** The PMEL completes this certificate or report when requested by a user or as directed by the calibration TO or other directive. When issued, the certificate or report shall contain the required information in paragraph 5.7.3.

**5.7.3 Calibration Certificate and Report Format.** The format of the certificate or report shall be specifically designed for each type of calibration, but the headings shall be standardized and include all information necessary for the interpretation of the calibration results. Each calibration certificate or report shall be accurate, clear, unambiguous and objective, in accordance with any instructions in the calibration authority. Where the certificate or report contains results of calibrations performed by other than the PMEL, these results shall be clearly identified. When issued, the certificate or report shall contain, as a minimum (NOTES shown below are to assist the PMEL's interpretation and verification of the requirement):

- a. Title, e.g. "Calibration Report" or "Calibration Certificate".
- b. Name and address of laboratory, and the location where the calibrations were carried out, if different from the address of the laboratory.
- c. Unique identification of the calibration report or certificate (e.g., the serial number), and on each page an identification in order to ensure that the page is recognized as a part of the calibration report or certificate, and a clear identification of the end of the calibration report or certificate.
- d. Name and address of customer.

NOTE: A requirement for the name and address of customer may be waived with customer coordination/concurrence.

- e. Identification of the method used.

NOTE: The calibration report or certificate may identify the method used in a manner similar to the following examples: a calibration procedure number; an ASTM, IEC, or other standard specification; or a narrative description of the method used (i.e. compared with laboratory standard X at 10 points between 10% and 100% of full scale).

- f. A description of, the condition of, and unambiguous identification of the item(s) calibrated.
- g. Date of receipt of the calibration item(s) where this is critical to the validity and application of the results, and the date(s) of performance of the calibration.
- h. Reference to the sampling plan and procedures used by the laboratory or other bodies where these are relevant to the validity or application of the results.

NOTE: The calibration report or certificate might not reference a sampling plan as sampling plans rarely apply to calibration; sampling plans normally are used in testing laboratories.

- i. The calibration results with, where appropriate, the units of measurement.
- j. The name(s), function(s) and signature(s) or equivalent identification of person(s) authorizing the calibration report or certificate.
- k. Where relevant, a statement to the effect that the results relate only to the items calibrated.
- l. The conditions (e.g., environmental) under which the calibrations were made that have an influence on the measurement results.
- m. The uncertainty of measurement or a statement of compliance with an identified metrological specification or clauses thereof.

NOTE: A calibration report or certificate that contains a statement of compliance to original manufacturer's specifications (with any exceptions or limitations noted) may satisfy this requirement.

- n. Evidence that the measurements are traceable.

**5.7.4 Calibration Certificate or Report Amendments.** Amendments to the calibration certificate or report after issue shall be made in the form of a separate document including the statement, "Supplement to Calibration Report (or calibration certificate)" and shall include the identifying number of the original report or certificate. Supplements shall meet all the requirements of original reports or certificates.

**5.7.4.1** Amendments are required for any event such as the identification of defective calibration equipment, that casts doubt on the validity of results given in any calibration report, certificate or amendment. Such amendments shall quantify the magnitude of error in the calibration results.

**5.7.5 Calibration Certificate or Report Confidentiality.** The issuing laboratory staff shall follow documented procedures ensuring confidentiality is preserved where customers require transmission of calibration results by telephone, telex, facsimile or other electronic means.

## **5.8 AFTO FORM 249, TMDE CALIBRATION DATA.**

The AFTO Form 249 has been deleted, but may be used until exhausted. The PMEL should use a locally-generated chart meeting the requirements of this TO and the applicable calibration procedure.

## **5.9 AFTO FORM 250, TMDE CALIBRATION CORRECTION CHART.**

The AFTO Form 250 has been deleted, but may be used until exhausted. The PMEL should use a locally-generated chart meeting the requirements of this TO and the applicable calibration procedure.

## **5.10 MEASUREMENT STANDARD DECALS.**

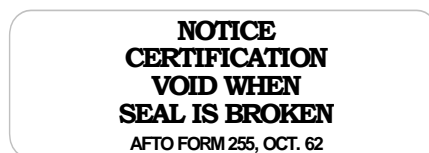
Equipment that is certified as an Air Force Measurement Standard or a Base Measurement Standard shall be identified with the appropriate decal established for this purpose. TO 33K-1-100-CD-1 identifies Base Measurement Standards.

**5.10.1 Gold Decal.** The gold Air Force Measurement Standard Decal and a certification label shall be affixed to standards possessed and used by the AFPSL as a basic measurement standard for the Air Force.

**5.10.2 Blue Decal.** The blue Base Measurement Standard Decal and a certification label shall be affixed to standards that are possessed and used by a PMEL as a Base Measurement Standard, and designated as such in TO 33K-1-100-2. PMEL personnel who certify or possess the standard shall affix the decal. The base measurement standard decal shall not be affixed to working standards calibrated by the possessing PMEL. The blue decals may be obtained from the AFPSL.

## **5.11 AFTO FORM 255, NOTICE CERTIFICATION VOID WHEN SEAL IS BROKEN.**

The AFTO Form 255 (see Figure 5-9) label or an alternate method listed below shall be applied to operator accessible controls or adjustments on standards and other TMDE, which if moved, will invalidate the calibration. If a panel must be removed to access controls or adjustments, they are not considered operator accessible. Apply this label sparingly and reserve for critical locations or TMDE susceptible to tampering. If label is broken or shows signs of tampering, the certification is void. Equipment shall be scheduled for certification unless situations addressed in exceptions paragraph apply. This label shall be validated with a K stamp of PMEL technician. Any non-PMEL organization applying the label can use inspection or production stamp or the initials of the responsible certifying technician. Do not cover the face of this label with any kind of tape that would defeat the purpose of the label. Alternate methods, such as sealant or manufacturer's calibration/warranty void seals, may be used at the option of the responsible calibrating work center to seal TMDE if the AFTO Form 255 cannot be applied satisfactorily.



**Figure 5-9. AFTO FORM 255, Notice Certification Void When Seal Is Broken Label**

**5.11.1 Exceptions** If the seal is broken accidentally, or to perform organizational maintenance such as cleaning or replacing fuses, pilot lights, batteries, or other minor hardware items, an identification tag such as an AFTO Form 350 shall be attached noting the reason, date, and OWC supervisor's signature. Recertification shall not be accomplished if calibration accuracy is not in question

## **5.12 AFTO FORM 45, REQUEST FOR CALIBRATION RESPONSIBILITY DETERMINATION.**

### **NOTE**

Ensure the *Request for Calibration Responsibility Determination*, AFTO Form 45 (see Figure 5-10), is **not** submitted for equipment owned and used by departments outside the Air Force. Such a customer is responsible to give the PMEL the capability to support new equipment, if the PMEL does not already have it.

The PMEL, with the assistance of the user of new TMDE, shall initiate the *Request for Calibration Responsibility Determination*, AFTO Form 45 (see Figure 5-12), to ensure that the AFMETCAL Program can support the particular item of TMDE. This information is required to enable the PMELs, the 562 CBSG and the inventory managers to obtain support equipment and write any calibration procedures for calibration and maintenance of the item. If inadequate data are submitted with the form and determination of responsibility cannot be made, the request may be returned. Many TMDE items also have accessories that require calibration; therefore, when submitting requests for calibration determinations, include data on any accessories that may require calibration so they can be included in the calibration determination. Electronic input of the AFTO Form 45 and supporting tech data through METWEB is preferred. Alternatively, the initiating PMEL shall complete the top portion of the form and forward the form to the 562 CBSG/GBSA or email to [AFMETCALAFTO22.45@afmetcal.af.mil](mailto:AFMETCALAFTO22.45@afmetcal.af.mil) (See METWEB "TO SUPPORT HOME" page). The PMEL shall retain a copy. When received, the 562 CBSG shall complete the form and make a copy available electronically on METWEB. Blocks marked with an asterisk (\*) are mandatory and shall be completed.

### **NOTE**

The submitted AFTO Form 45 must be current and properly addressed. AFTO Form 45s that are out of date and obsolete may be returned for re-submittal. The METWEB "TO SUPPORT HOME" page has the applicable web links.

**5.12.1 PMEL PORTION Blocks.** The blocks in the request portion of the form shall be completed by the PMEL, with the assistance and coordination of the user (see AFMAN 23-110), in the following manner:

- a. **MODEL/PART NUMBER/TYPE.** (Mandatory) Enter the manufacturer's model designation, part number or similar data. Provide all data available.
- b. **MANUFACTURER.** (Mandatory) Enter the name of the manufacturer of the item.
- c. **SERIAL NUMBER.** (Mandatory) Enter serial number of the item.
- d. **NOMENCLATURE.** (Mandatory) Enter nomenclature of item.
- e. **APPLICABLE MAINTENANCE MANUAL.** Identify the maintenance TO that applies to the unit.
- f. **NATIONAL STOCK NUMBER** (Mandatory) Enter the national stock number of the item. If not available, enter date stock number was requested.
- g. **QUANTITY.** Enter the quantity to be supported by the PMEL, if known.
- h. **WEAPON SYSTEM(s) OR END ITEM SUPPORTED.** (Mandatory) Identify the system or end item being supported. (e.g., F-16C or AN/ALQ-131V3)
- i. **ALLOWANCE SOURCE CODE.** (Mandatory) Enter the allowance source code (ASC) corresponding to system or item supported that was used to obtain this item. If none, explain in remarks the specific authority used to obtain the item (Maintenance T.O., commercial data, etc.).
- j. **LOCAL PURCHASE.** (Mandatory) Check the block for items locally purchased. The user is responsible for providing the PMEL any items required for maintenance and calibration of any item locally purchased. Before buying any items locally, the potential owner shall contact the PMEL to determine if PMEL support will require any additional equipment, supplies or data. See user responsibilities in Section 3.



- k. **WORK STOPPAGE.** Check if this refers to work stoppage due to a lack of this item, not the inability to calibrate this item.
- l. **ITEM ON HAND.** Check if the item is on hand in the PMEL or is available on call. Use the **PROJECTED CAL DUE DATE** to inform the 562 CBSG of the month and year the calibration procedure will be needed.
- m. **PROJECTED CAL DUE DATE (MO/YR).** Enter the projected date the item is expected to require calibration again.
- n. **SUPPORTING PMEL / PHONE / ADDRESS / BASE / COMMAND.** (Mandatory) Enter the name, phone, address and command of the PMEL submitting the request
- o. **USER NAME / PHONE / EMAIL / OWC/AGENCY / CMD/ORG / BASE/CITY.** (Mandatory) Enter the user's point of contact name, phone and email. Also enter the owning work center code, agency, command, organization, base and city.
- p. **NAME / PHONE / EMAIL OF REQUESTING INDIVIDUAL.** Enter name, Defense Switched Network (DSN) or commercial telephone number, and email address of PMEL point of contact in case further data is necessary.
- q. **SUPPORTING DATA SUBMITTED.** (Mandatory) Check the appropriate block. Identify specific items of commercial data submitted along with this form in the **REMARKS** block. If you reference a website, provide the site address in the **REMARKS** block. The 562 CBSG needs all available data to make the responsibility determination. It is also needed to write an adequate calibration procedure if the request results in a determination that the PMEL is responsible for calibration and repair of the item. If not enough data is submitted, a calibration responsibility determination cannot be made and the request shall be returned as "INSUFFICIENT DATA" without a final determination. The 562 CBSG shall ensure that all data are returned to the PMEL/user as soon as possible. **SUPPORTING DATA RECEIVED** and **DATE DATA RECEIVED** will be filled in by the 562 CBSG once the form and data arrive.
- r. **REMARKS.** One type of comment to include here is a calibration responsibility determination that the PMEL or user would recommend and include your reasons for the recommendation. Your PMEL knows who can best support the item. Include remarks regarding the actual measurement to be made, the owning organization, its capability to support the item, and what system the equipment is to be used on. Include any other comments the PMEL thinks may help the evaluator make the calibration determination. Include applicable work unit code(s) (WUC) whenever they exist for that part number.
- s. **REQUEST DATE.** Enter the date of the request.

**5.12.2 562 CBSG PORTION Blocks.** 562 CBSG personnel shall complete the following blocks:

- a. **562 CBSG CONTROL #.** Enter the applicable control number.
- b. **OPR ORG.** Enter the organizational symbol for the 562 CBSG office that shall serve as OPR for this request.
- c. **OPR NAME / PHONE / EMAIL.** Enter the name, DSN or commercial telephone numbers, and email address of the person that shall be OPR for this request.
- d. **DATE RECEIVED.** Enter date received by the OPR ORG.
- e. **RESPONSIBILITY DETERMINATION.** Check the block or fill in the responsibility determination.
- f. **NEW PROCEDURE REQUIRED.** Check the appropriate block.
- g. **WUC IS.** Enter the assigned WUC.
- h. **CALIBRATION INTERVAL IS.** Enter the initial calibration interval for this part number or model.
- i. **CALIBRATION AUTHORITY IS.** Enter the calibration authority if calibrated.
- j. **MAINTENANCE MANUAL IS.** Enter one, if one exists. It may provide useful data.

- k. REMARKS. This block is used to explain rationale behind the entry in one of the previous two blocks. Give specific reasons why a determination cannot be made or explain why a specific determination was made.
- l. ITEM. Check appropriate blocks.
- m. NON-TMDE. Check if item is not TMDE according to definition in TO 00-20-14 and is not PMEL responsibility. If this block is checked, the item under consideration is the responsibility of the USER for support.
- n. SUPERVISOR. Written name of supervisor of person called out above.
- o. RESPONSE DATE. Enter the date the calibration responsibility determination is made.

<b>REQUEST FOR CALIBRATION RESPONSIBILITY DETERMINATION</b>				<b>OMB NUMBER</b> 0704-0188	
Public reporting burden for this collection of information is estimated to average 6 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information including suggestions for reducing this burden to Department of Defense, Washington Headquarters Services, DIOR, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302 and to OMB, Paperwork Reduction Project (0704-0188), Washington DC, 20503. Please DO NOT RETURN your form to either of these addresses. Send your completed form to 562 CMSG/GBSA, 813 Irving-Wick Dr W, Bldg 2, Heath Ohio 43056-1199.					
<b>PMEL PORTION</b>				<b>(*) MANDATORY</b>	
MODEL/PART NUMBER/TYPE*		MANUFACTURER*		SERIAL NUMBER*	
NOMENCLATURE*				APPLICABLE MAINTENANCE MANUAL*	
NATIONAL STOCK NUMBER*	QUANTITY	WEAPON SYS(s) OR END ITEM SUPPORTED*		ALLOWANCE SOURCE CODE*	
LOCAL PURCHASE* <input type="checkbox"/>	WORK STOPPAGE <input type="checkbox"/>		ITEM ON HAND <input type="checkbox"/>	PROJECTED CAL DUE DATE (MO/YR)	
SUPPORTING PMEL			USER		
PHONE*			NAME*		
ADDRESS*			PHONE*		
			EMAIL*		
BASE*			OWC/AGENCY*		
COMMAND*			CMD/ORG*		
			USER BASE/CITY*		
REQUESTING INDIVIDUAL			SUPPORTING DATA SUBMITTED* <input type="checkbox"/>		
NAME*			SUPPORTING DATA RECEIVED* <input type="checkbox"/>		
PHONE*			DATE DATA RECEIVED*		
EMAIL*					
REMARKS					
MAIL TO: 562 CMSG/GBSA, 813 IRVING-WICK DR W, BLDG 2, HEATH OHIO 43056-1199					
REQUEST DATE*					
<b>562 CMSG PORTION</b>					
OPR NAME			PHONE		
OPR ORG			EMAIL		
CONTROL NUMBER			DATE RECEIVED		
RESPONSIBILITY DETERMINATION IS	<input type="checkbox"/> CANNOT BE MADE DUE TO INSUFFICIENT TECHNICAL INFORMATION. A DETERMINATION WILL BE MADE IF YOU SUBMIT THE NEEDED INFORMATION. SEE REMARKS.			NEW PROCEDURE REQUIRED <input type="checkbox"/> YES <input type="checkbox"/> NO	
WUC IS	CALIBRATION INTERVAL IS	CALIBRATION AUTHORITY IS	MAINTENANCE MANUAL IS		
REMARKS					
ITEM <input type="checkbox"/> WILL BE <input type="checkbox"/> WILL NOT BE <input type="checkbox"/> ALREADY IS <input type="checkbox"/> LISTED IN T.O. 33K-1-100 <input type="checkbox"/> LISTED IN CMS _____					
NON-TMDE <input type="checkbox"/> ITEM IS NOT TMDE ACCORDING TO DEFINITION IN TO 00-20-14, DOES NOT REQUIRE CALIBRATION AND IS "USER" RESPONSIBILITY					
SUPERVISOR				RESPONSE DATE	

AFTO FORM 45, 2007XXXX

PREVIOUS EDITION IS OBSOLETE

Figure 5-10. AFTO FORM 45, Request For Calibration Responsibility Determination.

**5.13 AFTO FORM 57, PMEL TECHNICAL ORDER INFORMATION.**

The AFTO Form 57 (see Figure 5-11) is for the PMEL to record data relative to a calibration procedure that pertains to their peculiar situation. It shall be filed in the folder holding the pertinent calibration TO. This form is not required with each TO. It is to be completed to the degree (and when) PMEL personnel feel is necessary or as needed. Also, it shall not be used in place of AFTO Form 22 action. The following guidance is provided for entries on this form:

**NOTE**

The technician shall verify information entered on the AFTO Form 57 prior to using such information.

- a. Block 1, MAINTENANCE TO INFORMATION. Enter the part number and maintenance TO for the different models or part numbers covered by the procedure in the appropriate blocks.
- b. Block 2, ADDITIONAL ITEMS REQUIRED FROM THE OWC. Enter any additional ancillary items or equipment that must be supplied by the OWC to facilitate repair or calibration of the TMDE entered in Block 1.
- c. Block 3, LOCATION OF TEST FIXTURES. Enter the PMEL storage location of test fixtures required for repair or calibration of the TMDE entered in Block 1.
- d. Block 4, SUITABLE SUBSTITUTES FOR STANDARDS REQUIRED IN CALIBRATION PROCEDURES. Enter the part number of all TMDE listed in the procedure that is not locally available and the part number of the substitute standard in the appropriate blocks.

**NOTE**

Ensure required uncertainty ratios are maintained when substituting standards during calibration.

- e. Block 5, AFTO FORM 22 INFORMATION. Enter all AFTO Form 22 information as necessary to identify deficiencies in the procedure. Enter date submitted, paragraph affected, and name of technician submitting the AFTO Form 22 as a minimum.

**NOTE**

Approval of an AFTO Form 22 is not justification to deviate from published technical data IAW TO 00-5-1.

- f. Block 6, ALTERNATE PROCEDURE INFORMATION. Enter any information that shall allow the technician to locate or perform approved alternate procedures.
- g. Block 7, PECULIARITIES OF TMDE OR CALIBRATION PROCEDURE. Enter any information that will assist the technician during calibration of the TMDE.
- h. Block 8, HIGH FAILURE COMPONENTS. Enter any components that are considered high failure items or components that are difficult to identify (Part Number and NSN) in the appropriate blocks.

**5.13.1 Continuation Sheets.** Continuation sheets can be attached as necessary.

PMEL TECHNICAL ORDER INFORMATION			
<b>1. MAINTENANCE TECHNICAL ORDER INFORMATION</b>			
<b>A. PART NUMBER</b>	<b>B. MAINTENANCE TECHNICAL ORDER</b>	<b>A. PART NUMBER</b>	<b>B. MAINTENANCE TECHNICAL ORDER</b>
<b>2. ADDITIONAL ITEMS REQUIRED FROM THE OWNING WORK</b>			
<b>3. LOCATION OF TEST FIXTURES</b>		<b>4. SUITABLE SUBSTITUTES FOR STANDARDS REQUIRED IN CALIBRATION PROCEDURES</b>	
		<b>A. TMDE CALLED FOR</b>	<b>B. SUBSTITUTE ITEM</b>
<b>5. AFTO FORM 22 INFORMATION</b>			
<b>6. ALTERNATE PROCEDURE INFORMATION</b>		<b>7. PECULIARITIES OF TMDE OR CALIBRATION PROCEDURE</b>	
<b>8- HIGH FAILURE COMPONENTS</b>			
<b>A. PART NUMBER</b>	<b>B. NOMENCLATURE</b>	<b>C. NATIONAL STOCK NUMBER</b>	

AFTO FORM 57, 19960301 (EF-V2)

**Figure 5-11. AFTO FORM 57, PMEL Technical Order Information.****5.14 AF FORM 537, PMEL SHIPPING LABEL.**

The AF Form 537 (not pictured) shall be used as prescribed when TMDE is shipped from one PMEL to another for calibration/repair and return.



## SECTION 6

### PMEL REPORTS: RCS HAF-ILM(SA) 7808 and RCS HAF-ILM(A) 9450

#### 6.1 PMELs Using PAMS.

No separate reporting is required from PAMS users. The 562 CBSG can extract all of the 7808 and 9450 information directly from the PAMS server.

#### 6.2 PMELs Not Using PAMS.

The 7808 (utilizing an AFTO Form 80) and 9450 reports shall be submitted to the 562 CBSG by 31 January of each year for the period 1 January - 31 December. The reports shall be prepared in accordance with the instructions found on the Customer Support Home page of METWEB.

**6.2.1 Maintenance Data Collection (MDC) of PMELs Not Using PAMS.** This data is used by the 562 CBSG to analyze reliability of TMDE semi-annually for possible adjustment of calibration intervals. Data for the period 1 January - 30 June must be sent by 31 July. Data for the period 1 July - 31 December must be sent as an attachment to the 7808 and 9450 reports by 31 January. Data may be submitted on 3 1/2" disks in regular or compressed format, or emailed as an attachment to [afmetcal.mdc@afmetcal.af.mil](mailto:afmetcal.mdc@afmetcal.af.mil). This is also documented on the Customer Support Home page of METWEB.

PRECISION MEASUREMENT EQUIPMENT LABORATORY REPORT										OMB No. 0704-0188	
										REPORTS CONTROL SYMBOL	
										RCS:	
Public reporting burden for this collection of information is estimated to average 6 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302; and to OMB, Paperwork Reduction Project (0704-0188), Washington DC 20503. Please DO NOT RETURN your form to either of these addresses. Send your completed form to AFMETCAL, DET 1/MLSP, 913 Irving Wick Dr W, Ste 4M, Heath Ohio 43056-6116.											
TO										AS OF DATE	
<b>I. WORKING ACTIVITY</b>											
1. MAJOR AND INTER COMMAND			2. BASE			3. UNIT			4. ORGANIZATION SYMBOL		
5. DSN			6. COMMERCIAL PHONE			7. EXTENSION			8. PMEL BUILDING NUMBER		
9. DATE OF LAST PMEL EVALUATION						10. CERTIFICATION DATE					
11. PMEL SUPERINTENDENT'S NAME AND RANK (Typed)						12. PMEL SUPERINTENDENT'S SIGNATURE					
<b>II. WORKLOAD</b>											
13. TMDE INVENTORY SUPPORTED FOR											
AF		ANG		AFRES		ARMY		NAVY		COAST GUARD	
										14. TOTAL	
15. TMDE INVENTORY ANALYSIS											
SCHEDULED				UNSCHEDULED							
PMEL		DEPOT		NCR		NPCR		CBU		STORAGE	
										OTHER	
										TOTAL	
16. WORKLOAD ANALYSIS ACTION TAKEN (Past six months)											
ACTION TAKEN		F		G		J		K		OTHER	
										TOTAL	
17. ACTIVITIES SUPPORTED											
UNIT DESIGNATION		MAJCOM AGENCY		LOCATION		PMEL		DEPOT		TFCU	
										ONSITE	
										MOB	
										WRM	
PMEL OWNED											
<b>III. PERSONNEL</b>											
18. MILITARY						19. CIVILIAN					
CAFSC		UDL AUTH		PMEL ASGD		ASGD FROM MAINT		SERIES AND GRADE		UDL AUTH	
										PMEL ASGD	
										ASGD FROM MAINT	
2P001											
2P001											
2P071											
2P051											
2P031											
OTHER											
TOTAL											
20. NUMBER ASSIGNED PERFORMING DIRECT LABOR (Technicians)											
<b>V. SELF SUFFICIENCY</b>											
ATTACH A LIST OF ITEMS SENT TO SOME OTHER AGENCY FOR CALIBRATION											

AFTO FORM 80 1 JAN 97 (REV 1) (Replaces AFM 80-1) PREVIOUS EDITION IS OBSOLETE

Figure 6-1. AFTO FORM 80, Precision Measurement Equipment Laboratory Report





## **SECTION 7**

### **PMEL ASSESSMENT AND CERTIFICATION PROGRAM**

#### **7.1 GENERAL.**

As directed by AFI 21-113, the 562 CBSG is the Air Force focal point for the AFMETCAL Assessment and Certification Program. It maintains a system to assess and certify calibration laboratories for compliance with this TO and other Air Force directives. The Assessment and Certification Program objective is to assess the capability of each PMEL to perform measurements that are safe, accurate, reliable, and traceable through the AFPSL to the National Institute of Standards and Technology (NIST) or other 562 CBSG approved sources. An AFMETCAL Program Certificate of Compliance is awarded when a PMEL meets assessment criteria.

#### **7.2 ASSESSMENT INTERVALS.**

The assessment team will assess each PMEL approximately every 24 months. Some short tour locations are assessed annually. Out-of-cycle assessments may be performed as required. The MAJCOM FAM will notify 562 CBSG/QP within 30 days of contract award or facility relocation so an assessment can be scheduled.

#### **7.3 CERTIFICATION PROCESS.**

There are three stages in the PMEL certification process: Preassessment, On-site Assessment, and Certification review.

**7.3.1 Preassessment.** This includes a review of the PMEL documentation to assess compliance with this TO and other Air Force directives.

**7.3.1.1** All laboratories shall submit the following:

- a. Current Quality Manual. If a significant portion of the Quality Manual information is sub-located in another policy document or continuity book, include documents with preassessment data.
- b. Master inventory data (when requested). This data shall be provided with the following headings in Excel spreadsheet format (not required if using PAMS 6.0):
  - (1) ID Number
  - (2) Part Number
  - (3) Work Unit Code
  - (4) Noun/nomenclature
  - (5) Date Calibrated
  - (6) Date Due Calibration
  - (7) Calibration Interval
  - (8) Certifying Technician K-Stamp Number
  - (9) Owning Work center
  - (10) Performing Work center
  - (11) K-Area
  - (12) Calibration Technical Order number or Technical Data identifier
  - (13) Status (AWM, INW, AWP, Awaiting pickup, etc.)
  - (14) Working Standard Field Designator
- c. Internal Audit/Management Review reports with resulting corrective actions and follow-up documentation.
- d. Previous 12 months of QP Summary Data as detailed in Section 9.
- e. Copies of critical nonconformity worksheets and documents essential to understand the nonconformity.

- f. Trend analysis documents for previous 12 months, with any resulting corrective actions and follow-up documentation.
- g. Environmental data summary for previous 12 months.
- h. A listing by K-Stamp number of the technicians qualified in each measurement area.

**7.3.1.2** Preassessment documentation shall be submitted in electronic format and through electronic means, to the greatest extent possible. On-site assessment shall normally occur after the preassessment documentation is reviewed by 562 CBSG/QP.

**7.3.2** On-site Assessment. As a minimum the on-site assessment shall assess:

- a. The PMEL implementation of their documented quality system. Includes compliance with the PMEL Quality Manual and/or additional PMEL policy/procedure documents (e.g., continuity books, work instructions, etc.). Includes all the documentation and effectiveness of their Internal Audit and Management Reviews.
- b. Measurement Capability Assessment (MCA): This shall include, but not be limited to processes for calibrating standards and TMDE; application of metrology principles and procedures; and condition and use of PMEL standards. The Assessment Team Chief, based on scope of calibrations performed and number of certifying technicians, shall select processes. The Assessment Team Chief shall provide PMEL management with a copy of the assessment plan during the in briefing. Each TFCU and on-site operation shall also be subject to assessment and the results combined with the main PMEL to produce a final result.
- c. Compliance with QP requirements.
- d. Compliance with facility requirements.
- e. Compliance with environmental requirements.
- f. Proficiency Testing/ Measurement Assurance Program (PT/MAP).
- g. Corrective actions resulting from previous on-site assessments.

**7.3.2.1** PMEL Notification. The 562 CBSG shall provide the maximum practical advance notice to the affected command of the plan to visit their installation. The MAJCOM PMEL FAM shall notify the PMEL to be visited and all other interested parties of the following information: purpose of the visit, assessment team identity, and their arrival and departure dates.

**7.3.2.2** Arrival Support Needed. The following information and support shall be available when the assessment team arrives:

- a. The PMEL Quality Manual, and referenced quality documents.
- b. Full names, grades, titles, and mailing addresses of commanders and/or senior level managers.
- c. PMEL floor plan annotated with room, square footage and location of ECS monitors.
- d. Environmental charts since the last on-site assessment, and Environmental Outage Log as detailed in paragraph 8.2.2.
- e. Copies of open facility and ECS work requests.
- f. Copies of command or local publications applicable to the operation of the PMEL.
- g. All records since the last on-site assessment applicable to the PMEL QP. This includes documentation of root cause analysis for all critical nonconformities identified and trend analysis performed.
- h. Geodetic survey data.
- i. Documentation of facility ground measurements.
- j. RADIAC Program documentation (if applicable).
- k. Records of qualifications, training, skills and experience for all assigned personnel.
- l. Transportation, billeting, and other assistance as required.

- m. Completed customer surveys since the last assessment.
- n. Copies of PMEL support agreements.

**7.3.2.3 On-site Team Actions.** The assessment team shall:

- a. Upon arrival, brief PMEL personnel and the highest level commander (or designated representative) on the installation having jurisdiction over the PMEL to explain the purpose of the visit and assessment criteria to be used.
- b. Perform the assessment.
- c. Prior to departure, brief PMEL personnel and the highest-level commander (or designated representative) on the installation having jurisdiction over the PMEL on the preliminary findings of the on-site assessment.

**7.3.2.4 Findings:** Findings will be documented as noteworthy, observation, problem (corrected) or problem as follows:

- a. Noteworthy: A finding that exceeds requirements and is considered highly effective and beneficial to the laboratory/program.
- b. Observation: A minor deficiency that does not directly affect accuracy or traceability; a recommendation that may improve products, processes, or services; and positive comments. An observation does not affect certification and does not require a response from the PMEL. However, when a large number of observations are noted and the cumulative effect may be detrimental to the quality of PMEL products, processes, or services, the assessment team may document the overall situation as a problem.
- c. Problem (Corrected): A problem that was corrected by the PMEL while the assessment team was still on site.
- d. Problem: A deficiency or non-compliance with published directives that affects the PMEL's ability to perform safe, accurate, reliable and traceable measurements.

**7.3.3 On-site assessment of Torque Calibration and Repair Site (TCS).** As a minimum, the on-site assessment shall assess:

- a. Measurement Capability Assessment. Approved torque standards properly certified; technical competence of qualified TQS calibration technicians; nonconformity rate observed, both product and process quality; records of individual qualifications; current technical orders on-hand and used; environmental conditions met.
- b. Quality Program. Certification Roster, maintained listing of qualified personnel; quality review/process review sample rates and log/record; adequate QP versus MCA results; documented corrective actions.
- c. Facility and Environment. Facility must support traceable measurements (adequate lighting and space); environment maintained within 73 degrees Fahrenheit plus or minus 9 degrees F; and 15 to 70 percent relative humidity during periods of use; chart recorders calibrated and properly placed; environmental records maintained between 562 CBSG assessments.

**7.3.4 Certification Review.** Certification review begins upon completion of the on-site assessment. During this period, all PMELs shall be in a status of "certification pending" until the Commander of the 562 CBSG renders a certification decision that is published in the final evaluation report. During certification review, the Certification Office shall validate assessment findings and review short-term PMEL corrective actions. On completion of the certification review, the Certification Office shall forward a recommendation to the Commander of the 562 CBSG to certify, withhold, keep the PMEL in pending status or close the PMEL.

**7.3.4.1 Certification Criteria.** The following criteria shall be assessed to determine if a PMEL meets the minimum requirements. Findings shall be compiled from objective evidence in these areas:

- a. Quality System Documentation. The QS shall meet all the requirements of this TO.
- b. Measurement Capability Assessment. The PMEL shall demonstrate the capability to perform traceable measurements.
- c. Quality Program. The QP shall meet all requirements of this TO.

- d. Facility. The facilities shall comply with operational requirements of this TO and applicable Air Force directives.
- e. ECS. The ECS shall comply with operational requirements of this TO and applicable Air Force directives.
- f. PT/MAP. Documentation and measurement results shall comply with the requirements of this TO.

**7.3.4.2 Certification Decision.** The 562 CBSG shall certify the PMEL when assessment results and any corrective actions demonstrate the PMEL is compliant with this TO. When assessment results indicate that the PMEL does not meet certification criteria, the 562 CBSG may convene the PMEL Certification Panel and/or take one or more of the following actions:

- a. Certify the PMEL.
- b. Determine specifically what is needed to bring the PMEL to full capability.
- c. Initiate corrective action within the capability of the 562 CBSG.
- d. Notify the Air Staff and the major command of the reasons for considering the PMEL incapable, any limitations imposed, the actions required to achieve certification, and recommendations for obtaining calibration support pending completion of corrective actions.
- e. Conduct technical assistance visits to aid in resolving problems when requested by the major command.
- f. Withhold the PMEL certification until the problems identified during the assessment are corrected.
- g. Recommend the assessment team perform a follow-up on-site assessment. The 562 CBSG shall coordinate this action with the affected MAJCOM.
- h. Recommend closure.

#### **7.4 PROFICIENCY TESTING/MEASUREMENT ASSURANCE PROGRAM (PT/MAP).**

PMELs shall be required to complete proficiency testing as directed by the 562 CBSG. Proficiency testing results may be based on PMEL compliance with completion and return of Exchange Standard Intercomparison Data Sheets found in TO 33K-2-11, data collected upon PMEL receipt and processing of exchange or transfer standards, or testing performed on a unique measurement artifact. The AFMETCAL Assessment and Certification Program shall consider the results of proficiency testing as objective evidence, along with Preassessment and on-site assessment findings, of the PMEL's ability to perform competent calibrations.

**7.4.1** Proficiency Testing on unique artifacts is the process used to assess laboratory performance by means of comparing and evaluating calibrations or tests on a measurement artifact. If a PMEL is selected for Proficiency Testing on a unique artifact, Paragraphs 7.4.1.1 through 7.4.1.4 will apply.

**7.4.1.1** Measurement artifacts for selected measurement areas shall be distributed to PMELs by the AFPSL based on a schedule determined by the 562 CBSG. The number of proficiency tests required of each PMEL annually will vary depending on the availability of measurement artifacts, but shall not exceed six (6) artifacts per PMEL annually.

**7.4.1.2** Artifact testing shall be scheduled by the AFPSL on behalf of the 562 CBSG. PMELs shall be notified in advance as to the approximate arrival date of the measurement artifact. Instructions for performing the test, reporting results, notifying the 562 CBSG and the AFPSL and shipping will be included with the measurement artifact.

**7.4.1.3** The PMEL shall be required to perform measurements on an artifact using the same calibration methods used to calibrate customer equipment or methods directed by the 562 CBSG. The PMEL shall report results as indicated in the PT/MAP instructions and data sheets provided by the 562 CBSG. The PMEL is expected to complete proficiency testing of a measurement artifact within the time allotted in the PT/MAP instructions. The measurement artifact shall not leave the PMEL unless otherwise directed by the PT/MAP instructions.

**7.4.1.4** Unless otherwise stated in the PT/MAP instructions, the performance of the proficiency test is judged by calculating the error, normalized with respect to the uncertainty, of the measurement as follows:

$$E_{\text{normal}} = \left| \frac{Value_{\text{PMEL}} - Value_{\text{ref}}}{\sqrt{Uncertainty_{\text{PMEL}}^2 + Uncertainty_{\text{ref}}^2}} \right|$$

Where

$E_{\text{normal}}$  = normalized error of the PMEL

$Value_{\text{PMEL}}$  = the value as measured by the PMEL

$Value_{\text{ref}}$  = the value as measured by the AFPSL (reference laboratory)

$Uncertainty_{\text{ref}}$  = the overall uncertainty of the AFPSL (reference laboratory)

$Uncertainty_{\text{PMEL}}$  = the overall uncertainty of the PMEL (e.g., Measurement uncertainty that would be provided to a customer)

Note: All Values and Uncertainties shall be expressed in the same units. To pass the proficiency test the PMEL shall have a value for  $E_{\text{normal}}$  less than 1 (e.g.,  $E_{\text{normal}} < 1$ ).

**7.4.2** The 562 CBSG shall notify the PMEL of their proficiency testing results. If a PMEL has been certified prior to the completion of the proficiency test, the status of the certification may change as a result of a failed proficiency test. The PMEL certification status may be changed to reflect a partial certification or completely suspended pending the PMEL's ability to successfully complete the proficiency test at a later date.

## **7.5 CERTIFICATION STATUS.**

PMEL certification status shall be specified in the final assessment report as one of the following:

**7.5.1 Certified.** A PMEL whose quality system documentation, MCA, QP, PT/MAP, facilities and ECS demonstrate the PMEL has the capability to perform accurate and traceable measurements shall be issued a Certificate of Compliance at the conclusion of the on-site assessment. The certificate, combined with the final assessment report, is proof of compliance with this TO and other applicable Air Force directives. The Certificate of Compliance shall remain in effect unless revoked by the 562 CBSG. All previous certificates are void when final certification status is certified, withheld or recommended for closure. Certification shall be reassessed if the contractor changes or the PMEL relocates to a different facility (Facility may include RASCAL units and on-site operations used as an extension of the main PMEL). 562 CBSG certification is proof of AFMETCAL Program compliance and should not be confused with third-party accreditation under commercial guidelines.

**7.5.2 Certification Pending.** Draft evaluation reports are considered unofficial "pending review". The final evaluation report may reflect a final status of pending when further data or action is required. A previously issued Certificate of Compliance remains in effect during this period. A final status of pending will change to withhold if the required data of action is not accomplished by deadlines specified in the final report.

**7.5.3 Certification withheld.** The PMEL failed to demonstrate the capability to consistently perform safe, accurate, reliable and traceable measurements. In most cases, calibrations may continue under increased surveillance of the problems or measurement areas that resulted in withhold. Refer to the final evaluation report. In other instances, the final evaluation report may require a Corrective Action Plan (CAP) prior to certification. A CAP shall be requested when identified problems require a formal response from the PMEL or base leadership. When requested, the CAP shall be provided to the 562 CBSG within 60 calendar days of the final report date. The CAP shall contain as a minimum: the documented problem(s), detailed corrective actions, and a time schedule for resolution of the problem(s).

**7.5.4 Not certified, recommended for closure.** Problems in quality system documentation, MCA, QP, facility, ECS, or PT/MAP prevent the PMEL from making accurate and/or traceable measurements and resolution is not expected.

**7.6 ASSESSMENT REPORTS.**

The assessment team shall prepare a report for each assessment.

**7.6.1 Report Content.** The report shall concisely and clearly describe the effectiveness of the quality system documentation, MCA, QP, facility, ECS, and PT/MAP.

**7.6.2 Report Distribution.** The 562 CBSG shall distribute one copy of the report for all PMEL assessments to the Wing Commander (or equivalent) and the affected major command. For laboratories not certified, one copy of the final report shall be forwarded to HQ USAF/A4MM, the affected MAJCOM, and the Wing Commander (or equivalent). An electronic copy of all final reports shall be maintained at the 562 CBSG.

**7.7 APPEAL PROCESS.**

The PMEL may appeal any finding or comment in the assessment report or the decision of the 562 CBSG by forwarding relevant information to the 562 CBSG. The 562 CBSG/CC may convene the PMEL Certification Panel for advice. The subsequent decision of the 562 CBSG/CC is final.

## SECTION 8

### PMEL FACILITY OPERATIONAL REQUIREMENTS

#### NOTE

This section does not contain PMEL design criteria. They are contained in AFMAN 32-1094, *Criteria for Air Force Precision Measurement Equipment Laboratory Design and Construction*, and AFI 32-1024, *Standard Facility Requirements*. PMEL managers and their senior leadership should encourage local civil engineering to coordinate with/seek assistance from HQ Air Force Civil Engineer Support Agency (AFCESA) Field Support (CEM) in the early design stages of any PMEL facility or environmental control system construction, modification or upgrade project.

#### 8.1 GENERAL REQUIREMENTS.

This section contains PMEL facility operating parameters and/or notes concerning environment, power, lighting, air filtration, air locks, controlled areas, cleaning area, flooring, ceilings and other subjects. One purpose of this section is to ensure that PMELs placed in buildings not built according to AFMAN 32-1094 meet minimum requirements. This section also contains some of the general information needed to determine space requirements within some of the laboratory areas. The data in this section provides guidance for the day-to-day operation of the PMEL as it relates to the facility. PMEL management shall make every effort to establish and maintain the PMEL facility in a condition facilitating proper performance of calibrations/verifications.

**8.1.1 Design Criteria.** AFMAN 32-1094 contains the design criteria for Type II( ) and Type III PMELs on Air Force installations and shall be complied with when modifying or repairing an existing PMEL, or designing a new PMEL facility. PMEL designs and layouts shall be evaluated on an individual basis and shall depend upon mission requirements. These criteria shall not be used as sole justification to improve facilities if conditions of existing facilities do not adversely affect the environmental requirements or mission performance of the PMEL. Assistance for determining facility requirements may be obtained from 562 CBSG/GBFA. Each PMEL shall maintain a file reflecting any deviation from AFMAN 32-1094, which was approved by 562 CBSG and/or HQ AFCESA.

#### 8.1.2 Coordination of Plans for Facility Projects.

**8.1.2.1** When any PMEL or major command first decides to build a new PMEL or modify an existing PMEL, 562 CBSG/GBFA shall be provided all justification available so 562 CBSG/GBFA can update long range planning and ensure interservice coordination of applicable projects. 562 CBSG/GBFA shall forward appropriate comments and recommendations to the command headquarters.

**8.1.2.2** When a project is approved for construction of a new facility or modification/improvement of an existing facility, the PMEL superintendent shall ensure that the command's PMEL functional area manager is placed on distribution and provided with a copy of the design criteria, specifications and drawings.

**8.1.2.3 PMEL Power Requirements.** PMEL power requirements are listed in AFMAN 32-1094. Equipment, which is critically sensitive to line voltage variation, shall require additional voltage regulation through use of bench type regulators and/or filters.

**8.1.2.4 Grounding Requirements.** The ground in the PMEL shall be checked to ensure it has retained its validity per AFI 32-1065 (once every two years). Measurement techniques for grounds are shown in TO 31-10-24. PMEL management shall maintain a copy of inspection forms provided by Civil Engineering IAW AFMAN 32-1065.

**8.1.2.5 Geophysical Surveys.** Most PMELs require certain geophysical surveys to be performed. AFI 14-205 gives information about obtaining these surveys. These surveys are only required when any of the following subparagraph measurement capabilities are required. Surveys are as follows:

- a. World Geodetic System of 1984: Geodetic positions, Latitudes and Longitude in degrees, minutes, and seconds. Required in order to perform accurate time measurements. Loran C requires a minimum 10 arc seconds accuracy for latitude and longitude.
- b. International Gravity Standardization Net of 1971 (IGSN 71): Gravity information in milligals. The required accuracy for use with dead weight piston pressure standards is 5 mGals. As long as the PMEL does not move, there is no need for an update. If your PMEL has moved to a new location, then your force

and pressure standards shall be recalibrated using the new gravity value before they can be used to obtain maximum accuracy.

- c. Astronomic Data. Astronomic azimuth in degrees, minutes and seconds. Needed if the PMEL is supporting north-seeking gyrocompass units. Accuracy needed is 10 arc seconds or less.

## **8.2 PMEL ENVIRONMENT.**

TO 33K-1-100-CD-1 identifies the measurement restrictions of measurement standards. To ensure measurement accuracy, it is necessary to maintain continuous control of the environment in which the measurement standards are maintained. Temperature, humidity, dust, vibration and electromagnetic interference can each have a detrimental affect on the ability of a standard to ensure measurement accuracy of TMDE. Each of the environmental factors impact calibration and repair operations to a different degree. It is a fact that most standards change value with a change in temperature. The temperature limits placed on the PMEL ensure that the measurement confidence level meets the needs of some of the more precise equipment. Humidity control is becoming a very significant environmental need in the PMELs, especially at the lower humidity levels because of the potential for electrostatic discharge (ESD) damage to integrated micro circuitry, as well as its interference with sensitive measurements. Therefore, a PMEL whose environment goes outside the limits for temperature and humidity cannot ensure calibration accuracy and/or presents an operating hazard to some element of the measurement setup. The calibration procedures may provide other restrictions.

**8.2.1 PMEL Environmental Control System (ECS) Effectiveness.** The ECS shall maintain the laboratory environment so that each room used for calibration meets requirements at least 90% of the time. When the PMEL ECS cannot maintain environmental specifications 90% of the time or more, aggressive action on the part of PMEL/upper-level management is required. Excessive out-of-tolerance periods can contribute to equipment degradation, production slow-downs or stoppages. PMELs may seek assistance from the Civil Engineering Maintenance Inspection Repair Team (CEMIRT) through their local Civil Engineering for assistance with long-term out-of-tolerance conditions.

**8.2.2 ECS Outages.** Laboratory management shall ensure nothing listed as environmentally sensitive is to be calibrated during environmental outages, unless special provisions are made, documented, and the documentation kept on file. An \*Environmental Outage Log shall summarize environmental data for each environmental monitor to include:

- a. Total hours recorded.
- b. Total hours temperature above applied limits.
- c. Total hours temperature below applied limits.
- d. Total hours relative humidity above applied limits.
- e. Total hours relative humidity below applied limits.
- f. Total hours overlap (both temperature and relative humidity outside limits).
- g. Total hours of missing data (e.g., dry pens, clock stopped, chart overrun).
- h. Reason and Fix for outage.

\*Not required if recorded in PAMS Environmental Log.

**8.2.3 PMEL Operational Environment.** The following operational environmental requirements apply only to a PMEL area where calibration/repair is performed. Particular care shall be taken when calibration/repair is performed at a site other than the permanent PMEL premises. Keep in mind these are operational requirements, not design requirements.

**8.2.3.1** Present measurement needs dictate the operational temperature in the PMEL facility shall be controlled as follows, unless the calibration procedure specifies other restrictions:

**8.2.3.1.1** Calibration and Repair area. A temperature of 73°F  $\pm$  6°F (22.8°C  $\pm$  3.3°C) in the calibration and repair areas of Type II or III PMELs, except for the 68°F dimensional calibration area.



**8.2.3.1.2** Dimensional 68°F Calibration and Repair area. A temperature of 68°F  $\pm 1.0^\circ\text{F}$  (20°C  $\pm 0.56^\circ\text{C}$ ) shall be maintained in the 68°F dimensional area of PMELs where 68°F dimensional areas are authorized (see paragraph 10.3). The 68°F dimensional calibration area criteria is based on the need for a closely controlled environmental area for calibration and use of higher accuracy dimensional TMDE. By international agreement the true size and shape of an object is that which exists at a uniform temperature of 68°F (20°C).

**8.2.3.2** An optimum operational humidity level is 35% RH. The relative humidity shall not be allowed to go lower than 20% RH or exceed 50% RH in any Type II or Type III PMEL.

**8.2.3.3** Temperature and humidity shall be monitored and recorded continuously. Span calibrations are encouraged for recorders used to monitor the environment in calibration areas. The span shall cover the operational requirement of the PMEL. The following rules apply to temperature and humidity recorders:

- a. Recording devices monitoring 68 °F calibration and repair areas shall be calibrated a minimum of  $\pm 0.5^\circ\text{F}$ ,  $\pm 5\%$  RH.
- b. Recording devices monitoring 73 °F calibration and repair areas shall be calibrated a minimum of  $\pm 2.0^\circ\text{F}$ ,  $\pm 5\%$  RH.
- c. If a computerized system is used to record environmental data, the time between data samples shall not exceed 15 minutes.
- d. Daily or weekly charts shall be used when not using computerized or roll type recording devices.

**8.2.3.3.1** A recording device is required for each 2000 ft<sup>2</sup> of calibration and repair area or per room if smaller than 2000 ft<sup>2</sup>.

**8.2.3.3.2** Recording device(s) shall be located in close proximity to areas where the most stringent calibrations are performed. Locate the recording device so that exterior wall temperature, high heat producing equipment and supply air do not adversely affect the recorder indication.

**8.2.3.3.3** Psychrometer readings (accomplished IAW established calibration procedures for hygrothermographs) shall be accomplished weekly (usually at the time of chart change) to check the accuracy of the recorder. The start and stop dates, standard thermometer reading and psychrometer readings (wet bulb and calculated humidity) shall be annotated on each chart.

**8.2.3.3.4** For those recorders not requiring weekly chart changes (e.g., continuous roll type graph or other electronic recorder), a psychrometer check is only required after any of the following instances:

- a. Quarterly
- b. Graph paper is changed (if the recorder uses graph paper)
- c. If any malfunction is suspected

If logging psychrometer readings on recorders of this type is impractical, a log may be substituted for recording the readings. Should the psychrometer readings indicate a recorder is outside its rated accuracy for either temperature or relative humidity, the recorder shall then be recalibrated. It is also recommended that the environmental charts for each area monitored be filed in separate folders to facilitate periodic review. Span calibrations are encouraged for recorders used to monitor the environment in calibration areas. The span shall cover the operational requirement of the PMEL.

#### NOTE

If the temperature and humidity chart recorder meets required accuracy and is calibrated through the entire span of the PMEL applicable temperature and humidity range, psychrometer readings are not required.

**8.2.3.3.5** Some recorders are slow responding. Differences between the psychrometer and recorder do not necessarily mean adjustments are required. Ensure the psychrometer is used properly and take a number of readings. Adjust the recorder only if repeated comparisons indicate the need.

**8.2.3.4** Because the measurement accuracy of many standards is affected by environmental changes, the environment shall be maintained within the foregoing environmental criteria (limits). This includes periods when

the PMEL is not in operation but items are being "soaked" prior to calibration. When this is not possible, the following applies:

- a. When the environmental system regains control, the PMEL environment shall be allowed to reach stability. Humidity out-of-tolerance conditions do not require a soak time, but metallic surfaces may require cleaning during and after periods of high humidity. The stable condition starts when the temperature excursions remain within the  $73^{\circ}\text{F} \pm 6^{\circ}\text{F}$  range ( $68^{\circ}\text{F} \pm 1^{\circ}\text{F}$  for the dimensional area) and repeatable measurements can be made. This time is sufficient for all measurements except as follows:
  - (1) Optical Flats (7 inches in diameter and larger): Do not calibrate or use without a "soak" time of 3 hours for every hour the environment is out of tolerance, up to a maximum of 24 hours "soak" time.
  - (2) Linear dimensions (1 inch and shorter): For accuracies better than  $\pm 0.0001$  inch, provide a "soak" time of one and one-half hours for each hour the environment is out of specification to a maximum of 12 hours prior to calibration or use of instruments.
  - (3) Linear dimensions (longer than 1 inch): For accuracies of  $\pm 0.0001$  inch/inch through  $\pm 0.001$  inch/inch, provide a "soak" time of one and one-half hour for each hour the environment is out of tolerance up to a maximum of 12 hours prior to calibration or use. For accuracies better than  $\pm 0.0001$  inch/inch, provide a "soak time" of three hours for each hour the environment is out of tolerance up to a maximum of 24 hours.
  - (4) In each temperature case identified above, the total "soak" time shall be equal to that specified, plus any waiting time that may be required to achieve repeatability of readings.
- b. PMEL operations affected by humidity shall cease as long as the humidity is out of specifications. No trouble shooting/repair shall be performed on ESD vulnerable (CMOS-MOSFETs-MOS) solid-state equipment when the humidity falls below 20% unless the following occurs: The use of ion generators may provide an acceptable environment for a localized area such as a workbench with a low ESD potential. This would permit repair and calibration on the bench even though the rest of the calibration and repair area is below the 20% humidity level. The PMEL shall periodically monitor the operation of ion generators to ensure the ion generator is providing safe ESD environmental conditions. ESD control procedures are described in MIL-HDBK-263, MIL-STD-1686, and TO 00-25-234.

### **8.3 TMDE ENVIRONMENTAL RESTRICTIONS.**

PMELs shall conform to the maintenance TO, calibration TO, or manufacturer's data regarding any environmental limitations or temperature coefficients of any item used in a measurement setup. The calibration TO may state specific environmental conditions which shall be met for the calibration.

### **8.4 DUST LEVELS.**

Dust is an enemy that makes it difficult to make accurate measurements in some measurement areas. The easiest way to keep dust out of the PMELs calibration and repair area is to have a positive airflow from the environmental system and/or locate the PMEL within an area of a building, which is relatively dust-free. Ensuring the filters in the ECS are clean is another major factor in keeping dust levels down. Vacuum cleaning, use of lint free dust cloths, and reduction of horizontal plane surfaces minimizes the effects of dust. Devices producing dust or residue particles from grinding or abrasion shall not be installed in, or used in, the calibration and repair area of the PMEL.

### **8.5 NOISE.**

It is recommended that the noise level in the PMEL be no greater than 70 dB. AFOSHSTD 48-19, *Hazardous Noise Program*, Chapter 2, identifies hazardous noise exposure limits.

### **8.6 VIBRATION.**

The PMEL areas where calibration is performed shall be maintained as vibration free as possible. The cause of vibration, which affects the repeatability of TMDE, shall be identified and reduced to acceptable levels. The PMEL shall notify 562 CBSG/GBNA & /GBEBA of any vibration problems that cannot be solved. An acceptable vibration level for a PMEL is anything less than 0.25 mm (10  $\mu$  in) from 0.1 to 30 Hz (displacement peak). The maximum acceleration peak is 0.001 G for frequencies from 30 Hz to 200 Hz.

## **8.7 ELECTROMAGNETIC INTERFERENCE (EMI)/RADIO FREQUENCY INTERFERENCE (RFI).**

EMI that causes degradation of equipment performance and disruption of calibration shall be suppressed or eliminated to the maximum extent possible.

**8.7.1 New PMEL Facilities.** The effects of EMI to PMEL equipment shall be minimized through the selection of locations for new PMEL facilities where the ambient radio frequency (RF) field strengths from 10 kHz to 18 GHz shall not exceed 1 V/m external to the proposed facilities. An electromagnetic compatibility (EMC) survey shall be performed for each proposed PMEL facility site. The results of the EMC survey shall be used to determine site suitability. The surveys shall be performed by the 85 EIS/SCYM in accordance with ACCI 33-104, *Engineering Installation (EI) Procedures*. Upon completion of the EMC survey, a formal engineering report shall be supplied to both the PMEL customer and 562 CBSG/GBFA.

**8.7.2 Existing PMEL Facilities.** EMI that causes degradation of equipment performance or disruption of calibration at existing sites shall be eliminated or suppressed to the maximum extent possible. The PMEL shall report apparent EMI problems to the 85 EIS/SCYM in accordance with AFI 10-707, *Air Force Spectrum Interference Resolution Program*. The 85 EIS shall provide on-site assistance in determining the source(s) of the EMI and propose solutions for the elimination or suppression of the EMI. Upon completion of the EMI survey a formal engineering report shall be provided to both the PMEL customer and 562 CBSG/GBFA.

**8.7.3 Obtaining Related Assistance.** An EMI or EMC survey shall be obtained through a request to the 85 EIS/SCYM at the following location:

85 EIS/SCYM  
670 Maltby Hall Dr, Ste 234  
Keesler AFB MS 39534-2633

Voice: DSN 597-3920 Comm 228-377-3920  
FAX: DSN 597-3956 Comm 228-377-3956

## **8.8 LIGHTING.**

**8.8.1 General Lighting.** The general lighting for all occupied areas shall be balanced to minimize shadows and produce uniform illumination.

**8.8.2 Minimum lighting.** Minimum lighting levels are specified to reduce the need for additional lighting fixtures in the calibration and repair area because they become dust collectors and can interfere with setting up a measurement capability. Proper illumination is required to perform precision measurements.

**8.8.3 Uniform Illumination.** Uniform illumination is defined as a distribution of light at the measured height where the maximum and minimum general illumination in the immediate work area (e.g., bench top, test set up) is not more than one-sixth above or below the average illumination in the area.

**8.8.4 Measurement of Lighting.** The average room illumination for general lighting shall be measured after 100 hours of use in the calibration and repair area at the level of the horizontal working surface of the PMEL bench and in the administrative areas at desktop level. The surface shall be free of items and adjacent personnel during the measurement to minimize shadows on the light meter sensor. The illumination level can drop drastically during the initial burn-in time.

### **Absolute Minimum**

- |                                   |                    |
|-----------------------------------|--------------------|
| a. Calibration/Repair/Dimensional | 50 Foot Candle(FC) |
| b. Cleaning                       | 50 FC              |
| c. Office and Administrative      | 50 FC              |
| d. Technical Library              | 50 FC              |
| e. Training Room                  | 50 FC              |
| f. Receiving, Issue               | 50 FC              |
| g. Bench Stock                    | 20 FC              |
| h. AWM/AWP Holding                | 10 FC              |
| i. Stairways, Corridors, Airlock  | 20 FC              |
| j. Elevators, Shipping Dock       | 20 FC or *         |

- k. Restroom, Utility, Storage 10 FC or \*

\* Not less than 1/5 of the brightest adjacent traffic area.

**8.8.5 Supplementary Lighting.** Additional general lighting shall be used for tasks that are difficult to perform within the ambient light level.

**8.8.6 Lighting Fixtures.** Fluorescent lamps shall be used wherever possible to conserve energy. Relamping of fluorescent luminaries shall be done using new fluorescent lamps of a white or daylight variety. They shall have an initial rated lumen output after 100 hours use of not less than 98% of the Illuminating Engineering Society rating for a cool white T-12 medium bipin lamp in the luminaire size lamp. Areas having special spectral emission requirements shall be lamped accordingly.

**8.8.7 Energy Conservation.** Lighting may be turned off during non-working hours providing:

**8.8.7.1** Due consideration is given to the effects on air conditioning reheat systems to ensure that energy is used efficiently by turning off the lights.

**8.8.7.2** Environmental limits can be maintained with the lighting turned off.

## **8.9 DOORS & WINDOWS.**

All windows and unused doors or other openings shall be sealed to prevent non-conditioned air infiltration and dust contamination from outside. Doors opening into the PMEL shall be designed and arranged to maintain effective dust and temperature controls. The doors for personnel passage shall be held to a minimum consistent with fire and safety regulations. A building with no windows in the calibration and repair area of the building is preferred because of the potential effect of the direct sunlight on measurement. There may be windows in the calibration and repair area as long as they are not in outside walls of the building because direct sunlight in the PMELs could cause higher temperature in small areas.

## **8.10 AIR LOCKS.**

Air locks shall be constructed at the entrance to the calibration and repair area of the PMEL. An exception can be made if the PMEL is contained inside another environmentally controlled building and the PMEL calibration and repair area has positive air pressure in relation to the outside environmentally controlled area. Shoe cleaners with a self-contained vacuum system (or external vacuum system) shall be located where they will be most effective in reducing contamination that might be carried into the calibration and repair area of the PMEL. Air locks and shoe cleaners are not required for Type IV PMELs. Carpeting shall not be installed in air locks due to possibility of the carpeting interfering with the operation of air lock doors.

## **8.11 CONTROLLED AREAS.**

**8.11.1 Dedicated Laser Room.** Any laser system that would interfere with or cause a safety problem for adjoining operations shall be placed in a dedicated room or area. The base bioenvironmental engineer can assist in determining the need for a separate room. Also refer to AFOSHSTD 48-139, *Laser Radiation Protection Program*. Size and configuration of the area depends upon the laser system. The HP 5528A is a typical laser not requiring a dedicated room.

**8.11.2 Other Measurement Area.** The PMEL shall define and control access to areas where unnecessary presence (electrostatic) or excessive body heat (68 degree room) may affect quality.

## **8.12 FLOORING.**

Selection of a floor covering for the calibration area is based on the characteristics of durability, resilience, ease of maintenance, and electrical insulation properties. Light colors are recommended due to their reflection. Carpeting is not permitted due to dust collection and ESD concerns. A high grade of commercial vinyl plastic floor covering material of continuous length is preferred. Installed asphalt, rubber, vinyl asbestos or vinyl tile that is in serviceable condition may continue to be used. Deteriorating vinyl asbestos tile may become a hazard. Contact your local bioenvironmentalist if the vinyl asbestos tile begins to deteriorate. Tile seams shall be flush and tight. Coved corners and edges are desirable to simplify cleaning. The continuous length floor covering provides a higher resistance to ground than the individual tiles and it simplifies the cleanup of hazardous materials such as mercury spills. Floors shall not be waxed due to dust and safety hazards. An electrostatic dissipative sealant may be used.

**8.13 FURNITURE AND FIXTURES.**

All furniture and fixtures shall be of a design that prevents accumulation of dust and facilitates cleaning. Working surfaces shall be resistant to heat, chemicals, chipping, or other deterioration. Cabinets or lockers will be flush mounted, if possible.

**8.14 FMS TYPE IV AND TYPE II ( ) PMEL FACILITY REQUIREMENTS.**

The following Type IV PMEL and supporting Type II ( ) PMEL facility requirements are in support of FMS customers only.

**8.14.1 F-15 Type IV PMEL Requirements.****8.14.1.1 Electrical Power.**

- a. 200 wye/115 +3-7 VAC, 3 Phase, 4 wire, 400  $\pm$ 20 Hz, 10 KVA.
- b. 120 VAC  $\pm$ 10% 1 Phase, 3 wire, 60  $\pm$ 6 or 50  $\pm$ 3 Hz, 20 KVA.
- c. 240 VAC  $\pm$ 10% 1 Phase, 3 wire, 60  $\pm$ 6 or 50  $\pm$ 3 Hz, 10 KVA.
- d. Grounding shall be in accordance with AFMAN 32-1094, measurement techniques per TO 31-10-24.

**8.14.1.2 Lighting.** (See paragraph 8.8.)

**8.14.1.3 Temperature and Humidity Controls.** A temperature of 73°F  $\pm$ 9°F and humidity control of 15 to 70% RH shall be maintained in the calibration and repair areas. The measurement restrictions of Table 2 in TO 1F-15A-37 apply. Temperature and humidity shall be continuously monitored and recorded.

**8.14.1.4 Floor Space.** Minimum space to support one ESS is 1,634 ft<sup>2</sup>. Two ESSs require 2234 feet<sup>2</sup>. This may vary if the unit has been mobilized. If the Type IV is consolidated into the Type II, this is the additional space that could be required in the Type II.

**8.14.1.5 Additional Requirements.**

**8.14.1.5.1** Capping of unmated connectors is not required.

**8.14.1.5.2** A portable or central vacuum cleaning system is required to clean TMDE and for general housecleaning. Cleaning TMDE within the calibration/repair area is acceptable, but is restricted to use of vacuum, small brushes, and small hand-held nontoxic spray-and-wipe cleaning. Where toxic fumes, excessive dust, or other safety hazards exist, cleaning shall be accomplished in an approved area outside the calibration and repair area. This includes devices containing mercury, such as manometers and barometers.

**NOTE**

Eating or drinking in the Type IV is permitted only in a designated area set aside for that purpose. A designated eating area is not authorized in the Type IV if an existing break area is convenient. No calibration or repair is permitted in that area.

**8.14.2 F-15 Supporting Type II ( ) PMEL Requirements.**

**8.14.2.1** A 16' X 15' floor area is required within the calibration/ repair area to accommodate a 6' X 3' granite surface plate and a line-of-site area for optical calibration of a HUD Mount Alignment Adapter. Floor loading beneath the surface plate shall be capable of supporting the surface plate (3,000 pounds), a granite angle block (1,500 pounds) plus other ancillary equipment. Total loading is for 5,000 pounds. The surface plate is mounted on either a tripod or a quadruped stand with four inch rectangular feet. Casters are normally provided on the stand.

**8.14.2.2** An increase in workload of approximately 300 items of F-15 related support equipment could be expected in the Type II.

**8.14.3 F-16 Type IV PMEL Requirements.****8.14.3.1 Electrical Power.**

- a. 200 wye/115 +3-7 VAC, 3 Phase, 4 wire, 400  $\pm$ 20 Hz, 10 KVA
- b. 120 VAC  $\pm$ 10% 1 Phase, 3 wire, 60  $\pm$ 6 or 50  $\pm$ 3 Hz, 20 KVA.

- c. 240 VAC  $\pm 10\%$ , 1 Phase, 3 wire, 60  $\pm 6$  or 50  $\pm 3$  Hz, 10 KVA.
- d. Grounding shall be in accordance with AFMAN 32-1094, measurement techniques per TO 31-10-24.

**8.14.3.2 Temperature and Humidity Controls.** Temperature shall be maintained between 73  $\pm 9^\circ\text{F}$  and humidity shall be maintained between 15 and 70% RH. These temperature and humidity limits differ from those of the Type II PMEL in order to permit use of the least restrictive facility requirements. These limits allow full use of the equipment. Temperature and humidity shall be continuously monitored and recorded.

**8.14.3.3 Floor Space.** Minimum area for one set is 1040 ft<sup>2</sup>, two sets is 1,600 ft<sup>2</sup>. If the Type IV is consolidated into the Type II, this is the additional space that could be required in the Type II.

**8.14.3.4 Lighting.** (See paragraph 8.8.)

**8.14.3.5 Additional Requirements.**

**8.14.3.5.1** Capping of unmated connectors is not required.

**8.14.3.5.2** A portable or central vacuum cleaning system is required to clean TMDE and for general housecleaning. Cleaning TMDE within the calibration/repair area is acceptable, but is restricted to use of vacuum, small brushes, and small hand-held nontoxic spray-and-wipe cleaning. Where toxic fumes, excessive dust, or other safety hazards exist, cleaning shall be accomplished in an approved area outside the calibration repair area. This includes devices containing mercury, such as manometers and barometers.

#### **NOTE**

Eating or drinking in the Type IV is permitted only in a designated area set aside for that purpose. A designated eating area is not authorized in the Type IV if an existing break area is convenient. No calibration or repair is permitted in that area.

**8.14.4 F-16 Supporting Type II( ) PMEL Requirements.**

**8.14.4.1** Type II( ) PMELs supporting the F-16 may require additional floor space to accommodate a 3' X 6' surface plate and stand. A surface plate of this size shall require a working area approximately 15 X 16 feet. Floor loading beneath the surface plate shall be capable of supporting approximately 5000 pounds (the 3500 pound surface plate plus ancillary blocks).

**8.14.4.2** Additional workspace may be required in a Type II PMEL supporting an F-16 ESS. An increase in workload of approximately 200 items of F-16 related support equipment can be expected in the Type II.

**8.15 ENVIRONMENTAL LIMITS FOR USNS OBSERVATION ISLAND AND RASCAL.**

**8.15.1** USNS Observation Island environmental operating limits are as follows:

- a. Temperature = 73  $\pm 6^\circ\text{F}$ .
- b. Humidity = 15% RH to 70% RH.

**8.15.2 RASCAL** environmental operating limits are as follows:

- a. Temperature = 73  $\pm 6^\circ\text{F}$ .
- b. Humidity = 20% to 50% RH.

## **SECTION 9**

### **QUALITY PROGRAM (QP)**

#### **9.1 QUALITY PROGRAM.**

The QP is a significant part of the overall quality system. The purpose of the QP in the AFMETCAL Program is to ensure weapon system safety, accuracy, reliability and traceability. The QP accomplishes two primary functions; collect PMEL quality data and use that data. First, PMEL personnel referred to as PMEL Quality Assurance (PQA) evaluators collect data to provide management personnel an overall picture of quality system effectiveness. PMEL management shall designate highly qualified PQA evaluators in writing. PQA evaluators shall not review their own products or processes. Second, PMEL supervisors and managers use the collected QP data to proactively monitor and control the quality of PMEL products and processes. By using QP data to identify the most significant problems and negative trends, managers can implement corrective actions to eliminate or minimize these problems and trends. All QP activity shall be thoroughly documented.

#### **9.2 TYPES OF REVIEW.**

There are three types of reviews. Two of these reviews focus on the quality of the product. They are Quality Reviews (QR) and Standard Reviews (SR). A critical nonconformity discovered during QRs and SRs may be a negative indicator of laboratory performance. It means that a piece of TMDE or a laboratory standard has a product quality defect. The third type of review, the Process Review (PR), is a management tool for internal investigation and process improvement and shall not be used or reported as an indicator of laboratory performance. Finding PR nonconformities is a first step in preventing QR and SR nonconformities. Because USAF PMEL workload is so diverse, it is impractical to sample enough TMDE to ensure end-of-line quality. Reviews under the QP are intended to sample PMEL production, categorize the defects and determine the biggest problem areas in the PMEL. Management is then able to focus improvement efforts on the most significant laboratory problems. The QP is not intended to fix individual equipment deficiencies. Technicians, supervisors and PQA personnel find and fix individual defects in the course of their daily activities.

#### **9.3 QUALITY REVIEW.**

A QR is a complete review of TMDE produced or certified. The QR alone does not sample enough TMDE to assess the overall quality of PMEL production. However, it does reveal product quality defects that may be the result of a faulty laboratory process. These defects point management toward areas that require further investigation using root cause analysis.

**9.3.1** TMDE shall be randomly selected and completed at a rate averaging no lower than 3 percent of production subject to QR per any 12-month period. The following MDC Action Taken codes are subject to QR: A, B, F, G, J, K, V, X (except QRs), and NRTS codes 0-9. ATE and TMDE calibrated on site are subject to the same selection criteria and method of review. A QR may be bypassed only when extraordinary reasons prevent completion. PMEL Management shall document, in the PMEL QM, the local policy for bypassing QRs and document a method of pre-selecting TMDE for QR that are inherently difficult to sample after certification (e.g. off-base, priority, jet engine test stand, etc).

**9.3.2** The QR includes the following:

- a. Safety compliance.
- b. Full parameter verification.
- c. Physical condition.
- d. Documentation (e.g. forms, labels, task qualification, etc.)
- e. Traceability (e.g. standards, reports, technical data, environment, facility, etc.)

**9.3.3** PMEL management shall document the procedures to be followed when full parameter verification is not performed. Although full parameter verification may not be possible on all items selected for QR, the review shall be performed even when the PMEL process did not include calibration. For example:

- a. Items with NRTS action taken codes shall be verified to ensure the NRTS action is appropriate.

- b. Items processed with 'G' action taken codes require verification that the item was properly repaired and that the repair did not affect calibration. This may include performing parameter verification.
- c. Items shipped to or from off-base support shall be reviewed for operation, damage, documentation and compliance with TO 33K-2-11.

#### **9.4 STANDARD REVIEW.**

The SR is a complete review of standards certified by PMEL and used to calibrate other TMDE. The SR alone does not sample enough laboratory standards to assess overall quality. However, it does reveal product quality defects that may be the result of a faulty laboratory process. These defects point management toward areas that require further investigation using root cause analysis. A minimum of one percent of all in-use standards shall be selected randomly at the beginning of each month and completed in the month selected. For PMELs with fewer than 100 standards, a minimum of one standard per month shall be randomly selected and completed. Targeted standard reviews may be accomplished, but they will not count toward the 1 percent requirement. An SR may be bypassed only when extraordinary reasons prevent completion. PMEL Management shall document, in the PMEL QM, the local policy for bypassing SRs. The SR includes the following:

- a. Safety compliance
- b. Full parameter verification
- c. Physical condition
- d. Documentation
- e. Traceability (e.g., standards, reports, technical data, environment, facility, etc.)

#### **9.5 SAMPLING RATES.**

PMEL managers shall perform and document review of QR and SR sampling rates during trend analysis. Consider adjusting rates when negative or positive quality trends are observed, when changes occur in the overall skill level of the workforce, or when there are changes in the TMDE workload.

#### **9.6 PROCESS REVIEW.**

The PR is a management tool used to target PMEL processes for investigation and improvement. The PR is not a revival of the "over-the-shoulder" concept. The primary focus of the PR is to review the process. If a technician is observed performing a process incorrectly, the subsequent investigation should focus on why the technician did not or could not properly perform the process.

**9.6.1** Use the PR to actively seek out and document procedural problems in order to correct them. PQA evaluators shall observe the selected process as it normally occurs, evaluate other objective data (MIS entry, interviews, etc.) and document any process improvement opportunities.

**9.6.2** Generate a PR as follows:

- a. As a step in root cause analysis for every QR and SR critical nonconformity. The PQA evaluator shall observe the certifying technician perform the suspect process without divulging the nonconforming condition. The PR may include the entire calibration process, selected steps, or support processes and any objective data as necessary to determine why the nonconformity occurred and if the normal process is sufficient. For example, a PQA evaluator discovers a spectrum analyzer to be out of tolerance for flatness; the PQA evaluator should observe the technician performing the flatness calibration to determine if the technician's process identifies the nonconformity and/or the process requires improvement. Interaction and discussion between PQA evaluator and technician should begin after the suspect task is completed. If the certifying technician is not available (e.g., PCS/TDY; no longer employed), perform the PR on another qualified technician to evaluate the laboratory's suspect process.
- b. All K-stamp holders shall participate in at least one PR of a calibration process every 12 months. Management shall ensure these PRs evaluate training and metrology skills appropriate to the technician's position (e.g., a full calibration of an item they typically calibrate). Again, this review is intended to discover faulty laboratory processes or identify training deficiencies.



- c. At management's discretion to target any portion of any process. Examination of a process may involve one or more PRs as necessary to collect sufficient data.

### **9.7 NONCONFORMITY (NC).**

Assigned NC codes are used in trend analysis to determine the most significant problems in the PMEL. By acting on the most significant problems, management improves overall PMEL performance. An item or process may have more than one NC and each NC shall be assigned a NC code. There are four NC classifications:

- a. Critical quality NC (QNC). Deficiencies discovered during QRs and SRs that affect safety, accuracy, reliability or traceability.
- b. Non-critical QNC. Minor QR or SR quality defects that may be tracked for trend analysis. The AFMETCAL program does not require PMELs to report non-critical NCs in their QP activity summary. The category is provided for the convenience of PMEL management.
- c. Critical process NC (PNC). Deficiencies discovered during PRs that could affect safety, accuracy, reliability or traceability. Used by internal PMEL management to improve PMEL processes and by 562 CBSG to verify the laboratory's Quality Program effectiveness.
- d. Non-critical PNC. Minor process defects that may be tracked for trend analysis. The AFMETCAL program does not require PMELs to report non-critical NCs in their QP activity summary. The category is provided for the convenience of PMEL management.

### **9.8 ROOT CAUSE (RC) ANALYSIS.**

Accurately classifying the RC code of identified NCs is an important step in the QP. The assigned RC codes are used in trend analysis to determine the most frequent cause of problems in the PMEL. By eliminating or reducing the most significant cause of problems, management improves overall PMEL quality performance. RC codes shall be assigned to all critical NCs. RC analysis is simply applying appropriate steps of the Process Improvement Model to the NC and determining the most accurate RC code. Supervisors and PQA evaluators, and the process owner (normally), perform the analysis. For QRs and SRs, the NC is found after the fact and your analysis relies on the technical expertise and experience available in your PMEL. For PR NCs, the RC is often directly observed by the PQA evaluator. Make every effort to determine the true root cause of the NC and not just a symptom. Avoid simply restating the NC. Usually one "action or inaction" appears to be responsible, but a good RC analysis will address what caused the "action or inaction." Documentation of RC analysis should concisely explain how and why the RC code was selected and what was done to correct the nonconformity. Where the review findings and root cause analysis conclude there is reason to doubt the correctness or validity of calibration results, the PMEL shall take immediate corrective action and initiate established recall procedures as necessary.

### **9.9 TREND ANALYSIS.**

Providing accurate data for trend analysis is absolutely critical. All the work done to this point in the QP is wasted unless management is provided the most accurate NC and RC codes. PMEL management shall periodically review the data collected by the QP and track the most frequent QNC, PNC, and associated RC codes. The use of bar charts is recommended. Non-critical NC codes may also be tracked at the discretion of the manager. Using the Process Improvement Model, management shall act upon the most significant problems and causes in the PMEL. Trend analysis shall be performed and documented at least semiannually.

### **9.10 PROCESS IMPROVEMENT MODEL.**

The process improvement model is only a tool that will help you find the most accurate root cause code and will also help management analyze laboratory trends. During RC analysis, use steps 'a' through 'c' to assign the RC analysis code. The emphasis in RC analysis is to reach the most accurate RC code. During trend analysis use all steps to analyze and correct the biggest laboratory NCs and RCs. The improvement model includes the following steps:

- a. State the NC or trend.
- b. List possible causes for the NC or trend.
- c. Select the most probable cause for the NC or trend.
- d. Propose corrective action(s) that will eliminate or minimize the root cause or trend.

- e. Select the corrective action most likely to eliminate or minimize the root cause or trend.
- f. Implement selected corrective action.
- g. Follow-up and assess the effectiveness of the corrective action. Return to step 'e' if the corrective action was not effective.
- h. Standardize the corrective action within the PMEL. This step may include updating training plans and/or operating procedures to ensure personnel are familiar with new procedures.

#### **9.11 REPORTING REVIEWS.**

QR, SR and PR review forms shall be designed to meet the objective of the applicable review. Retain review forms with critical NCs. The results of each review, with or without NCs, shall be recorded in the PAMS QP log or alternate system. File PRs generated from QR and SR nonconformities with the originating QR or SR. File PRs generated on individuals in a separate PR file. The review documentation for critical NCs shall include the appropriate steps of the process improvement model and shall specifically state if recall of TMDE was initiated or reasoning for not performing a recall. The PQA evaluator shall record the NC and RC codes in PAMS QP Module (or alternate system only if PAMS is not available) and forward the review form per local procedures as outlined in the PMEL QM. If PAMS is used, the following information, at a minimum, must be entered into the PAMS Quality Program: Closeout Date, NC code and RC code. PMEL management shall sign or initial all review forms containing critical NCs and approve/disapprove corrective actions. PMEL management shall document the process for routing of NC review forms in the PMEL QM. All review worksheets shall identify the ID number, Part Number, serial number, and work order/job control number (JCN) as applicable of the TMDE.

#### **9.12 QP ACTIVITY SUMMARY.**

A monthly QP activity summary shall be created and maintained for a minimum of two years or the next 562 CBSG Assessment, whichever is longer. This document is to include the following:

- a. QR.
  - (1) Total production subject to QR.
  - (2) Total number of items selected for QR.
  - (3) Total number of QRs completed.
  - (4) Percent of total production completed for QR (number of QRs completed/total production subject to QR).
  - (5) QR items with critical nonconformities (bar code number and nonconformity codes).
- b. SR.
  - (1) Total number of in-use laboratory standards (calibrated by the laboratory).
  - (2) Total number of SRs completed.
  - (3) Percent of in-use laboratory standards completed for SR (total number of SRs completed/total number of in-use laboratory standards [calibrated by the laboratory] ).
  - (4) SR items with critical nonconformities (bar code number and nonconformity codes).
- c. PR.
  - (1) List of PRs completed by ID number (do not reflect technician name/stamp/employee number).
  - (2) Type of PR: QR/SR Critical NC, Annual, Targeted.
  - (3) NC code assigned.
- d. List of all bypassed reviews with justification.
- e. Total number of certifying technicians (all personnel issued "K" stamps).

### 9.13 NONCONFORMITY AND ROOT CAUSE CODES.

Codes shall be assigned to each identified critical nonconformity and its respective root cause. The purpose of assigning codes is to group similar nonconformities and root causes for trending. Standard nonconformity and root cause codes are listed in table 9-1. These specific codes shall not be changed. However, PMEL managers are authorized to expand on QP codes for local use, for example: "A01" The item is unsafe or hazardous to use. "A01d" could represent "Strap ties not cut flush" or another category useful to your trend analysis. Recommend using your collected QP data to group your most frequent NCs into sub codes rather than diluting your trend data with a large number of sub codes with one or two NCs in each sub code.

**Table 9-1. Summary Of QP Codes.**

<b>Critical Quality Nonconformity (QNC) Codes:</b>	
<b>A01</b>	The item is unsafe or hazardous to use.
<b>A01a</b>	Item has hazardous foreign object inside (could result in damage or injury).
<b>A01b</b>	Item does not comply with TO 33-1-32.
<b>A01c</b>	Item is over-fused.
<b>A02</b>	The item is completely inoperative.
<b>A03</b>	The item has a function that is inoperative.
<b>A04</b>	The item does not meet calibration tolerances/uncertainties for all parameters certified.
<b>A05</b>	The item has a physical defect that affects accuracy or reliability.
<b>A06</b>	The item is not clean and its condition could affect accuracy, reliability or traceability.
<b>A07</b>	The item has a documentation error that affects accuracy or traceability.
<b>A07a</b>	Item is missing a TO directed limitation/annotation that affects safety, accuracy, or traceability.
<b>A07b</b>	Date due extended beyond CMS, K-100, or TO interval.
<b>A07c</b>	Item incorrectly identified.
<b>A07d</b>	Item certified better than calibration authority specifications or laboratory capability.
<b>A08</b>	The item has an intermittent function that affects accuracy, reliability or traceability.
<b>A09</b>	The traceability chain is broken (standards, technical data, calibration report, etc.).
<b>A10</b>	Technician not documented as task qualified, affects accuracy/traceability.
<b>Non-Critical QNC Codes:</b>	
<b>B01</b>	The item has a minor safety related defect.
<b>B01a</b>	Item has non-hazardous foreign object inside.
<b>B02</b>	The item is completely inoperative.
<b>B03</b>	The item has a function that is inoperative.
<b>B04</b>	Reserved.
<b>B05</b>	The item has a physical defect that does not affect accuracy or reliability.
<b>B06</b>	The item is not clean (does not affect accuracy, reliability, or traceability).
<b>B07</b>	The item has a documentation error that does not affect accuracy or traceability.
<b>B08</b>	The item has an intermittent function that does not affect accuracy, reliability or traceability.
<b>B09</b>	Traceability chain potentially broken (standards, technical data, calibration report, etc.)
<b>B10</b>	Technician not documented as task qualified, does not affect accuracy/traceability.
<b>Critical Process Nonconformity (PNC) Codes:</b>	
<b>L01</b>	Technical data incorrect, including calibration procedure, maintenance TO, commercial data, CPIN, etc. (use following sub codes when more accurate)
<b>L01a</b>	Wrong technical data used or technical data not current.
<b>L01b</b>	Technical data used contained an error requiring an AFTO Form 22. (affects safety, accuracy, reliability, or traceability)

<b>Table 9-1. Summary Of QP Codes – Continued.</b>	
<b>Critical PNC Codes-Continued:</b>	
<b>L01c</b>	Automated program/calibration software not validated/verified.
<b>L01d</b>	Automated program/calibration software otherwise incorrect.
<b>L01e</b>	Technical data not used (affects safety, accuracy, reliability, or traceability).
<b>L03</b>	Incoming or outgoing inspections were not performed or incorrectly performed. (affects safety, accuracy, reliability or traceability [FOD, TO 33-1-32, TO 33K-2-11, etc.]).
<b>L05</b>	Complete calibration could not be performed (affects safety, accuracy or traceability).
<b>L06</b>	Standard not used properly. (use following sub codes when more accurate).
<b>L06a</b>	Overdue or uncalibrated standard used.
<b>L06b</b>	Standard incorrectly substituted or test uncertainty ratio not maintained.
<b>L06c</b>	Standard not standardized or incorrectly standardized.
<b>L06d</b>	Standard not configured properly (incorrect setup, settings, connections, cables, loads, etc.).
<b>L06e</b>	Uncalibrated standard used for quantitative measurements (CBU, NCR, ICO w/o source data, etc.).
<b>L06f</b>	Laboratory does not possess standard required for certified specification.
<b>L06g</b>	Standard commercially calibrated without 562 CBSG approval.
<b>L07a</b>	Environment not considered (ignored or not monitored).
<b>L07b</b>	Item was calibrated during an out-of-tolerance environmental condition (affects accuracy).
<b>L07c</b>	Environmental data not properly documented (environmental charts, certification labels, etc.).
<b>L08a</b>	Calibration fixtures, accessories, or tools not used or improperly used.
<b>L09</b>	Technician not task qualified (documentation of skills, training, experience).
<b>L10a</b>	Critical step, note or caution improperly performed, not accomplished, ignored or misinterpreted (affect safety, accuracy, reliability or traceability).
<b>L11</b>	Technician failed to identify out-of-tolerance condition or incorrectly identified in-tolerance indication as out of tolerance.
<b>L12</b>	Test instrument certified better than calibration authority specifications.
<b>L13</b>	Test instrument missing mandatory or TO directed limitation.
<b>L14</b>	Calculations not performed or improperly performed.
<b>L15</b>	Calibration factors or correction charts not used, improperly used or not accomplished.
<b>L16</b>	Documentation improperly performed/omitted, affects accuracy or traceability.
<b>Non-Critical PNC Codes:</b>	
<b>L02</b>	Current technical order not used, or technical order used contained an error requiring an AFTO Form 22 (does not affect safety, accuracy, reliability, or traceability).
<b>L04</b>	Incoming or outgoing inspections not performed or performed incorrectly (does not affect safety, accuracy, reliability, or traceability).
<b>L07d</b>	The item was calibrated during out-of-tolerance environmental condition.
<b>L08b</b>	Calibration fixtures, accessories, or tools not used or were improperly used.
<b>L10b</b>	Non-critical step, note or caution improperly performed, not accomplished, ignored or misinterpreted.
<b>L17</b>	Documentation improperly performed/omitted, does not affect accuracy or traceability.
<b>M01</b>	Item in “Awaiting Parts” status an excessive amount of time.
<b>M02</b>	Replaced parts not documented in MDC.
<b>M03</b>	Incorrect UJC or SRD codes used when ordering parts.
<b>M04</b>	Deficiency report (DR) not submitted for defective parts of defective new item.

<b>Table 9-1. Summary Of QP Codes – Continued.</b>	
<b>M05</b>	Incorrect part(s) ordered or received.
<b>Non-Critical PNC Codes-Continued:</b>	
<b>M06</b>	Part(s) or order an excessive amount of time with no follow-up action.
<b>M07</b>	Part(s) available on bench stock, shop stock or work order residue not used.
<b>P01</b>	Item received dirty or had physical defects that were not documented.
<b>P02</b>	Item received without required documentation, technical data or accessories.
<b>P03</b>	Item received overdue calibration an excessive amount of time.
<b>P04</b>	Item in Awaiting Maintenance, Hold or Deferred status an excessive amount of time.
<b>P05</b>	Item not properly identified in database.
<b>P05a</b>	Part number not in CMS or TO 33K-1-100-2 and AFTO Form 45 not submitted.
<b>P05b</b>	Part number not purged from local K100 (when listed in CMS or TO 33K-1-100-2).
<b>P05c</b>	CMS not used or incorrectly used.
<b>P05d</b>	Data field incorrect.
<b>P06</b>	Item remained in Awaiting Customer status an excessive amount of time.
<b>P07</b>	Item not properly documented or improperly packaged for off-base shipment.
<b>P08</b>	Maintenance schedules or master listings incorrect, not updated or late.
<b>P09a</b>	PMEL coordinator information incorrect.
<b>P09b</b>	PMEL coordinator training not accomplished.
<b>P10</b>	Item improperly handled or stored in laboratory.
<b>Review Status Codes:</b>	
<b>N00</b>	No Defect.
<b>N01</b>	Review in process - not completed.
<b>N03</b>	Review in process over 30 days (or one month) – not completed.
<b>Root Cause (RC) Codes:</b>	
<b>C01</b>	Wrong or invalid calibration technical data used.
<b>C01a</b>	Process of validating technical data not followed or requires improvement.
<b>C01b</b>	Process of maintaining technical data/TO library not followed or requires improvement.
<b>C02</b>	Calibration technical data in error (qualified technician would not detect).
<b>C03</b>	Calibration technical data ambiguous (allows for more than one interpretation).
<b>C03a</b>	Technician aware of technical data ambiguity and did not submit AFTO Form 22.
<b>C04</b>	Technician misinterpreted technical data.
<b>C05</b>	Process for completing AFTO Form 22 not followed or requires improvement.
<b>E01</b>	Temperature monitoring process not followed or requires improvement.
<b>E02</b>	Humidity monitoring process not followed or requires improvement.
<b>F01</b>	Component failure caused degradation or hard failure (normal process would not find).
<b>F02</b>	Failure related to previous faulty maintenance or repair (normal inspection would not find).
<b>F03</b>	Failure related to thermal heating (not evident during normal warm-up).
<b>H01</b>	Human error: When all equipment, technical data, training and other factors are adequate. When another qualified technician would not have made the same error.
<b>H02</b>	Improper Action: When all equipment, technical data, training and other factors are adequate. The technician is fully aware of all requirements, demonstrates task competency, and the process is correct as written. Another qualified technician would not have made the same error and there is clear evidence the technician disregarded policy.

<b>Table 9-1. Summary Of QP Codes – Continued.</b>	
<b>RC Codes-Continued:</b>	
<b>I01</b>	Process inadequate or faulty. Established process for accomplishing the task is faulty.
<b>S01</b>	Standard out of tolerance (normal use would not detect).
<b>S02</b>	Standard overdue calibration (process for scheduling standards not followed or faulty).
<b>S03</b>	Standard limited for the function or accuracy used (process for checking limitations or limiting standards not followed or requires improvement).
<b>S04</b>	Standard intermittently malfunctioning (common metrology practices would not detect).
<b>S05</b>	Accessories or calibration fixtures faulty (common metrology practices would not detect).
<b>T01</b>	OJT insufficient (trainer demonstrates task proficiency).
<b>T01a</b>	OJT not accomplished.
<b>T02</b>	OJT insufficient (trainer does not demonstrate task proficiency).
<b>T03</b>	Incorrect substitution of standards (process not followed or requires improvement).
<b>T04</b>	Basic technical school deficiency.
<b>T04a</b>	Basic technical training not accomplished (process for monitoring entry-level trainees not followed or requires improvement).
<b>T05</b>	Advanced technical school deficiency.
<b>T05a</b>	Advanced technical training required but not accomplished (process for assigning specialized maintenance not followed or requires improvement)
<b>T06</b>	Mathematical skills deficiency.
<b>T06a</b>	Technician unable to calculate required accuracies.
<b>T07</b>	Technician does not demonstrate task competency (task certified in this laboratory).
<b>T08</b>	Technician does not demonstrate task competency (task certified elsewhere).
<b>U01</b>	User responsibility not accomplished (User not trained on responsibilities).
<b>U02</b>	User responsibility not accomplished (User trained on responsibilities).
<b>U03</b>	User did not receive schedules, listings, or documentation required to fulfill responsibilities (process not followed or requires improvement).
<b>U04</b>	Unique mission requirements precluded User from accomplishing responsibilities (PMEL provided maximum assistance and process normally adequate).
<b>U05</b>	User performed unauthorized maintenance on certified test instrument.

## SECTION 10

### AIR FORCE METROLOGY AND CALIBRATION LABORATORIES

#### 10.1 MAJOR COMMAND (MAJCOM) AND AGENCY CODES.

Table 10-1 contains MAJCOM and agency codes\* derived from the AFCA Table Management Distribution System (TMDS) website: [https://tmlds03.scott.af.mil/TMDS/tmlds\\_functional\\_index.xsql](https://tmlds03.scott.af.mil/TMDS/tmlds_functional_index.xsql) (search for Air Force Major Command Code).

**Table 10-1. MAJCOM and Agency Codes.**

MAJCOM/AGENCY	CODE*
Air Combat Command (ACC)	1C
Air Education and Training Command (AETC)	0J
AF Materiel Command (AFMC)	1M
AF Reserves Command (AFRC)	0M
AF Special Operations Command (AFSOC)	0V
AF Space Command (AFSPC)	1S
Air Intelligence Agency (AIA)	0U
Air Mobility Command (AMC)	1L
Air National Guard (ANG)	4Z
Pacific Air Forces (PACAF)	0R
US Air Force Academy (USAFA)	0B
US Air Forces in Europe (USAFE)	0D
US Central Command Air Forces (CENTAF)	3C

#### 10.2 AIR FORCE PRIMARY STANDARDS LABORATORY (AFPSL).

Table 10-2 contains AFPSL basic information. Address is AFPSL, 813 Irving-Wick Dr. W, Ste 4M, Heath OH 43056-6118.

**Table 10-2. AFPSL Site Information.**

SITE NUMBER	LAB LOCATION	BASE GEOLOC Code*	PMEL Type	MAJ COM	CMD Code	68°F Rm(D)	JETSC (#)	TFCU (°)	Remarks
A001	562 CBSG Heath, OH	RRTC	AFPSL	AFMC	1M	D			Contract

\* Derived from AFCA Table Management Distribution System (TMDS) website:  
<https://tmlds03.scott.af.mil/TMDS/geoloc.shtml>

**10.3 PRECISION MEASUREMENT EQUIPMENT LABORATORIES (PMELs).**

Table 10-3 contains the assigned PMEL NUMBER and basic site information for all Air Force PMELs.

**Table 10-3. PMEL Site Information.**

PMEL LOCATION	SITE NUMBER	BASE GEOLOC Code	PMEL Type	MAJ COM	CMD Code	68°F Rm(D)	JETSC (#)	TFCU (")	Remarks
Altus AFB OK	P001	AGGN	IIB	AETC	0J				MEO
Al-Udeid AB, QT	P078	ALDA	III	CENTAF	3C		#		MIL
Andersen AFB, GU	P002	AJJY	IIB	PACAF	0R			*	Contract
Andrews AFB MD	P003	AJXF	IIB	AMC	1L		#		MEO
Arnold AFB TN	P004	ANZW	IIC	AFMC	1M	D			Contract
Aviano AB IT	P005	ASHE	IIB	USAFE	0D		#	*	CORE
Barksdale AFB LA	P006	AWUB	IIB	ACC	1C		#		Contract
Beale AFB CA	P007	BAEY	IIB	ACC	1C		#		Contract
Brooks City-Base TX	P008	CNBC	III	AFMC	1M				Contract
Cannon AFB NM	P009	CZQZ	IIB	ACC	1C		#		Contract
Cape Canaveral AFS FL	P010	DBEH	IIC	AFSPC	1S	D			Contract
Cavalier AFS ND	P011	EGYN	III	AFSPC	1S				Contract
Charleston AFB SC	P012	DKFX	IIB	AMC	1L		#	*	CORE
Clear AFS AK	P013	DXEB	III	AFSPC	1S				Contract
Columbus AFB MS	P014	EEPZ	IIB	AETC	0J		#		Contract
Davis Monthan AFB AZ	P015	FBNV	IIB	ACC	1C		#	*	CORE
Dover AFB DE	P016	FJXT	IIB	AMC	1L		#		MEO
Duluth IAP MN	P017	FMKM	IIB	ANG	4Z		#	*	CORE
Dyess AFB TX	P018	FNWZ	IIB	ACC	1C		#		Contract
Edwards AFB CA	P019	FSPM	IIC	AFMC	1M	D	#	*	CORE
Eglin AFB FL	P020	FTFA	IIC	AFMC	1M	D	#		CORE
Eielson AFB AK	P021	FTQW	IIB	PACAF	0R		#		Contract
Ellsworth AFB SD	P022	FXBM	IIB	ACC	1C		#		Contract
Elmendorf AFB AK	P023	FXSB	IIA	PACAF	0R	D	#	*	Contract
F.E. Warren AFB WY	P024	GHLN	IIB	AFSPC	1S				Contract
Fairchild AFB WA	P025	GJKZ	IIB	AMC	1L				Contract
Feltwell RAF UK	P026	MSET	IIA	USAFE	0D	D	#	**	Contract
Forbes Field KS	P027	GUQG	IIB	ANG	4Z		#	*	CORE
Grand Forks AFB ND	P028	JFSD	IIB	AMC	1L				Contract
Hickam AFB HI	P029	KNMD	IIB	PACAF	0R		#	*	Contract
Hill AFB UT (OOALC)	P030	SGQM	IIA	AFMC	1M	D	#	***	Civil Service/ Contract
Holloman AFB NM	P031	KWRD	IIC	ACC	1C	D	#	*	CORE
Kadena AB JA	P032	LXEZ	IIA	PACAF	0R	D	#		CORE
Keesler AFB MS	P033	MAHG	IIB	AETC	0J		#		Contract
Kirtland AFB NM	P034	MHMV	IIB	AFMC	1M		#	*	MEO
Kunsan AB ROK	P035	MLWR	IIB	PACAF	0R		#	*	CORE
-Reserved-	P036								
Langley AFB VA	P037	MUHJ	IIB	ACC	1C		#	*	CORE
Laughlin AFB TX	P038	MXDP	IIB	AETC	0J		#		CORE
Little Rock AFB AR	P039	NKAK	IIB	AETC	0J		#		CORE
Luke AFB AZ	P040	NUEX	IIB	AETC	0J		#		CORE



**Table 10-3. PMEL Site Information-Continued.**

PMEL LOCATION	SITE NUMBER	BASE GEOLOC Code	PMEL Type	MAJ COM	CMD Code	68°F Rm(D)	JETSC (#)	TFCU (')	Remarks
MacDill AFB FL	P041	NVZR	IIB	AMC	1L		#		Contract
Malmstrom AFB MT	P042	NZAS	IIB	AFSPC	1S		#	*	Contract
Maxwell AFB Gunter Annex AL	P043	JUBJ	IIB	AETC	0J		#		Contract
McChord AFB WA	P044	PQWY	IIB	AMC	1L		#	*	CORE
McConnell AFB KS	P045	PRQE	IIB	AMC	1L		#		Contract
McGuire AFB NJ	P046	PTFL	IIB	AMC	1L		##	**	CORE
Minot AFB ND	P047	QJVF	IIB	ACC	1C		#		Contract
Misawa AB JA	P048	QKKA	IIB	PACAF	0R		#	*	CORE
Moody AFB GA	P049	QSEU	IIB	ACC	OV		#		Contract
Mt Home AFB ID (with RASCAL #1)	P050	QYZH	IIB	ACC	1C		#	**	CORE
Nellis AFB NV	P051	RKMF	IIB	ACC	1C		#	*	CORE
New Boston AFS NH	P052	RNGF	III	AFSPC	1S				Contract
Offutt AFB NE	P053	SGBP	IIB	ACC	1C		#		Contract
Osan AB ROK	P054	SMYU	IIB	PACAF	0R		#	*	CORE
Otis ANGB MA	P055	SPBQ	IIC	ANG	4Z	D	#	*	CORE
Patrick AFB FL	P056	SXHT	IIB	AFSPC	1S			***	Contract
Peterson AFB CO	P057	TDKA	IIB	AFSPC	1S		#		Contract
Pope AFB NC	P058	TMKH	IIB	AMC	1L		#		MEO
Ramstein AB GE	P059	TYFR	IIB	USAFE	0D		##	*	CORE
Randolph AFB TX	P060	TYMX	IIB	AETC	0J		#		CS
Robins AFB GA (WRALC)	P061	UHJC	IIA	AFMC	1M	D	#	*	Civil Service/ Contract
Scott AFB IL	P062	VDYD	IIB	AMC	1L		#	*	MEO
Selfridge ANGB MI	P063	VGLZ	IIB	ANG	4Z		#	*	CORE
Seymour Johnson AFB NC (with RASCAL #2)	P064	VKAG	IIB	ACC	1C		#	**	CORE
Shaw AFB SC	P065	VLSB	IIB	ACC	1C		#	*	CORE
Sheppard AFB TX	P066	VNVP	IIB	AETC	0J		#		Contract
Thule AB GL	P067	WWCX	IIB	AFSPC	1S				Contract
Tinker AFB OK (OCALC)	P068	SHDF	IIA	AFMC	1M	D		*	Civil Service/ Contract
Travis AFB CA	P069	XDAT	IIB	AMC	1L		#	**	CORE
Tyndall AFB FL	P070	XLWU	IIB	AETC	0J		#		Contract
USAF Academy CO	P071	XQPZ	IIB	USAF	0B				MEO
USNS Observation Island	P072	n/a	III	ACC	1C			**	Contract
Vance AFB OK	P073	XTLF	IIB	AETC	0J		#		Contract
Vandenberg AFB CA	P074	XUMU	IIC	AFSPC	1S	D			Contract
Whiteman AFB MO	P075	YWHG	IIB	ACC	1C		#		Contract
Wright-Patterson AFB OH	P076	ZHTP	IIC	AFMC	1M	D	#	***	Contract
Yokota AB JA	P077	ZNRE	IIB	PACAF	0R		#		CORE
<p><b>NOTE:</b> "D" - The "D" indicates PMELs authorized a 68°F Dimensional Room.  "# " - The number of "# "s indicates JETSCs owned by the PMEL.  "***" - The number of "***"s indicates TFCUs owned by the PMEL.</p> <p><b>Remarks:</b> CS - Civil Servant Operated  MIL - Military Operated  CORE - Core PMEL, Military  MEO - MEO Operated</p>									

**10.4 AUTHORIZED USER TORQUE CALIBRATION AND REPAIR SITES:**

Table 10-4 contains the assigned Site Number and basic site information for all authorized torque calibration and repair sites. See Figure 10-1 following for a list of organizational acronyms used in the table.

**Table 10-4. Torque Site Information.**

TORQUE SITE LOCATION	SITE NUMBER	CMD	ORGANIZATION	LIMITATION / REMARKS	LOCAL GRAVITY (cm/sec <sup>2</sup> ) 1 cm/sec <sup>2</sup> = 1 gal
Battle Creek ANGB (MI)	T035	ANG	110MXS/MXMV	0.0 - 2000 FtLb, 2% Min Accuracy.	980.29336
Birmingham IAP (AL)	T037	ANG	117ARW/MXMV	0.0 - 250 FtLb, 2% Min Accuracy.	979.52234
Buckley AFB (CO)	T006	ANG	140W/MXMV	0.0 - 250 FtLb, 2% Min Accuracy.	979.59594
Capital MAP (Springfield IL)	T014	ANG	183FW/MXMV	0.0 - 2000 FtLb, 2% Min Accuracy.	980.06743
Carswell JRB (Fort Worth TX)	T047	ANG	136AW/MXMV	0.0 - 250 FtLb, 2% Min Accuracy.	979.456
Channel Island AGS (Port Hueneme CA)	T051	ANG	146AW/MXMV	0.0 - 250 FtLb, 2% Min Accuracy.	979.65301
Charlotte-Douglas IAP (NC)	T050	ANG	145AW/MXMV	0.0 - 1000 FtLb, 2% Min Accuracy.	979.71193
Cheyenne MAP (WY)	T053	ANG	153AW/MXMV	0.0 - 2000 FtLb, 2% Min Accuracy.	979.68648
Des Moines (IA)	T007	ANG	132FW/MXMV	0.0 - 1000 FtLb, 2% Min Accuracy.	980.18361
Ebbing ANGB (Fort Smith MAP AR)	T016	ANG	188FW/MXMV	0.0 - 250 FtLb, 2% Min Accuracy.	979.68333
Ellington Field (Houston TX)	T020	ANG	147FW/MXMV	0.0 - 250 FtLb, 2% Min Accuracy.	979.27466
Fort Wayne (IN)	T009	ANG	122FW/MXMV	0.0 - 250 FtLb, 2% Min Accuracy.	980.18688
Fresno (CA)	T005	ANG	144FW/MXMV	0.0 - 250 FtLb, 2% Min Accuracy.	979.82178
Gen Mitchell ANGB (Milwaukee WI)	T042	ANG	128ARW/MXMV	0.0 - 1000 FtLb, 2% Min Accuracy.	980.34114
Gowen Field (Boise ID)	T041	ANG	124WG/MXMV	0.0 - 1000 FtLb, 2% Min Accuracy.	980.194
Great Falls (MT)	T012	ANG	120FW/MXMV	0.0 - 250 FtLb, 2% Min Accuracy.	980.49770
Hancock Field (Syracuse NY)	T027	ANG	174FW/MXMV	0.0 - 250 FtLb, 2% Min Accuracy.	980.38216
Hector Field (Fargo ND)	T011	ANG	119FW/MXMV	0.0 - 250 FtLb, 2% Min Accuracy.	980.71334
Joe Foss Field (Sioux Falls SD)	T002	ANG	114FW/MXMV	0.0 - 2000 FtLb, 2% Min Accuracy.	980.34805
Kelly ANG (San Antonio TX)	T026	ANG	149FW/MXMV	0.0 - 250 FtLb, 2% Min Accuracy.	979.19380
Key Field (Meridian MS)	T066	ANG	186ARW/MXMV	0.0 - 2000 FtLb, 2% Min Accuracy.	979.46872
Kingsley Field (Klamath Falls OR)	T013	ANG	173FW/MXMV	0.0 - 250 FtLb, 2% Min Accuracy.	979.96515

**Table 10-4. Torque Site Information-Continued.**

TORQUE SITE LOCATION	SITE NUMBER	CMD	ORGANIZATION	LIMITATION / REMARKS	LOCAL GRAVITY (cm/sec <sup>2</sup> ) 1 cm/sec <sup>2</sup> = 1 gal
Lambert IAP (St Louis MO)	T008	ANG	131FW/MXMV	0.0 - 2000 FtLb, 2% Min Accuracy.	979.98764
Lincoln MAP (NE)	T054	ANG	155ARW/MXMV	0.0 - 2000 FtLb, 2% Min Accuracy.	980.15899
Louisville IAP (KY)	T040	ANG	123AW/MXMV	0.0 - 1000 FtLb, 2% Min Accuracy.	979.94283
Mansfield-Lahn AP (OH)	T064	ANG	179AW/MXMV	0.0 - 1000 FtLb, 2% Min Accuracy.	980.13092
Martin SAP-175th (Baltimore MD)	T062	ANG	175WG/MXMV	0.0 - 2000 FtLb, 2% Min Accuracy.	980.10363
Martinsburg RAP (WV)	T059	ANG	167AW/MXMV	0.0 - 250 FtLb, 2% Min Accuracy.	980.02011
McEntire ANGB (SC)	T024	ANG	169FW/MXMV	0.0 - 250 FtLb, 2% Min Accuracy.	979.61301
Minn St Paul ANG (MN)	T044	ANG	133AW/MXMV	0.0 - 1000 FtLb, 2% Min Accuracy.	980.58015
Montgomery RAP (AL)	T017	ANG	187FW/MXMV	0.0 - 250 FtLb, 2% Min Accuracy.	979.49259
Muniz ANGB (PR)	T055	ANG	156AW/MXMV	0.0 - 1000 FtLb, 2% Min Accuracy.	978.67471
Nashville MAP (TN)	T038	ANG	118AW/MXMV	0.0 - 2000 FtLb, 2% Min Accuracy.	979.76761
New Orleans (LA)	T004	ANG	159FW/MXMV	0.0 - 250 FtLb, 2% Min Accuracy.	979.30931
Pease ANGB (Portsmouth NH)	T073	ANG	157ARW/MXMV	0.0 - 2000 FtLb, 2% Min Accuracy.	980.450
Peoria AP (IL)	T065	ANG	182AW/MXMV	0.0 - 250 FtLb, 2% Min Accuracy.	980.14997
Pittsburgh ANG (PA)	T060	ANG	171ARW/MXMV	0.0 - 1000 FtLb, 2% Min Accuracy.	980.08508
Portland IAP (OR)	T001	ANG	142FW/MXMV	0.0 - 600 FtLb, 2% Min Accuracy.	980.63196
Reno-Tahoe IAP (NV)	T052	ANG	152AW/MXMV	0.0 - 250 FtLb, 2% Min Accuracy.	979.67276
Richmond IAP (VA)	T019	ANG	192FW/MXMV	0.0 - 250 FtLb, 2% Min Accuracy.	979.94519
Springfield MAP (OH)	T015	ANG	178FW/MXMV	0.0 - 250 FtLb, 2% Min Accuracy.	980.05680
Toledo MAP (OH)	T023	ANG	180FW/MXMV	0.0 - 250 FtLb, 2% Min Accuracy.	980.21689
Truax Field (Madison WI)	T028	ANG	115FW/MXMV	0.0 - 250 FtLb, 2% Min Accuracy.	980.35841
Tulsa IAP (OK)	T025	ANG	138MXS/MXMV	0.0 - 1000 FtLb, 2% Min Accuracy.	979.76148
Will Rogers ANGB (Oklahoma City OK)	T048	ANG	137MXS/MXMV	0.0 - 250 FtLb, 2% Min Accuracy.	979.65157
Willow Grove ARS (PA)	T036	ANG	111FW/MXMV	0.0 - 250 FtLb, 2% Min Accuracy.	980.142

**Table 10-5. List Of Acronyms In Table 10-4.**

RAP	Regional Airport
MAP	Municipal Airport
IAP	International Airport
AGS	Air Guard Station
ARS	Air Reserve Station
ANGB	Air National Guard Base
JRB	Joint Reserve Base
ARB	Air Reserve Base
AP	Airport
CAP	Commercial Airport
AFB	Air Force Base
ANG	Air National Guard
AFR	Air Force Reserve