UNITED STATES MARINE CORPS
ENGINEER EQUIPMENT INSTRUCTION COMPANY
MARINE CORPS DETACHMENT
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LESSON PLAN

TOOL ROOM MANAGEMENT AND USE OF TMDE

NCOM-A03

NCO MECHANICS COURSE

A16ACU1

REVISED 04/30/2014

APPROVED BY _____ **DATE** _____

INTRODUCTION **(10 MIN)**

(ON SLIDE #1)

1. GAIN ATTENTION.
We are all professionals, and that professionalism is what pushes us to complete any task assigned to the best of our ability. In order to do the job right, you must motivate your Marines and have the required support. However, in completing many jobs we require certain Support and Test Equipment.

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(ON SLIDE #2)

2. OVERVIEW. Good morning/afternoon class. My name is _____. The purpose of this period of instruction is to provide you with the information on how to determine what support and test equipment you should be maintaining, how to maintain calibration control records, and to perform advance use of TMDE to diagnose advanced level engineer equipment faults per the references..

(ON SLIDE #3)

INSTRUCTOR NOTE
Introduce learning objectives.

3. LEARNING OBJECTIVES.

a. TERMINAL LEARNING OBJECTIVES.

(1) Given the requirement and the references, supervise inventory of tool sets, chests, and kits to reconcile inventory records for accountability and serviceability. (1341-ADMN-2002)

(2) Given a requirement, equipment, personnel, and references, maintain a section calibration control program To ensure equipment provides accurate test, measurement, and diagnostic capabilities. (1341-ADMN-2006)

(3) Given a requirement, appropriate tools, an item of equipment, and the references, perform advance use of test measurement and diagnostic equipment (TMDE), to diagnose advanced level engineer equipment faults. (1341-MANT-2001)

b. ENABLING LEARNING OBJECTIVES.

(1) Without the aid of references, identify support and test equipment required to support the mission per the MCO P4790.2_. (1341-ADMN-2002a)

(2) Without the aid of reference, Identify (TMDE) requirements per the MCO P4733.1_. (1341-ADMN-2006a)

(3) Without the aid of references, identify the control procedures for support and test equipment per the MCO P4790.2_ and MCO 4733.1_. (1341-ADMN-2002b)

(4) Without the aid of references, identify inventory requisitioning procedures per MCO P4790.2_ and GPN 3-12. (1341-ADMN-2002c)

(5) Without the aid of reference, maintain a section calibration control program per the MCO P4733.1. (1341-ADMN-2006b)

(6) Provided references and a degraded piece of engineer equipment, troubleshoot to determine the appropriate system check per the appropriate technical manuals. (1341-MANT-2001a)

(7) Provided TMDE, engineer equipment, and references, demonstrate the correct use of TMDE per the appropriate technical manuals. (1341-MANT-2001b)

(8) Provided TMDE, and references, identify required PMCS per the appropriate technical manuals. (1341-MANT-2001c)

(ON SLIDE #4)

4. METHOD/MEDIA. This class will be taught using the lecture method, aided by a detailed outline, your student outline, computer generated slides, a demonstration, and a practical application.

INSTRUCTOR NOTE
Explain Instructional Rating Forms to students.

(ON SLIDE #5)

5. EVALUATION. There will be a written examination, without the aid of references, at the time indicated on your training schedule.

6. SAFETY/CEASE TRAINING (CT) BRIEF. Explain inclement weather route, safety area, and procedures; as well as fire evacuation route and procedures to students.

TRANSITION: Are there any questions over what will be taught, how I will teach it, how you will be evaluated, or safety and cease training? If not, we will now discuss Support and Test Equipment. As a maintenance resource, the term "support and test equipment" is comprehensive. This term includes tool sets, kits, chests, TMDE, jack stands, and hoists. In order to determine what support and test equipment applies to our specific work areas, we must consider several things. The first document we will look at is our unit Table of Organization.

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BODY **(23 HRS, 35 MIN)**

(ON SLIDE #6)

1. TABLE OF ORGANIZATION. (10 min)

Each unit in the Marine Corps has a document which not only provides the authority for personnel staffing, but also is the basis for all other resources. The T/O serves as the basic source document for all resources because it contains a unit's mission, organization, concept of employment, administrative capabilities, and logistics capabilities.

(ON SLIDE #7)

a. The mission statement within the T/O determines the personnel skills and equipment that a unit will need. Not only does the mission statement determine T/E needs, but any resource requirement review starts with the mission statement.

b. The organization paragraph contains a listing of a unit's subordinate elements and identifies the source of the internal maintenance support and maintenance requirements.

(ON SLIDE #8)

c. The concept of employment is as vital to the commander as it is to the operations staff. The concept of employment will determine the type of support required and the manner in which the support must be provided.

(ON SLIDE #9)

d. The administrative and logistics capabilities paragraphs specify the exact administrative, supply, and maintenance functions authorized the command.

(ON SLIDE #10-11)

TRANSITION: So far we have discussed the Table of Organization. Are there any questions over this material? I have a question for you. (Q) What is the purpose of the Table of Organization? **(A) IT PROVIDES AUTHORITY FOR PERSONNEL STAFFING AND SERVES AS THE SOURCE DOCUMENT FOR ALL OTHER RESOURCES.** We will now move on to the Table of Equipment.

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(ON SLIDE #12)

2. TABLE OF EQUIPMENT. (5 min)

The T/E is a list of equipment which a unit is required to possess and maintain in order to accomplish its mission. Further, when used with the T/O, it serves as the basis for determining what publications and additional equipment that may be required by the unit.

(ON SLIDE #13-14)

TRANSITION: We have discussed the Table of Equipment. Are there any questions over this material? I have a question for you. (Q) What is the purpose of the Table of Equipment? **(A) IDENTIFIES EQUIPMENT THAT THE UNIT IS REQUIRED TO POSSESS AND MAINTAIN IN ORDER TO ACCOMPLISH ITS MISSION; WHEN USED WITH T/O, SERVES AS BASIS FOR DETERMINING PUBLICATIONS AND ADDITIONAL EQUIPMENT REQUIREMENTS.** We will now move on to the control of Support and test equipment.

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(ON SLIDE #15)

3. CONTROL OF SUPPORT/TEST EQUIPMENT. (1 hr)

a. **Identify.** Using the unit's T/E and allowance list (to include special allowances), the MMO, Supply Officer, and Maintenance Officers/Chiefs must identify all Support and Test Equipment.

b. **Locate.** Each tool set, chest, kit and items of TMDE within the unit should be located; and responsibility for accounting for and maintaining the tool set, chest, kit, or TMDE should be assigned.

(ON SLIDE #16)

c. **Inventory**. When all of the equipment has been located, the MMO, Supply Officer, Responsible Officer, and Maintenance Officers/Chiefs should match the tool sets, chests, kits and TMDE to the T/E and allowance list to ensure that all items have been accounted for.

(1) A complete inventory of all tool sets, chests, kits and TMDE should be made using the appropriate SL-3, SL-3 extract, or US Army catalog.

(2) Additionally, those common or special tools for which the unit commander has established allowances, because they are above T/E and special allowance requirements, must also be inventoried and contained on an SL-3 Inventory/SL-3/SL-3 Extract. Each SL-3 Inventory/SL-3/SL-3 Extract will be maintained per the TM 4700-15/1_, Ch. 2, pg. 2-6-1, and local MMSOP. Any one of the following may be used:

(ON SLIDE #17)

(a) SL-3 – Marine Corps Stock Lists

1 List all components of collection-type items, such as chests, sets, kits, TMDE, and components to such Principal End Items (PEI) as vehicles, TMDE kits.

2 The data is arranged in columnar form and presents the information needed to identify the item and determine its type of issue.

(ON SLIDE #18)

(b) SL-3 Extracts

1 Information on the extract is from the SL-3 and the form is locally reproduced. An example is located in the TM-4700-15/1_, Ch. 2 pg. 2-6-2/3).

2 The last page of the extract should have space for the signature of the person conducting the inventory, date of the inventory, and signature of the person supervising the inventory.

(c) Automated System. These may be used, providing the automated system contains the same information required by the manual system.

(ON SLIDE #19-20)

INTERIM TRANSITION: Up to this point we have discussed considerations for identifying, locating, and inventorying support and test equipment. Are there any questions over this material? At this time we will take a ten minute break.

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(BREAK – 10 MIN)

INTERIM TRANSITION: Prior to the break we discussed considerations for identifying, locating, and inventorying support and test equipment. We will now discuss how to complete inventory forms.

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(ON SLIDE #21)

(3) The following information must be contained in the SL-3 Inventory/SL-3/SL-3 Extract.

(a) In the **INVENTORY FOR** section, enter the noun name of the tool kit, set, chest, or Principle End Item (PEI).

(b) In the **EXTRACT OF** section, enter the publication number and the **date** of the publication that contains the items. For locally procured kits, enter the authorizing letter and date as the reference publication.

(c) In the **TOOL BOX #** section, enter the number assigned the tool set, chest, kit, or Principle End Item (PEI). In those cases where a serial number has not been assigned, a local serial number must be assigned to the end item per the UM 4400-124 (FMF SASSY Using Unit Procedures).

(ON SLIDE #22)

(d) In the **ITEM NO.** section, enter the item number for each item contained in the tool set, chest, or kit as listed in the equipment's publication. Components of kits or sets contained within tool set, chest, or kit will either be listed as individual components under their parent kit or set, or contained on a locally produced SL-3 extract for the kit or set.

(e) In the **NOMENCLATURE** section, enter the nomenclature of the item. Entering the NSN in this section will

aid in ordering items that are missing or unserviceable and is optional.

(ON SLIDE #23)

(f) In the **U/I** section, enter the unit of issue or unit of measure of the item.

(g) In **QTY** section, enter the quantity authorized for the tool set, chest, or kit.

(h) In the **MONTH** section, enter the calendar date the inventory was conducted. Use the symbols contained in the legend block to indicate the status of the item.

(ON SLIDE #24)

(i) In the **REMARKS** section, enter the document number or the ERO number, when an ERO is used, for each item on order. Enter the serial number of serialized components, where appropriate. Enter temporary remarks in pencil.

(ON SLIDE #25)

(j) In the **INVENTORIED BY (SIGNATURE)** section, the individual conducting the inventory signs certifying that the inventory was properly conducted.

(k) In the **SUPERVISED BY** section, the individual supervising the inventory signs certifying that the inventory was properly supervised, conducted, and corrective action has been initiated on all defects.

(l) In the **DATE** section, the supervisor enters the date the inventory was conducted.

(ON SLIDE #26)

(4) Filing. Maintain a copy of the completed inventory/SL-3/SL-3 Extract in the tool kit, set, or chest, or in a file folder maintained by the tool NCO/commodity manager in a secure area.

(ON SLIDE #27)

(5) Disposition. Maintain completed SL-3 Inventory/SL-3/SL-3 Extracts for 1 year.

(ON SLIDE #28)

d. **Excess Tools**. Excess tools will be rolled backed to the supply system per MCO P4400.150_.

(ON SLIDE #29)

e. **Control**.

(1) Categories that tool sets, chests, or kits can be placed in and their required inventory intervals are as follows:

(a) Tool sets, chests, and kits that are issued to an individual where locks and a secure storage area are provided will be inventoried at least semiannually. Tool sets, chests, and kits issued to an individual will be secured when not in the custody of the individual. A duplicate key or a copy of the lock's combination should be maintained by the RO.

(b) Tool sets, chests, and kits that are issued to the responsible officer (RO) and securely stored will be inventoried at least annually.

1 Tool sets, chests, and kits that are issued to a responsible officer (RO) will also be inventoried upon change of RO.

(ON SLIDE #30)

(2) All tool sets, chests, or kits will be inventoried using the SL-3, SL-3 extract, or U.S. Army supply catalog. Any Supply System Responsibility Item (SSRI) and Using Unit Responsibility Item (UURI) needing replacement will be requisitioned per MCO P4400.150_. It is imperative that the unit budget for tool replacement to eliminate a shortage of funds when critical tools are required.

(ON SLIDE #31-32)

(a) SSRI/Basic Issue Items (BII). Items listed under this category are furnished by the supply system when the end item is issued and will be transferred with the end item during redistribution or other changes of custody unless other wise specifically directed by appropriate authority. These items are required to be maintained on hand or on order (or identified as an un-funded deficiency) unless specifically directed within the SL-3. Requisitioning of SSRI/BII assets needing replacement, when the end item is outside the stores distribution system, is the responsibility of the using unit. For principal end items that are components of a major end item (i.e., General Mechanics Tool Box - component of a Contact Truck) the items are to be accounted for under the serial number of the primary NSN.

(ON SLIDE #33)

(b) UURI. These are items that are not issued with the end item during Initial Issue Provisioning (IIP) and subsequent fielding. The using unit, not to exceed the stated quantity, must requisition these items. The CO can authorize in writing to hold less than the stated quantity. Additionally, where "AR" (As Required) is the stated quantity, the commander must establish that quantity in writing. These quantities will be reviewed and updated at least annually.

(ON SLIDE #34)

(3) Tool sets, chests, or kits held by the section's tool room for issue to individuals should be maintained in an area secure against pilferage. The MSC MMSOP will include a method to account for issues and receipts. Some examples of suggested techniques are:

(a) Logbook

(b) Stamped Tags (ID tag blanks)

(c) Sign-out cards

(ON SLIDE #35)

(4) Control must also be maintained over requisitions for components of tool sets, chest, or kits. Several techniques are available to exercise this control:

(a) Logbook

(b) Suspense copies of the requisitions.

(c) Use of the reporting unit's demand listing by citing designated supplementary addresses on the requisitions (SASSY-supported units).

(d) Use of MIMMS/AIS DPR by using ERO's as outlined in the TM 4700-15/1_ and appendix "C" of the MCO P4790.2_.

(ON SLIDE #36)

f. **Inspect**. Despite the requirement to conduct required inventory intervals, there still remains a requirement for the MMO to inspect tools and verify inventory records and requisitions during normally scheduled inspections with a unit.

(ON SLIDE #37)

g. **Garrison Tool Allowances**. FMF unit commanders (not to go below the battalion/squadron level except for detached units) are authorized to establish in writing special tool allowances for tools not currently maintained within T/E sets, kits, and chests that are needed to meet garrison peculiar requirements; and for required, locally fabricated, tools.

(ON SLIDE #38)

(1) Garrison Peculiar Tools are defined as those tools needed to support requirements that would not exist in a deployed situation. The tools required to conduct authorized levels of maintenance on organic equipment or in support of the T/O mission will be either T/E items or components of T/E items.

(ON SLIDE #39)

(2) Locally Fabricated Tools are those tools whose fabrication is directed by a technical publication. The authorization list for locally fabricated tools will reference the technical publication, which sets the requirement for the tool.

(3) Prior to submitting requests for modification of allowance (MOA) or SL-3/TM changes (especially tools that are unit peculiar), other end items/tool kits already on the unit's T/E should be checked as a source of required tools.

(ON SLIDE #40-43)

TRANSITION: During this period we have discussed completion, filing, and disposition of inventory forms, what to do with excess tools, control category assignment, inspection requirements, and garrison tool allowances. Are there any questions over this material? I have a couple questions for you. (Q1) How many signatures are required on the inventory? **(A1) 2.** (Q2) Tool sets, chest, and kits that are issued to an individual where locks and a secure storage area are provided will be inventoried how often? **(A2) SEMI-ANNUALLY.** (Q3) How often must "As Required" items be reviewed and updated? **(A3) AT LEAST ANNUALLY.** We will now discuss equipment SL-3/TM components.

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(ON SLIDE #44-45)

4. EQUIPMENT SL-3/TM COMPONENTS. (10 min)

a. All other SL-3/TM components will be accounted for on locally devised inventory sheets, which will be based on the appropriate SL-3 or TM. These sheets will reflect serial numbers of the end items, and the serial numbers of serialized components, where appropriate. Detailed instructions can be found within the MCO P4790.2_. Although this order addresses only tool kits, sets, and chests, these procedures will be used for all SL-3/TM inventories. Inventories will be conducted as follows:

(1) For items in use, on a semi-annual basis.

(2) For items not in use and stored in a secure area, on an annual basis.

(3) In addition to the preceding; if the item is issued to an RO, it will be inventoried upon change of an RO.

(ON SLIDE #46-47)

TRANSITION: We have discussed equipment SL-3/TM components. Are there any questions over this material? I have a question for you. (Q) Will items issued to an RO be inventoried upon change of RO? **(A) YES.** After we return from a ten minute break we will discuss the purpose and policy of the Marine Corps Calibration Control Program.

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(ON SLIDE #48)

(BREAK- 10 MIN)

INTERIM TRANSITION: Are there any questions over SL-3/TM component requirements? We will now discuss the purpose and policy of the Marine Corps Calibration Control Program.

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(ON SLIDE #49)

5. PURPOSE AND POLICY OF THE MARINE CORPS CALIBRATION CONTROL PROGRAM. (10 min)

a. The Marine Corps Test, Measurement, and Diagnostic Equipment (TMDE) Calibration and Maintenance Program (CAMP) has been developed to provide and maintain prescribed accuracies in standards of measurement and to make sure satisfactory

performance of all Marine Corps TMDE throughout the Fleet Marine Forces. (MCO 4733.1_)

(ON SLIDE #50)

b. The Marine Corps policy is to have all TMDE calibrated only to the extent and at the intervals necessary to adequately perform the measurement involved. In addition, the policy of the Marine Corps is to accomplish such calibration in the most cost-effective way that will satisfy operational requirements.

c. Marine Corps Calibration Facilities (CF) is the preferred source for calibration and maintenance of Marine Corps TMDE.

(ON SLIDE #51)

d. It is the Department of Navy policy to provide the organizational, intermediate, and depot maintenance levels with diagnostic capabilities to detect and isolate faults to design threshold levels and to ensure all testing and measurement equipment used for quantified measurements are maintained and calibrated at the lowest practical maintenance level per the SECNAVINST 3960.6.

(ON SLIDE #52)

e. Inter-service calibration support can be used at the discretion of the commanding officer.

(ON SLIDE #53-57)

TRANSITION: Up to this point we have discussed the purpose and policy of the Marine Corps Calibration Control Program. Are there any questions over this material? I have some questions for you. (Q1) What is the purpose of TMDE CAMP? **(A1) TO PROVIDE AND MAINTAIN PRESCRIBED ACCURACIES IN STANDARDS OF MEASUREMENT AND TO ENSURE SATISFACTORY PERFORMANCE OF ALL MARINE CORPS TMDE THROUGHOUT THE FLEET MARINE FORCES.** (Q2) What is the Marine Corps policy on TMDE calibration? **(A2) TO HAVE ALL TMDE CALIBRATED ONLY TO THE EXTENT AND AT THE INTERVALS NECESSARY TO ADEQUATELY PERFORM THE MEASUREMENT INVOLVED; AND TO ACCOMPLISH SUCH CALIBRATION IN THE MOST COST-EFFECTIVE WAY THAT WILL SATISFY OPERATIONAL REQUIREMENTS.** (Q3) What is the preferred source for Marine Corps TMDE calibration and maintenance? **(A3) MARINE CORPS CALIBRATION FACILITY.** (Q4) Inter-service calibration support can be used at whose discretion? **(A4) COMMANDING OFFICER.** We will now discuss the responsibilities of units holding TMDE items.

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(ON SLIDE #58)

6. <u>RESPONSIBILITIES OF ORGANIZATIONS HOLDING TMDE</u>. (10 min)
Calibrations control will be established and maintained per appendix "D" of the MCO P4790.2_.

a. <u>Organizations holding TMDE shall</u>:

(1) Submit for calibration all TMDE requiring calibration.

(2) Schedule TMDE for calibration in such a manner as to maintain, on hand, a sufficient amount of TMDE to preclude the loss of required test capabilities.

(ON SLIDE #59)

(3) Ensure all items of TMDE submitted for calibrations are complete and have had the proper preventive maintenance performed.

(4) Ensure that all TMDE is adequately protected during transportation to and from the Calibration facility by using packing materials and/or containers.

(5) Ensure all items of TMDE without current calibration labels are not used. TMDE received directly from the supply system with a current calibration label affixed should not be used until a crosscheck has been performed.

(ON SLIDE #60)

(6) Submit to the supporting unit calibration facility a list of all items of TMDE which are to be included in the calibration program when such a program is provided by the calibration facility.

(7) Analyze measurement requirement and request special calibration for TMDE when its entire measurement capability is not being utilized.

(8) Request Inactive calibration labels from the calibration facility for specifically identified TMDE.

(ON SLIDE #61)

(9) Ensure all TMDE is used properly to preclude damage to the equipment or the item being tested.

(10) As necessary, request assistance from the supporting calibration facility for education of personnel in analyzing measurement requirements and proper use of TMDE.

(ON SLIDE #62-63)

TRANSITION: We have discussed responsibilities of units holding TMDE items. Are there any questions over this material? I have a question for you. (Q) Calibrations control will be established and maintained per what MCO? **(A) MCO P4790.2_, APPENDIX "D."** We will now discuss the Calibration laboratory responsibilities.

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(ON SLIDE #64-65)

7. CALIBRATIONS LABORATORY RESPONSIBILITIES. (10 min)

Intermediate maintenance activities designated as calibration laboratories perform equipment repair and calibration for supported units within their authorized capability and forward equipment to higher EOM when repairs exceed their authorized levels. The calibration laboratory aids in management of the calibration program by projecting calibration requirements and resources, and by identifying the need for additional capability. They also provide the using unit intra-/inter-service support and use commercial contracts, as necessary, to satisfy calibration demands.

(ON SLIDE #66)

a. Calibration facilities are designated by Headquarters Marine Corps and are authorized the necessary equipment to perform calibration and repair operations.

b. Calibration support is received from Marine Corps Calibration Facilities (ELMACO and supporting FMF units) where available. In the event there are no local Marine Corps facilities, calibration should be done by the local calibration facility (Army, Civilian, etc.).

(ON SLIDE #67-68)

TRANSITION: During this period we discussed the Calibration laboratory responsibilities. Are there any questions over this material? I have a question for you. (Q) Can the Calibration laboratory provide the using unit intra-/inter-service support

and use commercial contracts, as necessary, to satisfy calibration demands? **(A) YES.** We will now discuss control of the Calibration Control Program.

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(ON SLIDE #69)

8. CALIBRATION CONTROL PROGRAM. (1hr)

a. **Identify TMDE.**

(1) Annually, units should conduct an inventory of all their TMDE to ensure calibration control records are accurate and complete.

(2) The unit's T/E and allowance list (to include special allowance) can be used by the MMO and maintenance personnel to identify all items of TMDE authorized to the unit.

(ON SLIDE #70)

(3) The Federal Logistics Data on compact disc (FEDLOG) also identifies all TMDE that requires calibration by placement of the number "3" under the OTC (operational test code). The OTC can be found in FEDLOG management view screen under the service/agency (S/A) MGMT CTL data element in position 6. If a question remains concerning the need for calibration or the calibration interval, the personnel at the calibration facility should be consulted.

(ON SLIDE #71)

b. **Locate TMDE.**

(1) All items of TMDE within the unit/commodity shall be located. As the equipment is located, the control system shall be annotated to identify the section/area holding the equipment.

(2) During the search to locate TMDE, it must be kept in mind that many items are component parts; e.g., pressure gauges, transducers, etc.

(ON SLIDE #72)

c. **Inventory TMDE.** When all TMDE items have been located, the MMO and maintenance representative should match the TMDE and control cards/charts or automated systems with the T/E and the

unit allowances to ensure that all TMDE has been accounted for and is complete.

(ON SLIDE #73-75)

INTERIM TRANSITION: Up to this point we have discussed identifying, locating, and inventorying items of TMDE. Are there any questions over this material? I have a question for you. (Q) How often should units conduct an inventory of all their TMDE? **(A) ANNUALLY.** At this time we will take a ten minute break.

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(BREAK – 10 MIN)

INTERIM TRANSITION: Prior to the break we discussed identifying, locating, and inventorying items of TMDE. Now let's discuss categories, labels, seals, and tags associated with TMDE CAMP.

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(ON SLIDE #76)

d. **Categories, Labels, Seals and Tags.**

(1) There are four categories of calibration. All TMDE will be assigned to one of these categories and have a current label affixed. Assignment of the categories should be based not only on the equipment's present use but also on requirements to task organize, form detachments, or field contact teams. The four categories of calibration are:

(ON SLIDE #77-78)

(a) FULL CALIBRATION. The using unit has determined that the TMDE is required for use across its full extent measurement capability. The Calibration label indicates that the TMDE has been adjusted within the specifications approved by the Marine Corps. Label is Black on White and come in three sizes.

(ON SLIDE #79-80)

(b) SPECIAL CALIBRATION. The using unit has determined the TMDE is not used to the maximum extent of its capabilities and the calibration facility has been provided the specific ranges, functions, etc., to be calibrated. Items labeled "Special Calibrations" will have only one calibration tag affixed

indicating limitations. Label is Black on Green, and come in three sizes. The Calibrations Tag is Black on Green.

(ON SLIDE #81-82)

(c) CALIBRATIONS NOT REQUIRED (CNR). The using unit has determined that the TMDE is not used in any Quantitative or Qualitative application. Equipment used solely in training applications normally falls into this category. The period that equipment can be in a "CNR" status is unlimited until repair is required on the equipment or the equipment requires calibration for Q/Q application. Equipment designated as "CNR" will not be calibrated unless specifically requested by the using unit. Label is Orange on White.

(ON SLIDE #83)

NOTE: *CNR labeled equipment does not require resubmission. Exceptions are: the equipment is defective, submitted for an LTI, or the owning unit requires a change in its status.*

(ON SLIDE #84)

(d) INACTIVE CALIBRATION. The using unit has determined that the TMDE is not being used and not expected to be used in the near future. TMDE in an Inactive status requires calibration prior to use. TMDE bearing an Inactive sticker shall be reviewed three years from the date that the sticker was applied. If the using unit determines that the TMDE item is still not expected to be used in the near future, the unit should consider requesting a change to their Table of Equipment.

(ON SLIDE #85-88)

1 Using units shall request necessary Inactive and CNR labels from the supporting Marine Corps calibration facility by Naval letter, or submit directly to the calibration facility. The minimum information required on the letter shall be instrument model number/Nomenclature, serial number, the calibration due date, barcode number and the exact label desired for each item. A copy of the request letter from the owning unit shall be maintained by the calibration facility for a minimum of three years. If the TMDE is not currently calibrated or operational the TMDE must be submitted to the calibration facility for a full operational check IAW the TM. Once the operational check is complete, the calibration facility will place the TMDE in the requested status (CNR or INACTIVE). If TMDE is inoperative, submit TMDE for repair. Once repaired the calibration facility will affix the appropriate label requested. Label is Green on White.

NOTE: *ENCLOSURE (1) has a flow chart to assist using units in determining the level of calibration required.*

INSTRUCTOR NOTE
Walk students through Enclosure (1) flow chart.

(ON SLIDE #89-90)

(2) Rejected Label. This type of label shall be affixed to an item of TMDE, which is returned to the owning unit for failure to meet acceptance criteria of the calibration facility. A Rejected Tag shall also remain on the TMDE until it is repaired or calibrated. Rejected Label and Tag are both Black on Red.

(ON SLIDE #91-92)

(3) Calibration Void If Seal Is Broken Label. The purpose of this seal is to increase confidence in the reliability of TMDE which has current calibration labels affixed. A broken seal indicates that an instrument control, chassis, or plug-in unit may have been adjusted, replaced, removed, or tampered with to the extent that the validity of the calibration is questionable. This seal is not intended to restrict authorized maintenance in the performance of assigned corrective or preventive maintenance tasks. Label is Red on White.

(ON SLIDE #93)

(4) Removing Calibration Labels, Tags, or Seals. Only the calibration facility personnel are authorized to remove calibration labels, tags, and seals, except when the using unit is provided CNR or INACTIVE labels as previously mentioned.

(ON SLIDE #94)

e. **Calibration Scheduling Process**.

(1) The result of scheduling TMDE for calibration is to establish calibration due dates for the TMDE. When preparing the calibration schedule, the section/unit must ensure that sufficient assets are on hand for day-to-day operations.

(2) Calibration scheduling is automatic; the next scheduled calibration period is that date entered on the calibration label affixed to the equipment by the calibration facility. Equipment must be promptly turned in for calibration. The exceptions to this are as follows:

(ON SLIDE #95)

(a) Due to repair, receipt of new equipment, training exercises, etc, several items of the same type of equipment may become due for calibration at the same time.

(b) Training exercises or actual commitments may dictate a change in calibration scheduling.

(c) You may not be able to turn in an item due for calibration because it is mission-essential, or its replacement has been delayed in its return from calibration.

(ON SLIDE #96)

(3) The mentioned exceptions as well as poor management can cause uneven calibration scheduling. This may result in a reduced capability within a unit to perform its mission by having a majority of specific type of equipment due for calibration during the same period. An even spread across the calibration cycle is required.

(ON SLIDE #97-98)

f. **Control Of TMDE**. Control of TMDE will be solely conducted via means of GCSS-MC. All other options that we're previously available (i.e. wall charts and Cal 2000) are obsolete.

(ON SLIDE #99)

g. **The Equipment Calibration Process Is As Follows**:

(1) By the calibration due date, the equipment should be removed from the immediate working area to an area where it will be processed for induction into the calibration facility. (This is necessary to prevent usage of an item whose accuracy is suspect.) Identify the extent of calibration required on the Service Request (SR) utilized to obtain calibration services. A unit should not have an item due for calibration, which does not have a SR initiated.

(ON SLIDE #100)

(2) Units will normally collect items for calibration and induct them two to four times a month, depending on location, the number of items due for calibration, and need of the equipment. This means that items will be in the processing area awaiting evacuation past the calibration due date. This time will be kept to a minimum and will not be longer than 15 days past the calibration due date.

(ON SLIDE #101)

(3) At least annually, the unit will evaluate all of its TMDE and ensure that it is in the correct calibration category consistent with its mission as well as to determine when an item is required/not required.

(ON SLIDE #102)

(4) The calibration schedule will contain the SR number .

(5) Upon return from the calibration facility, the calibration control point Install Base with the calibration due date, which comes from the label affixed to the TMDE in accordance with TM-4700-15/1_.

(ON SLIDE #103)

h. **Inspect**. The MMO and maintenance officer/commodity manager will ensure that, as part of the normal inspection process within the unit, the equipment is properly labeled and within the calibration intervals.

i. **Filing and disposition**. Upon completion of Calibration Service Request, ensure GCSS-MC Install Base is updated with the current calibration data.

(ON SLIDE #104-107)

TRANSITION: During this period we discussed categories, labels, seals and tags associated with TMDE CAMP, scheduling of TMDE, calibration control systems, and the calibration process. Are there any questions over this material? I have some questions for you. (Q1) What are the four categories of calibration? **(A1) FULL, SPECIAL, CALIBRATION NOT REQUIRED, AND INACTIVE.** (Q2) How often must units review items designated as "INACTIVE"? **(A2) EVERY THREE YEARS.** After we return from a ten minute break we will discuss preparation instructions for calibration control systems.

_____

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(BREAK – 10 MIN)

TRANSITION: Prior to the break we discussed categories, labels, seals and tags associated with TMDE CAMP, scheduling of TMDE, calibration control systems, and the calibration process. Are there any questions over this material? We will now discuss preparation instructions for calibration control systems.

_____
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(ON SLIDE #108)

11. <u>ADMINISTRATIVE REMARKS</u>. (10 min) While the units control system will be maintained in the units' calibration control center, if a centralized control system is maintained, it is advisable that each section/shop within a unit which holds/uses TMDE establish its own calibration control system.

(ON SLIDE #109)

a. **<u>New Items of Equipment</u>**. Calibration requirements for new items of equipment received from the supply system should be determined upon receipt. When the item is a totally new item to the unit, calibration requirements may be obtained from the supporting calibration facility. In either case, the equipment should be entered into the unit's calibration control program and submitted for calibration, when required. When calibration is not required or when the equipment is to be placed in "INACTIVE" status, the appropriate labels should be obtained from the supporting calibration facility. Upon receipt of new item of TMDE, supply shall add the serialized item as an Item Instance.

(ON SLIDE #110)

b. **<u>Unserviceable Equipment</u>**. When notified by the calibration facility that the equipment has been declared unserviceable or beyond the repair capacity of the facility and a recoverable item report has been submitted, Requisition a replacement item in accordance with standard supply procedures. If the unserviceable item was a child, requisition the replacement under the Parent Service Request.

(ON SLIDE #111)

INSTRUCTOR NOTE
Inform students of the publications listed in Enclosure (2).

(ON SLIDE #112-#113)

<u>TRANSITION</u>: During this period we have discussed administrative remarks associated with TMDE CAMP. Are there any questions over this material? I have a question for you. (Q) Can a new item of TMDE be used prior to being crosschecked with the Calibration

facility? **(A) NO.** We will now discuss Test Measure and Diagnostic Equipment.

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(ON SLIDE #114)

12. <u>TEST MEASURE AND DIAGNOSTIC EQUIPMENT</u>. (10 MIN) Test Measure and Diagnostic Equipment is any tool or equipment that measures quantitative or qualitative amounts.

(ON SLIDE #115-116)

<u>TRANSITION</u>: We've just discussed test measure and diagnostic equipment. Are there any questions over this material? (Q) What is TMDE? **(A) Any tool or equipment that measures quantitative or qualitative amounts.** We will now talk about the VADS.

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(ON SLIDE #117)

13. <u>The VADS</u>. (1 HR 30 MIN) The VADS is a lightweight portable diagnostic system of modular design that is used to perform intrusive diagnostics on diesel engines, transmissions, central tire inflation systems, and other mechanical, electrical and hydraulic systems via an Interactive Electronic Technical Manual (IETM) or other testing software interface, using the vehicle diagnostic interfaces. The primary component of the VADS is the Test Adapter Vehicle (TAV), which is interfaced with an IBM compatible personal computer or laptop controller with available serial port, CD-ROM drive, and Microsoft Windows operating systems.

(ON SLIDE #118)

a. The VADS comes with two weather resistant transit cases which contain a complete set of interconnect cables, transducers/adapters and probes, including:

(ON SLIDE #119)

(1) <u>Diagnostic Connector Assembly (DCA) Cable</u>. Connects VADS to vehicle. The DCA cable may be used to carry signals from vehicle under test to VADS, or it may act as a power cable.

(ON SLIDE #120)

(2) NATO Power Cable. Provides power to the VADS. The NATO cable is not used when DCA is acting as power cable.

(ON SLIDE #121)

(3) RS-232 Serial Cable. Connects serial port of computer to serial port of VADS TAV. The Serial cable enables signal and data flow between computer and TAV.

(ON SLIDE #122)

(4) Databus Cables. Connects TAV to vehicle equipment with databus capability.

(ON SLIDE #123)

(5) Transducer Cable and Internal Combustion Engine (ICE) Test Adapter Set. Transducer Cable connects ICE Test Adapter to TAV to collect various test data based on type of vehicle under test and the type of test being conducted.

(ON SLIDE #124)

(6) Volt-Ohm Probe. Used to collect electrical data and connected directly to the TAV.

(ON SLIDE #125-126)

b. **Controls and Indicators**.

(1) Controls. The single operator control is the double-throw power switch located on the left side of the TAV. To activate the system, pull switch out and press down if powering VADS through the DCA, or pull out and press up if powering VADS through NATO cable.

(2) Indicators. VADS provides operators and maintainers with two indicator lights located on the left side of the TAV. A red power (PWR) indicator, which will light when power is applied and a green ready (RDY) indictor, which will light after the TAV completes the power-up and self-test. The green (RDY) indicator may blink or flicker during operation.

(ON SLIDE #127)

c. **Start Up Procedures**.

(1) Power-up Procedures. Prior to VADS power-up, ensure that test vehicle battery/voltage gauge indicates sufficient

power to run VADS (18 – 36 volts in DCA mode and 10 – 36 volts in NATO mode).

(ON SLIDE #128-129)

(2) Connect appropriate power cable. If using the NATO power cable: P2 to TAV J5 and P1 to vehicle slave receptacle (Figure 2-2.). If using the DCA as a power cable: P1 to TAV J1 and P2 to vehicle DCA connector. Refer to vehicle operator's manual for DCA connector location. Cable connector is keyed; make sure key on cable is facing up so cable can mate with connector. Verify that cable is fully seated and locked before proceeding.

(ON SLIDE #130)

(3) Apply power to the TAV. The power switch is a dual position switch; pull switch out and press down if powering the TAV through the DCA, pull out and press up if powering the TAV through the NATO cable. Red indicator (PWR) on side of VADS will light when power is applied.

(4) The TAV will perform an internal self-test. When the TAV completes self-test, the green indictor (RDY) will light.

(ON SLIDE #131-132)

d. **Operating Procedures**.

(1) Connect TAV RS232 serial cable. P2 to computer serial port and P1 to TAV J14. Turn on computer. When computer has finished booting up and Windows is operating, select "Start" moving the curser to the lower left corner of the display and clicking the mouse or by using the touch screen capability of the computer.

(ON SLIDE #133)

(2) Select the appropriate IETM from list of programs using the mouse or touch screen capability of the computer. Follow the setup and testing procedures provided on the display.

INSTRUCTOR NOTE
IETM testing procedures must be followed exactly as presented. Failure to follow IETM testing procedures may cause IETM and/or VADS software to malfunction.

(ON SLIDE #134)

(3) Connect the following as appropriate for the test being performed:

(a) Databus Cable. P1 to TAV J6 and P2 to vehicle Data Bus connector. Refer to vehicle operator's manual for Data Bus connector location.

(ON SLIDE #135)

(b) Volt-Ohm Probe. P1 to TAV J4.

(ON SLIDE #136)

(c) Transducer Cables. P1 to TAV J2/J3 and P2 to appropriate transducer.

(ON SLIDE #137-138)

(4) If no IETM is available for a particular test vehicle, you may use the VADS software. Select the VADS software from the Microsoft Windows operating system, select VADS as the testing system, and then select ICE tests. The VADS software main menu (Figure 2-5) presents the following options:

(ON SLIDE #139)

(a) ICE Tests. Conducts a variety of interactive tests based on test vehicle selection. A selectable list of available tests is presented to the operator. VADS has the capability to run two complementary tests simultaneously.

(ON SLIDE #140)

(b) Health Check. After entering vehicle and operator's data, performs four groups of tests (engine off, engine cranking, engine idling, and engine at full throttle) automatically. Test vehicle must be equipped with DCA capability to run Health Check.

(ON SLIDE #141)

(c) DMM Utility. Displays electrical data as a Digital Multi-Meter. Electrical measurements are taken by the Volt-Ohm Probe.

(ON SLIDE #142)

(d) (F1) Help. Provides a help menu for the VADS software.

(e) (Esc) Exit. Exits VADS software and returns to the Microsoft Windows desktop.

(ON SLIDE #143)

e. **Power-Down Procedures**.

(1) Shut down the TAV by pulling and positioning the power switch to the center position.

(2) Remove all test cables.

(3) At the end of the session, exit application IETM.

INSTRUCTOR NOTE

The laptop (TAMCN A2546) included in this system as an SL-3 component is a piece of diagnostic equipment in support of tactical equipment. This equipment is not authorized to connect to the Navy Marine Corps Internet. This unique functionality/equipment will remain supported by the MCHS program and therefore should not transition as NMCI seat assignments.

(ON SLIDE #144)

f. **Troubleshooting**.

(1) Red Indicator (Pwr) Fails To Light Immediately When Power Is Applied.

(a) Turn off power to the TAV.

(b) Check 10 amp NATO and 5 amp DCA circuit breakers to ensure they are properly engaged.

(c) Check power cable and ensure cable is correctly installed and making good connection to the TAV and to the power source.

(d) Re-check test vehicle battery/voltage gauge for sufficient power to run VADS.

(e) Reapply Power-up Procedures (paragraph 2.2 a). If Red Indicator (PWR) fails to light, return VADS for repair.

(2) Green Indicator (RDY) Fails to Light After Power is Applied to the TAV and 5 Minutes Have Passed.

(ON SLIDE #145)

(a) Turn off power to the TAV. Leave power off for at least 30 seconds. Rapid cycling of power switch may cause power-up failure or improper operation.

(b) Reapply power-up procedures (Paragraph 2.2 a). If green indicator (RDY) fails to light, return VADS for repair.

(ON SLIDE #146)

(3) "Read Timeout" or Other Error Message(s) Occurs While Performing Diagnostics Via IETM or ICE Software.

(a) Make sure the RS-232 serial cable is securely connected from the laptop to the TAV.

(b) Check COM port setup within the Mircrosoft Windows operation system for proper configuration.

(c) Verify test software is properly configured for the test hardware and COM port.

(d) Reboot laptop and the TAV following proper power down and power up procedures.

(e) Contact NSWC Crane Division at 1 (877) 418-6824.

(ON SLIDE #147-148)

INTERIM TRANSITION: We've just discussed the VADS system. Are there any questions over this material? At this time we will take a ten minute break.

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_____
_____

(BREAK – 10 MIN)

INTERIM TRANSITION: Prior to the break we discussed VADs system. I will now demonstrate how to set up the VADs system.

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_____
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(ON SLIDE #149)

INSTRUCTOR NOTE
Perform the following demonstration.

DEMONSTRATION. (1 hr) Allow 1 hour to demonstrate how to set up and run the wiggle test on the VADS system on the Grader. The purpose of this demonstration is to show the students how to set up and to run the VADS.

STUDENT ROLE: Students are to participate in the demonstration by making a circle around the VADS and get into position to where they can see. They are to ask questions or make comments for clarification.

INSTRUCTOR ROLE: Demonstrate how to set up and run various functions on the VADS.
1. Safety Brief: N/A
2. Supervision and Guidance: Explain the steps as you move through the set up, probing for understanding as you go.
3. Debrief: Allow students the opportunity to ask questions and comment on the demonstration. Answer student questions and provide feedback on student comments.

INTERIM TRANSITION: We have observed a demonstration of how to set up and run a test on the VADS. You will now perform a practical application to develop this skill.

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(ON SLIDE #150)

INSTRUCTOR NOTE
Introduce the following practical application.

PRACTICAL APPLICATION. (9 hrs) Allow 9 hours for completion and review of this Practical Application exercise. There is one instructor required. Each group will start with the VADS in the case "start from scratch". They will set it all up and run the same test as the demonstration. Provide assistance, as required, to each student. The purpose of this practical application is to build confidence in using and trusting the VADS.

PRACTICE: Each group will open the VADS, inventory and identify verbally all the cables and components. Set up the VADS and run the wiggle test on the Backhoe. Once the test is performed and prac app is satisfactory the group should pack the cables and components back in the case.

PROVIDE HELP: Instructor will be in the immediate area of the prac app. Instructor will be available to answer student questions throughout the entire practical application time period.
1. Safety Brief: N/A
2. Supervision and Guidance: Instructor will walk around the area and observe student performance. Instructor will be available to answer student questions throughout the entire practical application time period. Allow the students to take breaks as needed.
3. Debrief: Allow students the opportunity to ask questions and comment on the demonstration. Answer student questions and provide feedback on student comments.

(ON SLIDE #151-153)

TRANSITION: During this period you performed a practical application exercise designed to develop your proficiency on the VADS. Are there any questions over this practical application? I have some questions for you and then we will take a ten minute break. **(Q1)** What is the primary component of the VADS? **(A1)The Test Adapter Vehicle (TAV). (Q2)** What cable do you connect to the computer? **(A2) TAV RS232 serial cable.** (Q) What is TMDE? **(A) Any tool or equipment that measures quantitative or qualitative amounts.**

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(BREAK – 10 MIN)

INTERIM TRANSITION: Are there anymore questions before we talk about micrometers.

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(ON SLIDE #154-155)

14. Micrometers (15 MIN) Micrometers use the principle of a screw to amplify small distances that are too small to measure directly into large rotations of the screw that are big enough to read from a scale. The accuracy of a micrometer derives from the accuracy of the thread-form. There are 3 basic types of micrometers.

a. **Outside micrometer** (aka micrometer caliper), typically used to measure wires, spheres, shafts and blocks.

b. **Inside micrometer**, used to measure the diameter of holes. (Cylinder walls)

c. **Depth micrometer**, measures depths of slots and steps.

d. Each number on the sleeve of the micrometer represents 1/10 of an inch or .100.

(ON SLIDE #156)

e. Each of the four equal spaces between each number represents ¼ of .100" or .025". One complete revolution of the thimble changes the reading one space on the sleeve scale or .025".

(ON SLIDE #157)

f. The beveled edge of the thimble is divided into 25 equal parts, each space representing 1/1000 of an inch or .001". (One thousandth of an inch.)

(ON SLIDE #158)

g. The step by step process of taking a micrometer reading involves the addition of three separate readings which are obtained as follows:

(ON SLIDE #159)

(1) First, read the largest number on the sleeve that has been uncovered by the thimble, if it's 3 it means you have .300" to start with.

(ON SLIDE #160)

(2) Second, count the number of lines that the thimble has uncovered past the 3, it will be 2, and since each space is equal to .025, 2 spaces will equal 2 x .025" or .050", to be added to the original figure, making the total so far .035".

(ON SLIDE #161)

(3) Third, the graduations on the thimble show that it has revolved 12 spaces beyond the 0 mark, which means that .012" this must also be added to the total. This step completes the reading which is: .362

(a).300 Largest number on the sleeve
.050 Two lines past largest number

.012
.362 Total

(ON SLIDE #162)

INSTRUCTOR NOTE
Show clip on "How to use a Mircometer". (6.58 min)

INTERIM TRANSITION: We've just covered how to use a micrometer, are there any questions? If not let's move onto a demonstration covering how to use and read a micrometer.

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_____
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(ON SLIDE #163)

INSTRUCTOR NOTE
Perform the following demonstration.

DEMONSTRATION. (1 hr) Allow 1 hour to demonstrate how to read a Micrometer. The purpose of this demonstration is to build confidence in reading/using a Micrometer.

STUDENT ROLE: Students are to watch the instructor as he demonstrates on the dry erase board. They are to ask questions or make comments for clarification.

INSTRUCTOR ROLE: Demonstrate how to read a Micrometer on the dry erase board. Work the first problem on the Prac Ap. Explain that micrometers are good for blueprinting engines and checking cylinder/piston tolerances.

1. **Safety Brief:** N/A
2. **Supervision and Guidance:** During the demonstration ensure that the students understand as you go along. Probe after each step and allow the students to tell you the next step.
3. **Debrief:** Allow students the opportunity to ask questions and comment on the demonstration. Answer student questions and provide feedback on student comments.

(ON SLIDE #164)

INTERIM TRANSITION: We have discussed how to read and use a Mircormeter and observed a demonstration. You will now perform a practical application to develop this skill.

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INSTRUCTOR NOTE
Introduce the following **two part** practical application.

PRACTICAL APPLICATION. (3 hrs) This is a two part Prac Ap. Allow 1 hour for completion and review of the first part. Allow 2 hours for the second part. There is one instructor required. The purpose of this practical application is to build confidence in reading/using a Micrometer. Part 1: Distribute one copy of Prac Ap worksheet to each student. Handouts are located in the classroom filing cabinet. Part 2: Have students measure the pre-determined spots on the crankshafts and cylinder walls. They must be within 100^{th} of an inch +/- on every spot in order to move on.

PRACTICE: Part 1: Each student will read the directions and enter the correct or required information micrometer worksheet provided on the practical application. Students will raise their hand to gain the attention of the instructor if they have a question. Students will not talk, except to ask the instructor a question. Part 2: Students will line up in 3 sticks the first one in each stick will step up and begin measuring a crankshaft in the pre-determined spots. The student will then write down the measurements they got and show the instructor. Once the instructor has ensured they have the correct measurements the student will return to the classroom.

PROVIDE HELP: Part 1: Instructor will walk around the classroom and observe student performance. Instructor will be available to answer student questions throughout the entire practical application time period. Part 2: Instructor will be in immediate area where the prac ap is being conducted. He will be observing the students performance. Instructor will be available to answer questions throughout the entire practical application time period.

1. Safety Brief: N/A
2. Supervision and Guidance: Instructor observes student performance. Allow a 10 min break in between each part of the Prac Ap. Instructor will be available to answer student questions throughout the entire practical application time period.
3. Debrief: Review each entry on the practical application exercise forms. Show the Practical application handout answer key on the screen.

(ON SLIDE #165-166)

INTERIM TRANSITION: You've just performed a practical application exercise designed to develop your proficiency on a Micrometer. Are there any questions over this practical application? At this time we will take a ten minute break.

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_____

(BREAK – 10 MIN)

(ON SLIDE #167)

TRANSITION: Prior to the break we discussed the steps on how you read and use a Micrometer. You also observed a demonstration and had the opportunity to perform a practical application exercise designed to develop your proficiency. Are there any questions over the material we have covered to this point? If not, I have some questions for you. (Q1) Each number on the sleeve of the micrometer represents what? **(A1) 1/10 of an inch or .100.** (Q2) The beveled edge of the thimble is divided into 25 equal parts, each space representing what? **(A2) 1/1000 of an inch or .001". (One thousandth of an inch.).** We will now discuss Torque Wrenches.

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_____
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(ON SLIDE #168-169)

15. Torque Wrenches. (15 min) A torque wrench is used where the tightness of bolts and gaskets is crucial.

a. Although they don't look like it, bolts are springs that work by being stretched, put under a strain. That spiral of threads on the bolt is actually a wedge wrapped around the shank. When you tighten a bolt, the threads work to stretch the shank by wedging the end of the bolt away from the head. A torque wrench is a tool used to precisely apply a specific torque to a fastener such as a nut or bolt. It was originally designed to prevent over tightening bolts on water main and steam pipe repairs underground.

(ON SLIDE #170)

(1) Gasket surfaces also need to be held together by a certain amount of force, so that they can resist penetration by whatever it is that the gasket is supposed to restrain. A head gasket, for instance, that does not have adequate clamping force exerted on it will eventually blow out because the mating

surfaces on either side do not provide enough grip to support it against combustion pressure.

(ON SLIDE #171)

(2) A torque wrench is used where the tightness of bolts and gaskets is crucial. It allows the operator to measure the torque applied to the fastener so it can be matched to the specifications for a particular application. This permits proper tension and loading of all parts.

(ON SLIDE #172)

b. Thread locking compounds such as Loctite have a lubricating effect. When using Loctite, cut back on the published figure by 10% UNLESS the manual says to use Loctite on the fastener.

(ON SLIDE #173)

(1) You may also see in your manual a demand along these lines: "Torque down to X lbs/ft of torque, then turn an additional ¼ turn." You'll often find that for head bolts. When it calls for that, do it. The engineers have figured out that the method will, in that particular case, be the most reliable way of achieving the necessary torque on the bolt.

(ON SLIDE #174)

(2) When tightening down groups of bolts in an assembly you should do it in the order specified by the book. If there is no specific order set forth, work in a criss-cross pattern. If it is a long piece, start with the two screws closest to the center, then work your way to the ends, criss-crossing as you go.

(ON SLIDE #175)

(3) Usually, it is better to approach max torque in two or three stages. For instance, if the instructions call for 22 lbs/ft, then I like to go through the tightening pattern at about 12, then 18, then the final value. Then do a circuit around the edge at the highest torque value just to make sure you get them all.

(ON SLIDE #176)

c. U.S. torque specifications are usually spec'd in lbs/ft or lb/inches of torque. (You see foot-pounds used as a method of expressing torque all the time. It has become the usual

method of expression, but properly speaking, work is measured in ft/lbs and torque in lbs/ft, or lb/inches.)

(ON SLIDE #177)

(1) A lb/ft of torque is the amount of leverage exerted by a one-pound weight hung at the end of a one-foot lever extending out at 90 degrees from the point of attachment. If the pull is exerted at less than 90 degrees the torque is correspondingly less.

(ON SLIDE #178)

(2) An lb/in of torque is a one-pound weight hung on a 1-inch lever. Lb/inches are used to express small amounts of torque. You can convert directly by using a factor of twelve. 10 lbs/ft of torque is 120 lb/inches. 96 lb/inches is eight lbs/ft, etc.

(ON SLIDE #179)

d. Types of Torque Wrenches. There are two basic and common types of torque wenches, the Beam and the Click.

(ON SLIDE #180)

(1) Beam Type. The simplest form of torque wrench consists of a long lever arm between the handle and the wrench head, made of a material which bends elastically in response to applied torque. A second, smaller bar with integral mechanical indicator is also connected to the head; this is never subjected to torque and thus maintains a constant position with respect to the head. When no torque is applied to the lever arm the indicator rests parallel to the lever arm. A calibrated scale is fitted to the handle so that applied torque, and the associated bending of the main lever, causes the scale to move under the indicator. When the desired torque is reached (as shown by the indicator), the operator stops applying force. This type of wrench is simple, inherently accurate, and inexpensive.

(ON SLIDE #181)

(2) Click Type. A more sophisticated method of presetting torque is with a calibrated clutch mechanism. At the point where the desired torque is reached, the clutch slips, signaling the desired torque and preventing additional tightening. The most common form uses a ball detent and spring, with the spring preloaded by an adjustable screw thread, calibrated in torque units. The ball detent transmits force until the preset torque is reached, at which point the force exerted by

the spring is overcome and the ball "clicks" out of its socket. The advantage of this design is greater precision and a positive action at the set point. A number of variations of this design exist for different applications and different torque ranges. A modification of this design is used in some drills to prevent gouging the heads of screws while tightening them.

(ON SLIDE #182)

INSTRUCTOR NOTE
Show clip "How to use a use and adjust a torque wrench". (3.19 min)

(ON SLIDE #183)

INTERIM TRANSISTION: We've just covered the torque wrench, are there any questions? If not let's move on to a demonstration covering how to set it up.

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(ON SLIDE #184)

INSTRUCTOR NOTE
Perform the following demonstration.

DEMONSTRATION. (45 min) Allow 45 minutes to demonstrate how to set up and read a torque wrench. One instructor is needed for this demonstration. The purpose of this demonstration is to build confidence in reading/using a torque wrench.

STUDENT ROLE: Students are to watch the instructor as he demonstrates changing the different settings on the torque wrench. They are to ask questions or make comments for clarification.

INSTRUCTOR ROLE: Break the class up into equal groups so that they all can see. Utilizing torque wrenches as training aids, set two different torque wrenches (lbs/ft and lbs/in). Have each group come up as you set each wrench. After setting the torque wrench and everyone understands; zero it out before the next group comes up. Explain to the students that they should always zero the torque wrench out after each use.

1. Safety Brief: N/A

2. Supervision and Guidance: During the demonstration ensure that the students understand as you go along. Probe after each step and allow the students to tell you the next step.
3. Debrief: Allow students the opportunity to ask questions and comment on the demonstration. Answer student questions and provide feedback on student comments.

(ON SLIDE #185)

INTERIM TRANSITION: We've just observed a demonstration on how to set and zero a torque wrench. You will now perform a practical application to develop this skill.

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_____
_____

INSTRUCTOR NOTE
Introduce the following practical application.

PRACTICAL APPLICATION. (1 hr) Allow 1 hour for completion and review. There is one instructor required. The purpose of this practical application is to build confidence in reading/using a torque wrench. Students will come up one by one and set two different torque wrenches (lb/ft and lb/in) and then zero it out. The setting will be whatever the instructor calls out to the student. Each one should be different.

PRACTICE: Students will come up in their groups and line up in a single file line. The first one will come approach the instructor and pick the torque wrench up and set it to whatever the instructor tells him to set it at, the student will then pick up the other one and repeat the same process. When finished they will zero each one out prior to next student coming up.

PROVIDE HELP: Instructor will observe student performance. Instructor will be available to answer student questions throughout the entire practical application time period.

1. Safety Brief: N/A
2. Supervision and Guidance: During the prac app ensure that the students understand as they go along. Probe after each step and allow the students to tell you the next step.
3. Debrief: Allow students the opportunity to ask questions and comment on the prac app. Answer student questions and provide feedback on student comments.

(ON SLIDE #186-188)

TRANSITION: You've just performed a practical application exercise designed to develop your proficiency on a torque wrench. Are there any questions over this practical application? (Q1) A torque wrench allows the operator to do what? **(A1) Measure the torque applied to the fastener so it can be matched to the specifications for a particular application.** (Q2) What are two basic and common type torque wrenches? **(A2) Beam and click types.** At this time we will take a ten minute break.

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(BREAK – 10 MIN)

TRANSITION: During the break did anyone come up with any questions over the torque wrenches? If not, we will now discuss Multimeters.

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(ON SLIDE #189)

16. Multimeters. (15 MIN)

One of the most important debugging tool in any toolbox is a multimeter. A multimeter can measure continuity, resistance, voltage and sometimes even current, capacitance, temperature, etc.

(ON SLIDE #190)

a. **Continuity**. Continuity means, are two things electrically connected. So if two electronic parts are connected with a wire, they are continuous. If they are connected with cotton string, they are not: while they are connected, the cotton string is not conductive.

(ON SLIDE #191)

b. You can always use a resistance-tester (ohmmeter) to figure out if something is connected because the resistance of wires is very small, less than 100 ohms, usually. However, continuity testers usually have a piezo buzzer which beeps. This makes them very useful when you want to poke at a circuit and need to focus on where the probes are instead of staring at the meter display.

(ON SLIDE #192)

c. Continuity is one of the most important tests. Here are some things it is good for:

(1) Determine if your soldering is good. If your solder joint it is a *cold solder connection* it will appear connected but in actually it is not! This can be really frustrating if you are not experienced in visually detecting cold solder joints.

(ON SLIDE #193)

(2) Determine if a wire is broken in the middle. Power cords and headphone cables are notorious for breaking inside the shielding, it appears as if the cable is fine but inside the wires have been bent so much they eventually broke.

(ON SLIDE #194)

(3) Reverse-engineering or verifying a design back to a schematic.

(ON SLIDE #195)

d. You can only test continuity when the device you're testing is not powered. Continuity works by poking a little voltage into the circuit and seeing how much current flows, it’s perfectly safe for your device but if its powered there is already voltage in the circuit, and you will get incorrect readings.

(ON SLIDE #196)

e. Always test to make sure your meter is working before starting the test by brushing the two tips together, and verifying you hear the beep. Maybe the battery is low or its not in the right mode.

f. Continuity is non-directional, you can switch probes and it will be the same.

(ON SLIDE #197)

g. To get you multimeter into correct mode, look for the icon that looks sort of like a “sound wave”.

h. When actually testing for continuity for example on a wire the display will usually show “OL” if not connected. If the circuit or wire that you are testing is connected it will display the low Ohms for example “004.7”

(ON SLIDE #198)

i. **Resistance**. Resistance is just what it sounds like, it's the characteristic that makes a component fight current flow. The bigger the resistance value (in ohms Ω) the more it fights.

(ON SLIDE #199)

j. Look for an ohm (Ω) symbol, if it's a ranging meter there will be a bunch of subdivided modes. If it's auto-ranging there will be only one.

(ON SLIDE #200)

k. **Voltage.** testing is very common; verify that your circuit is getting enough power: when all of the blinky lights are on, is the power supply drooping too low? Testing batteries, solar cells, wall plugs, and power outlets.

(ON SLIDE #201)

l. You can only test voltage when the circuit is powered. If there is no voltage coming in (power supply) then there will be no voltage in the circuit to test. It must be plugged in (even if it doesn't seem to be working).

(ON SLIDE #202)

m. Voltage is always measured between two points. There is no way to measure voltage with only one probe, it is like trying to check continuity with only one probe. You must have two probes in the circuit. If you are told to test at a point or read the voltage at this or that location what it really means is that you should put the negative (black) probe at **ground** (which you must determine by a schematic or somewhere else in the instructions) and the positive (red) probe at the point you would like to measure.

(ON SLIDE #203)

n. DC voltage and AC voltage are very different. Make sure you are testing the right kind of voltage. This may require pressing a mode button or changing the dial. There are often two separate modes for AC and DC voltage. Both will have a V but one will have two lines, one dashed and one solid (DC) and one with have a wave next to it (AC).

(ON SLIDE #204-205)

INTERIM TRANSISTION: We've just covered the multimeter, are there any questions? If not let's move on to a demonstration covering the continuity test.

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INSTRUCTOR NOTE
Perform the following demonstration.

DEMONSTRATION. (15 Min) Allow 15 min to demonstrate how to set up and demonstrate a continuity and volt test. One instructor is needed for this demonstration. The purpose of this demonstration is to build confidence in reading/using a multimeter.

STUDENT ROLE: Students are to watch the instructor as he demonstrates changing the different settings on the multimeter. They are to ask questions or make comments for clarification.

INSTRUCTOR ROLE: Break the class up into equal groups so that they all can see. Utilizing multimeters as training aids, set multimeter to the continuity setting, take a wire and put the black (ground probe) on one end and the red (power or hot) probe on the other and listen for an audible beep. After hearing the beep and everyone understands that this wire is good and there is no break internally. Set the multimeter to voltage setting and test a set of batteries connected in series, one probe on one battery and the other probe on the other battery (positive and negative on each respective battery); observe the reading and explain if they have the probes backwards they will have a negative reading. Zero the multimeter out before the next group comes up. Explain to the students that they should always zero the multimeter out after each use.

1. **Safety Brief:** N/A
2. **Supervision and Guidance:** During the demonstration ensure that the students understand as you go along. Probe after each step and allow the students to tell you the next step.
3. **Debrief:** Allow students the opportunity to ask questions and comment on the demonstration. Answer student questions and provide feedback on student comments.

(ON SLIDE #206)

INTERIM TRANSITION: We've just observed a demonstration on how to set and zero a multimeter. You will now perform a practical application to develop this skill.

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INSTRUCTOR NOTE
Introduce the following practical application.

PRACTICAL APPLICATION. (1 hr) Allow 1 hour for completion and review. There is one instructor required. The purpose of this practical application is to build confidence in reading/using a multimeter.

PRACTICE: Students will come up one by one and set multimeter to the continuity setting then test the wire. Once the student hears the audible beep then they are to explain to the instructor what the significance of doing the test. Set the multimeter to voltage setting and test a set of batteries connected in series, one probe on one battery and the other probe on the other battery (positive and negative on each respective battery); observe the reading. Then zero out the multimeter and hand it to the next student in line. When finished they will zero each one out prior to next student coming up.

PROVIDE HELP: Instructor will observe student performance. Instructor will be available to answer student questions throughout the entire practical application time period.

1. **Safety Brief:** N/A
2. **Supervision and Guidance:** During the prac app ensure that the students understand as they go along. Probe after each step and allow the students to tell you the next step.
3. **Debrief:** Allow students the opportunity to ask questions and comment on the prac app. Answer student questions and provide feedback on student comments.

(ON SLIDE #207-208)

TRANSITION: You've just performed a practical application exercise designed to develop your proficiency on a multimeter. Are there any questions over this practical application? (Q1) What are a couple of reasons why you would perform a continuity test? **(A1)Making sure you have a good solder and that the wire is good (no break in the middle).** (Q2) What does the icon look like on the multimeter for a continuity test? **(A2) A soundwave.** At this time we will take a ten minute break.

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(BREAK – 10 Min)

TRANSISTION: Did anyone think of any questions during the break? If not, let's talk about Preventive Maintenance Requirements.

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(ON SLIDE #209-210)

15. **Preventive Maintenance (PM) Requirements**. **(5 MIN)**

(1) Organizational PM. TMDE will be continuously maintained in a clean and complete condition with functionally clean air filters and functionally charged batteries if so equipped. Any missing components must be on a valid requisition. This procedure combined with an operational check of the equipment in accordance with the equipment technical manual shall constitute organizational PM for all categories of TMDE and requires no scheduling. TMDE equipped with batteries will have them removed while in an "INACTIVE" status.

(2) Intermediate PM. Intermediate PM is performed by the calibration facilities and units authorized intermediate maintenance on test equipment. This PM is normally conducted during calibration of the equipment and requires no scheduling. Intermediate PM will be conducted in accordance with the applicable TM.

(ON SLIDE #211-212)

SUMMARY: **(5 MIN)**

During this period of instruction we have covered T/O and T/E, Control of Support and Test Equipment, Equipment SL/3/TM Components, Purpose and policy of the Marine Corps calibration control program, Responsibilities of organizations holding TMDE, Calibrations Lab responsibilities, Filing and disposition of Calibration and administrative remarks, and several types of TMDE. I feel confident you can go back to you units and utilize the knowledge you gained in this class gaining even more confidence in your superiors, peers, and subordinates; ultimately getting you promoted. Those students with those Instructional Rating Forms go ahead and fill those out the rest of you take a 10 min break.

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(BREAK – 10 Min)

STUDENT REFERENCES:

Appropriate Technical Manuals

Current GCSS-MC Procedural Notices (GPN)

MIMMS Field Procedures Manual MCO P4790.2_

Marine Corps TMDE Calibration and Maintenance Program MCO P4733.1_

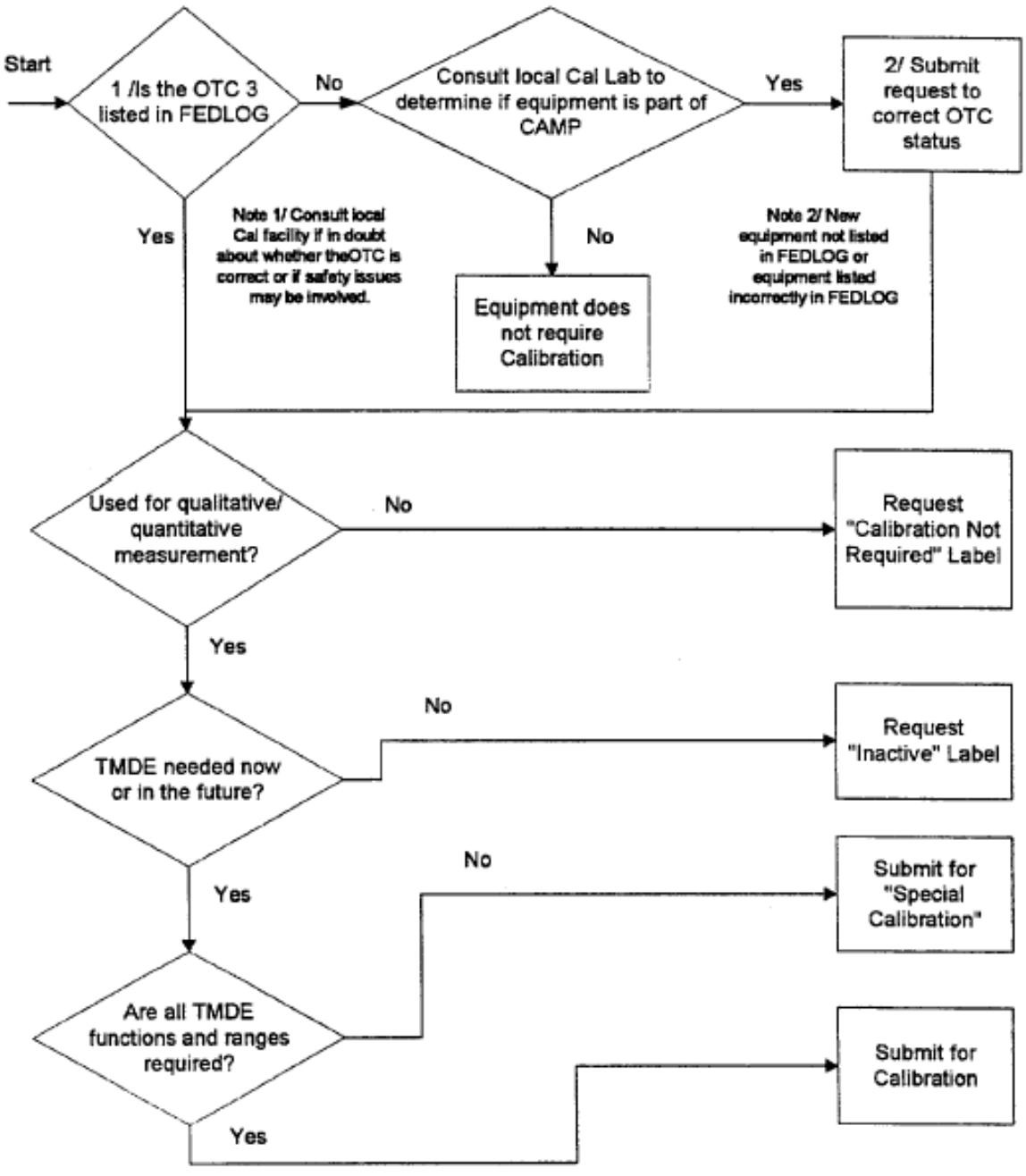

Figure 1. Level of Calibration Determination.

LIST OF PERTINENT REFERENCES ADDRESSING TEST, MEASUREMENT, AND DIAGNOSTIC EQUIPMENT (TMDE) AND THE CALIBRATION AND MAINTENANCE PROGRAM (CAMP)

1. SECNAVINST 3960.6, Department of the Navy Policy and Responsibility for Test, Measurement, Monitoring, Diagnostic Equipment and Systems, and Metrology and Calibration (METCAL).

a. Purpose. Establishes policy and responsibility for incorporating testability and diagnostic capability into weapons platforms, weapons systems, surveillance, communications, navigational guidance, deception/protection systems, meteorological systems, and associated support systems.

2. MCO 10510.18, Policy and Responsibility for Electronics Test and Measuring Equipment.

a. Purpose. Establishes policy and responsibility for the selection, development, acquisition, standardization, application, and logistics support of all types of manual, semiautomatic and automatic general purpose, and special purpose Marine Corps-procured electronic test and measuring equipment.

3. SC-6625/2, Electronic Test and Measuring Equipment, Support Concept.

a. Purpose. Provides information and support guidance pertinent to general and special purpose electronic test and measuring equipment.

4. TI-4733-15/1, Calibration Requirements, TMDE.

a. Purpose. Provides instructions for calibration of TMDE prior to issue by the Marine Corps Logistics Bases and identification of TMDE, which requires calibration at periodic intervals by Marine Force units. Additionally, provides identification and use instructions of calibration labels, tags, and seals.

5. TI-4733-15/2, Sliding Calibration Interval Program, TMDE.

a. Purpose. Provides instructions and specific guidelines relative to the establishment of an optional Sliding Calibration Interval program within the Marine Corps TMDE CAMP.

6. TI-4733-15/3, Retirement of Unstable or Unreliable TMDE.

a. Purpose. Provides instructions for retiring unstable or unreliable TMDE.

NOTE: *TI-4733-15/2 and TI-4733-15/3 will be incorporated into a new TI to be published at a later date.*

7. TI-4733-15/6, TMDE Calibration and Maintenance Support.

a. Purpose. Provides information to aid commanders in obtaining calibration and maintenance support for Marine Corps procured TMDE.

8. TI-4733-15/9, Radiation, Detection, Indication and Computation (RADIAC) Instruments, Calibration Requirements.

a. Purpose. Provides information relative to calibration of RADIAC instruments.

9. TI-4733-15/10, Special Calibration of Torque Wrenches.

a. Purpose. Provides instructions for the calibration of torque indicating (measuring) instruments.

10. TI-4733-15/11, Infantry Weapons Gage Calibration Program.

a. Purpose. Provides procedures for the operation of the Infantry Weapons Gage Calibration program.

11. TI-4733-15/12, Calibration Requirements for Thermistor Mounts/Power Sensors, Marine Corps Calibration Program.

a. Purpose. Provides procedures for the operation of the Thermistor Mount Calibration program.

12. TI-4733-15/21, Survey Instrument Calibration Program (SICP).

a. Purpose. Provides instructions and procedures for the operation of the Marine Corps SICP.

13. TI-4733-35/23, Navy and Marine Corps Calibration Laboratory Audit/Certification Manual.

a. Purpose. Requires that all Naval and Marine Corps calibration laboratories be reviewed at least once every three years; this will be coordinated by TMDE/Calibration and TMDE Management Systems, the Marine Corps Liaison Officer, Corona, and the individual laboratories.

14. TI-4733-35/5, Calibration Equipment Recommendations, Marine

Corps Calibration Program.

a. Purpose. Provides guidance in recommending additional calibration equipment.

15. TI-4733-35/8, Marine Corps Standards Program, CAMP.

a. Purpose. Provides procedures for the operation of the Marine Corps Standards Calibration program.