

**BY ORDER OF THE  
COMMANDER**

**30TH SPACE WING INSTRUCTION 21-103**

**1 OCTOBER 1998**



**Maintenance**

**TEST, MEASUREMENT, AND DIAGNOSTIC  
EQUIPMENT (TMDE)**

**COMPLIANCE WITH THIS PUBLICATION IS MANDATORY**

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This instruction describes the control system that helps customers make sure TMDE used in measuring and testing government-owned systems and equipment is accurate and uniform throughout the 30th Space Wing (30 SW). Control and calibration are essential to ensure exact and repeatable systems alignment. The TMDE program is dedicated to this goal and is defined in this instruction. This instruction applies to all agencies who uses or has custody of TMDE.

"The Paperwork Reduction Act of 1974 as amended in 1996 and AFI 37-160, Volume 8, *The Air Force Publications and Forms Management - Developing and Processing Forms*, affects this publication."

**SUMMARY OF REVISIONS**

This revision of this publication is to meet the format standards required by the Air Force. No content material has changed. Some required format changes has been made to allow for the conversion process.

**1. INTRODUCTION**

**1.1. General.** The 30th Space Wing provides TMDE calibration services at Vandenberg Air Force Base (AFB). The Precision Measurement Equipment Laboratory (PMEL), 340 Airfield Road, (building 1737), Vandenberg AFB CA 93437-6118, repairs, calibrates, and certifies all TMDE. To have an effective calibration program, TMDE customers will:

- 1.1.1. Provide TMDE inventory information to PMEL.
- 1.1.2. Make sure assigned TMDE is calibrated at periodic intervals.
- 1.1.3. Furnish auxiliary equipment, such as cables, probes, and electrical cords, needed to calibrate TMDE.
- 1.1.4. Ensure care and handling procedures are followed for the TMDE in their custody.

1.1.5. Perform preventive maintenance that includes proper use, cleaning, preservation, servicing, and minor external repairs. (Excluded is any work needing adjustment or replacement of parts or components that affect calibration.)

1.1.6. Maintain technical data files of equipment owned. Provide technical data with TMDE when requested by PMEL. The TMDE user/owner will ensure adequate maintenance and technical data for each item of TMDE are available.

1.1.7. Seek assistance from the program office for resolving technical problems needing special consideration (such as system or subsystem calibration, on-site calibration, limited certifications, acceptance tests, and new test equipment purchases).

1.1.8. Only use TMDE that was serviced by an authorized PMEL and has a valid TMDE Certification Label affixed.

1.1.9. Consider the alternative of Limited Calibration, No Periodical Calibration (NPC) and Calibrate Before Use (CBU), when possible.

**1.2. Traceability** . Reference standards used in the PMEL are traceable to the National Institute of Standards and Technology (NIST) directly through the Aerospace Guidance and Metrology Center (AGMC) or through the US Naval Observatory for precise time.

### **1.3. Responsibilities:**

1.3.1. The Commander, 30 SW has overall responsibility for the PMEL program at Vandenberg AFB.

1.3.2. The 30th Contracting Squadron is responsible for overall compliance of the PMEL contract.

1.3.3. The Quality Assurance Office (30 LSS/LGQ) assesses, documents, and reports contractor performance of the PMEL contract and statement of work requirements.

1.3.4. The Program Office (30 LSS/LGQP) is the office of primary responsibility (OPR) for technical guidance and to monitor PMEL program compliance

## **2. Care, Handling, and Storage of TMDE:**

**2.1. General.** The accuracy and useful life of TMDE are directly influenced by proper use, care, handling, and storage. Manufacturer's operating and maintenance manuals, describing specific items of TMDE, are excellent references as they contain precautionary instructions related to use and operation. Each item of TMDE is usually designed for a particular application. Therefore, the knowledge of assigned TMDE technical specifications is a basic requirement and all workcenter personnel are urged to read the manufacturer's manual prior to using equipment.

**2.2. Care and Handling.** It is beyond the scope of this instruction to give detailed care and handling instructions for all contingencies that may be encountered at individual workcenters. Guidelines listed below are general procedures for the care and handling of test equipment.

2.2.1. Do not stack test equipment on the floor and do not place open liquid containers on or near test equipment.

2.2.2. Before lifting or carrying test equipment, disconnect and coil all cables and leads so they do not drag on the floor.

2.2.3. Get help when lifting or carrying heavy or bulky equipment. Heavy equipment is defined as weighing in excess of 50 pounds. A person carrying equipment is especially subject to tripping, since his view of the floor is usually obstructed. Use wheeled carts to move equipment whenever practical.

2.2.4. Use carrier handles to move storage cells.

2.2.5. Avoid stacking test equipment more than two units high. When equipment must be stacked, always place smaller, lighter units on top.

2.2.6. Arrange TMDE used during testing to minimize possibility of tripping over test leads or cables. Cart-mounted equipment must be located adjacent to work benches.

2.2.7. Avoid blocking aisles, exits, or access to fire extinguishers with test equipment mounted on carts.

2.2.8. Avoid subjecting TMDE to any unnecessary mechanical shock. If an item is accidentally dropped, it must be removed from service immediately, tagged and sent to the PMEL for recalibration.

2.2.9. Wear special gloves to handle items, such as unplated precision iron weights, to protect them from moisture on the skin.

2.2.10. Avoid putting fan-equipped TMDE in a position that will restrict or block air flow when it is operating. Check rack-mounted test equipment to make sure cooling is adequate, fan filters are clean, and air flow is not restricted.

2.2.11. Do not use any item of TMDE suspected of malfunctioning or when its certification date has expired and it is due calibration.

2.2.12. Workcenters obtaining loan equipment must bear responsibility for proper care while equipment is in their custody.

**2.3. Meters.** Meters are very delicate measuring equipment. Basic precautions when using them include:

2.3.1. Ensuring the amplitude of signal under test is within the range of the meter being used. If amplitude of signal is unknown, always begin with highest available range.

2.3.2. Avoid placing meters close to magnets or strong electromagnetic fields.

2.3.3. Disconnect equipment from power sources prior to doing continuity or resistance tests. This eliminates the possibility of burning out the meter.

2.3.4. This conserves battery life.

2.3.5. When replacing batteries in multi-meters, extreme care must be taken to avoid using batteries with steel cases. Nonrechargeable, standard cell batteries encased in steel will produce random errors of 5 to 15 percent due to magnetic fields between meter movement and steel cases of batteries.

**2.4. TMDE Storage.** To avoid mechanical damage and to protect TMDE from dust and effects of moisture, the following storage instructions apply:

2.4.1. A definite storage area must be assigned for all test and measurement equipment when not in use. Shelves, work bench drawers, or cabinets may be used for storage purposes and must be identified as test equipment storage areas.

2.4.2. Test and measurement equipment having magnets (such as meters and waveguide isolators) must be kept away from degaussing fields. Keep these items separated by at least six inches to prevent magnetic coupling.

2.4.3. Mechanical test and measurement devices must be stored carefully to avoid nicks, burring, abrasion, corrosion and rust.

2.4.4. In areas where dust control is a problem, place test and measurement equipment in plastic bags prior to storage. These bags are available in a variety of shapes and sizes and may be ordered through logistics channels.

2.4.5. When physical size or weight of equipment renders shelf storage impractical, it will be stored in the area where it is used.

2.4.6. Small portable items stored in drawers are protected from shock through generous use of vibration absorbent material. Two acceptable cushioning materials are urethane foam and sponge rubber.

2.4.7. Noncalibrated accessory items, such as adapters, probes, and cables (when not stored as part of the test and measurement equipment) should be in drawers, on racks, or on shelves. These storage areas are designated and marked to make sure individual items are properly stored. Coaxial cables and accessories that are damaged, dented, creased, or have faulty connectors, will be tagged with a manila tag listing the discrepancy, and stored in an area designated as nonconforming equipment hold area. When repairs are finished, the tag is removed and the item returned to service.

2.4.8. The effects of moisture are minimized by storing equipment in a dry storage area. Equipment with cases are stored in their cases with the covers closed and latched. When test equipment has been exposed to rain, it is removed from its case, dried, and installed in the case prior to application of power or placing in storage.

2.4.9. Protective covers are installed on waveguide parts when test equipment is not in use.

2.4.10. All internal dry cell batteries must be removed from instruments placed in long-term or permanent storage to prevent damage from battery acid leakage. Dry cell batteries must be removed from test equipment declared excess. Removal of batteries is the responsibility of custodian declaring item excess.

### **3. TMDE Scheduling and Control:**

**3.1. General.** Periodic calibration and maintenance of test equipment are necessary to ensure equipment remains accurate within design limits. This chapter prescribes procedures for implementing and operating an automated system of TMDE scheduling.

3.1.1. A preprinted slip is used for scheduled maintenance of TMDE and a handscribed slip for unscheduled maintenance. Maintenance data recorded on these forms are used to update the master identification (ID) listing in the PMEL Automated Management System (PAMS) for each item

of TMDE that requires calibration, repair, or recertification. The master ID is used to produce reports and listings relative to scheduling and control of TMDE.

3.1.2. PAMS printed slip is used to control routing and receipt of TMDE and the transfer of information from the owning workcenter (OWC) to the PMEL.

3.1.3. Copies of these slips are used to update information in the master ID listing in PAMS, so it is important they contain all the required information.

**3.2. TMDE Schedule.** The PMEL sends three copies of the monthly calibration and maintenance schedule to the OWC each month.

3.2.1. The workcenter schedules are to be reviewed by the OWCs to make sure they are accurate and to make all necessary additions and deletions for the month.

3.2.2. One signed copy of the corrected schedule is returned to the PMEL.

3.2.3. All items must be available to the PMEL on date shown on schedule or as established by the PMEL scheduler. Overdue items must not be used until they have been calibrated and recertified.

3.2.4. OWC retains their copy of schedule for 30 days after all equipment is calibrated; copy is then destroyed.

**3.3. Scheduled Maintenance.** Each month the TMDE scheduler sends the OWC a due calibration listing and PAMS slips for equipment scheduled for that calendar month. It is the OWC's responsibility to ensure all TMDE due calibration for the month is received by PMEL for calibration. Any TMDE that is scheduled for calibration and is no longer needed should be brought to the attention of the PMEL scheduler so it can be eliminated from the master ID listing.

**3.4. Unscheduled Maintenance.** Unscheduled TMDE includes items new to the inventory, items overdue calibration, and items that have failed prior to the calibration due date. All unscheduled maintenance of TMDE will be coordinated with the PMEL scheduler prior to work being accomplished.

**3.5. Initial Calibration.** No Identification (ID) Number Assigned. When new items are added to the inventory, the OWC notifies the TMDE scheduler of model/part number and serial number so these items can be added to the master ID listing.

**3.6. Monthly TMDE Overdue Report.** The status of OWC TMDE shown as overdue (not updated) as of the end of the reporting period is included as part of the TMDE monthly schedule. Workcenters must verify overdue items are submitted to the PMEL immediately.

3.6.1. When a unit of equipment is to be removed from the master inventory for any reason (condemned, obsolete, excess to requirements, etc.), OWC notifies the TMDE scheduler.

3.6.2. When the schedule or inventory contains wrong information and a correction, addition, or deletion is necessary, put information in red on the monthly schedule or TMDE inventory document as it is being edited.

**3.7. Cleanliness and Completeness of Equipment.** OWC is responsible for the cleanliness and completeness of its equipment. Items, such as test leads and probes, must be replaced when lost or in need of repair. All equipment is handled in the manner TMDE requires.

3.7.1. All equipment must be cleaned externally before pickup by the PMEL. Incomplete equipment received by the PMEL is returned to the OWC without repair or calibration (except in cases where PMEL help is needed to replace defective items). Protective covers should be installed on all unmated connectors (such as waveguide ports, BNC, etc.) prior to submitting equipment to PMEL. Equipment air filters are cleaned as needed.

**3.8. Adjustment of Calibration Cycle (Interval).** The Air Force calibration interval (calibration cycle) listed in T.O. 33K-1-100-2 is the period of time over which the equipment will perform its function with a statistically derived end-of-period reliability (will maintain specifications) of 85% or better. These intervals are established and modified as necessary, from data collected through the maintenance data collection system on the total TMDE population. TMDE that has exceeded the prescribed calibration interval will not be used. When no calibration interval is prescribed or the item is not listed in T.O. 33K-1-100-2, the interval must not exceed 12 months. For items not listed in T.O. 33K-1-100-2, calibration requirements and responsibilities will be determined by Aerospace Guidance and Metrology Center (AGMC) through the submittal of an AFTO Form 45, **Request for Calibration Responsibility Determination**, by PMEL.

**3.9. Torque Wrenches.** Torque Wrenches are considered TMDE and will be treated as such. No special considerations apply.

**3.10. Seldom Used Items.** TMDE that normally is not used at least once during the calibration interval need not be periodically calibrated. This TMDE is designated calibrate before use (CBU). CBU items must be calibrated at least once before being designated CBU. PMEL cannot make an item CBU without the owner's direction or permission.

3.10.1. An AFTO Form 99, **Limited/Special TMDE Certification**, or AFTO Form 398, **Limited/Special TMDE Certification**, will be used as the certification label. The date calibration block will have the last date TMDE was calibrated. The date due block will have the date the TMDE would normally be due calibration followed by "/ CBU". The CBU designation will be entered in the PMEL Master ID in place of the frequency.

**3.11. Removal of TMDE from Storage.** When TMDE is removed from storage, it is the responsibility of the owning workcenter or custodian to ensure calibration is within the time frame of the PMEL certification label. If the certification time frame has expired, the owning workcenter or custodian will resubmit the item to the PMEL for recalibration.

**3.12. No Periodic Calibration Required (NPC).** Based on its application, TMDE may not require periodic calibration and may be designated NPC. This TMDE will require an initial calibration and be calibrated when it is repaired to ensure it meets the requirements of the applicable calibration T.O. PMEL cannot make an item NPC without the owner's direction or permission.

3.12.1. Items designated NPC will use an AFTO Form 99 or 398 as the certification label. The date calibrated block will have the last date the item was calibrated. The letters "NPC" will be entered in the date due calibration block.

3.12.2. The instrument may be used provided its performance is verified, checked, or monitored by other certified TMDE. Also, if it will not affect safety and is not used to verify equipment performance factors or make absolute measurements.

**3.13. Limited Calibration.** There are several situations where the PMEL may be authorized to perform a limited calibration. These situations will require the use of an AFTO Form 99 or 398. The

OWC supervisor is required to sign the AFTO Form 99 or initial the AFTO Form 398 when the item is returned for use.

3.13.1. Limited PMEL Capability. When the PMEL does not have the capability to calibrate the full range of TMDE, the PMEL supervisor will advise the user of the extent of services available. The user will then determine whether the available service will meet mission requirements. If the limited calibration service will not meet their needs, action will be taken to obtain support in accordance with T.O. 00-20-14.

3.13.2. Limited User Requirements. When a user requires less than the full capability of associated TMDE, the user will specify the desired calibration points or ranges to PMEL. PMEL will clearly identify the certified points or ranges on the certification label (AFTO 99 or 398).

3.13.3. Instrument Limitation. When a function, range, or specification on an item cannot be economically restored to original specifications, the PMEL supervisor will advise the using activity of the condition. The using activity will determine if the test instrument limited capability will support mission requirements or a replacement is needed.

3.13.4. T.O. Directed Limitation. The calibration procedure can identify any limitations caused by lack of adequate reference standards available to the PMEL.

#### 4. TMDE Priority Service:

**4.1. General.** Normal day-to-day TMDE calibration and repair service will be provided on a routine basis. Priority calibration service will be provided by the Vandenberg AFB PMEL to meet nonroutine requirements.

**4.2. Priority Categories.** Priorities will generally be classified as Emergency or Priority.

4.2.1. Emergency is used for calibration/repair of TMDE that will render an operational weapons system to be out of commission. Included are Emergency War Operations (EWO) or space launches, when failure to immediately process the item will cause a work stoppage. Emergency items will be processed into PMEL immediately and work will continue, including overtime (when approved by the contracting officer), until the TMDE is serviceable/calibrated or awaiting parts (AWP).

4.2.2. Priority is used for TMDE that is urgently needed to support mission requirements, but does not require around the clock work. Included are items that create a work stoppage condition prior to a combat training launch (missile crew training) or a simulated test of flight/integrated systems. Priority items will be processed on a first-in, first-out basis, ahead of routine work.

4.2.3. All other TMDE work will be handled on a routine basis. Average turn-around time for calibrations is 5 days, excluding repairs.

4.2.4. Special case is considered when a loss of test equipment causes a hardship work situation on using organization. A priority may be assigned to items by mutual agreement between PMEL and user. All items not in priority categories are considered routine and are serviced in order received.

**4.3. Procedure for Obtaining Priority Support.** Each unit of TMDE requiring priority service may be delivered (or picked up by request) to PMEL, accompanied by a 30 SW Form 50, **Priority Request**, justifying the requirement and including the following information: Priority Request Date,

Owning Work Center, Part/Model Number, Noun, PAMS Label Number, Emergency or Priority, Date Needed, Point of Contact with Phone Number, Signature of Authorized Individual, and Signature of TMDE Coordinator.

**4.4. After-Hours and Weekend PMEL Service.** To obtain PMEL services after hours, the operations control supervisor will inform the Range Operations Scheduling Branch of the PMEL requirement. The Scheduling Branch will alert PMEL and obtain PMEL operating time. Upon notification of PMEL operating time, the operations control supervisor will arrange for transportation to deliver equipment to PMEL. PMEL personnel will also need approval from the Contracting Officer prior to any overtime work being accomplished.

**4.5. Upgrading Priorities.** When operational demands justify upgrading priorities, OWC will prepare and deliver a letter of justification. Workcenter will pick up any equipment for which priority work is requested.

## 5. Support Responsibilities:

**5.1. General.** To be effective, the TMDE program requires active support from various organizational elements. This chapter will recap support functions and outline responsibilities not previously discussed.

**5.2. TMDE Owner/User .** Care of TMDE is a shared responsibility between the owner/user and the PMEL. Specific responsibilities assigned to the user/owner are outlined in T.O. 00-20-14 and T.O. 33-1-27. Some of the owner/user responsibilities are as follows:

5.2.1. Appoint a PMEL coordinator.

5.2.2. Calibrate and certify TMDE not specified in T.O. 33K-1-100-2 as PMEL responsibility or obtain calibration and maintenance support from the lowest level having the capability.

5.2.3. Accomplish and use applicable forms, labels, and alternate methods of certification in accordance with T.O. 00-20-14.

5.2.4. Return all TMDE specified as PMEL responsibility in T.O. 33K-1-100-2 to the PMEL when scheduled for calibration or when unscheduled maintenance is required.

5.2.5. Ensure TMDE sent to PMEL has all ancillary equipment (e.g., preamps, power supplies, adapters, cables, or probes) needed for calibration. PMEL personnel will advise the user/owner when an item is not complete to allow full calibration and may return the item without action if the ancillary equipment and/or technical data is not available.

5.2.6. Provide proper care, handling, and cleanliness of all TMDE.

5.2.7. Provide technical data with the TMDE when requested.

5.2.8. Identify and/or coordinate any requirements for limited or special calibrations with the PMEL.

5.2.9. Perform organizational maintenance on assigned TMDE in accordance with T.O. 33-1-27.

5.2.10. Perform all periodic maintenance and inspections as directed by maintenance technical orders.

5.2.11. Ensure all forms, labels, and calibration charts received with the TMDE from the PMEL are complete. Place authorizing signature on AFTO Form 99, Limited/Special TMDE Certifica-

tion, or initials on AFTO Form 398, Limited TMDE Certification, for TMDE that has received limited or special calibration, or for TMDE that is to be exempted from periodic calibration.

5.2.12. Return to PMEL one corrected TMDE Scheduling Report prior to the date indicated in the paragraph at the top of the listing. The corrections will be made in red ink in the same format and printed above the data that is being corrected.

**Forms Prescribed.** 30 SW Form 50, **Priority Request.**

CRAIG J. PRIEBE, Lt Col, USAF  
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**Attachment 1****GLOSSARY OF REFERENCES, ABBREVIATIONS, ACRONYMS, AND TERMS*****References***

AFI 21-113, *AF Metrology and Calibration (AFMETCAL) Program.*

T.O. 00-20-14, *AF Metrology and Calibration Program.*

T.O. 33K-1-100-1, *TMDE Interval, Calibration and Repair.*

T.O. 33K-1-100-2, *Reference Guide and Work Unit Code Manual.*

T.O. 33-1-27, *Logistic Support of PME & Owning Responsibilities for PME.*

*PMEL Handbook.*

***Abbreviations and Acronyms***

**AFB**—Air Force Base

**AGMC**—Aerospace Guidance and Metrology Center

**AWP**—Awaiting Parts

**BNC**—Type of Connector

**CBU**—Calibrate before use

**DDC**—Date due Calibration

**EWO**—Emergency War Operations

**ID**—Identification

**MDC**—Maintenance data collection

**NIST**—National Institute of Standards and Technology

**NCR**—No Calibration Required

**NPC**—No Periodic Calibration Required

**NSN**—National Stock Numbers

**OPR**—Office of Primary Responsibility

**OWC**—Owning Work Center

**PAMS**—PMEL Automated Management System

**PME**—Precision Measurement Equipment

**PMEL**—Precision Measurement Equipment Laboratory

**TMDE**—Test, Measurement, and Diagnostic Equipment

**T.O.**—Technical Order

**USNO**—United States Naval Observatory

*Terms*

**Accessories**—Item of general adaptability or special-purpose items related to specific measurement or test equipment that are necessary to complete desired equipment connections or test configuration.

**AFTO Form 256—No Calibration Required (NCR) decal**—. Must be affixed to all NCR items.

**AFTO Form 108 and AFTO Form 394—TMDE Certification Label**—. Shows when an item is calibrated and the next calibration due date. This label will not be defaced any time.

**AFTO Form 255—Notice Certification Void When Seal is Broken**—decal. Affixed to unit by PMEL at time of calibration. This seal will not be broken.

**Calibration**—Comparison between instruments, one of which is a standard of known accuracy, to detect and correlate, or adjust, any variation in the accuracy of the instrument being compared.

**Calibration Interval**—Length of time between calibrations during which each item of test equipment is expected to retain reliable measurement capability.

**Calibration Responsibility**—A term used to identify agency responsible for doing calibration of equipment. Calibration responsibility, except for NCR items, will be listed as PMEL.

**Certification**—Act of stating that standards and test measurement and diagnostic equipment have been calibrated and meet established requirements.

**Owning Workcenter**—This is the workcenter having primary use of TMDE.

**PMEL Automated Management System**—Used for inventory control and tracking of items of TMDE.

**Precision Measurement Equipment Laboratory**—A standards-possessing activity responsible for calibration and certification of Test Measurement and Diagnostic Equipment traceable to the National Institute of Standards and Technology (NIST).

**Test, Measurement, and Diagnostic Equipment (TMDE)**—Equipment used to maintain, measure, calibrate, test, inspect, diagnose, or otherwise examine materials, supplies, equipment, and systems to identify or isolate actual or potential malfunctions, or decide if they meet operational specifications established in technical documents.