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Materiel Test Procedure 6-3-070
USA Electronic Proving Ground3448
U. S. ARMY TEST AND EVALUATION COMMAND
COMMODITY SERVICE TEST PROCEDURE

DIRECTION FINDER SET, RADIO

1. OBJECTIVE

The objective of this MTP is to describe the service test procedures required to determine the degree to which radio direction finding sets meet the military characteristics expressed in the Qualitative Materiel Requirements (QMR), Small Development Requirements (SDR), or other applicable criteria, and the suitability of the equipment for military use.

2. BACKGROUND

A radio direction finder (DF) is used to determine the direction of a radio signal. Because signal sources are normally many wavelengths distant, the received signal is assumed to have a plane wave front at right angles to the direction of travel. In its simplest form, a direction finder set consists of three basic elements: a directional antenna, a radio receiver, and an indicator. The directional antenna provides a means for locating the wave front since the antenna power output varies with the orientation of the plane of the antenna relative to the wave front. The radio receiver detects and amplifies the desired signal, and the indicator shows the operator the direction of arrival of the wave front. The indication may be a visual display on a CRT or meter, or direction may be determined from orientation of the antenna during reception of an aural null.

Direction finder sets may be fixed station, transportable (semi-fixed station), mobile, or man-portable. Some larger stations may include separate facilities for direction finding, intercept reception, frequency measurement, communications, and other features and refinements.

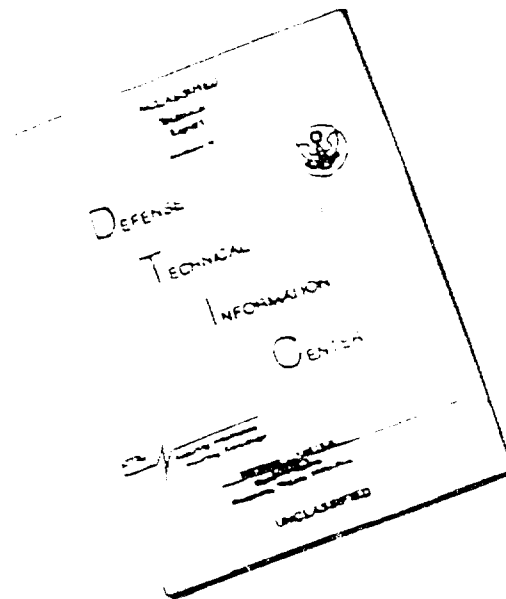
Service tests under actual and/or simulated field conditions will determine the degree to which the test item and associated maintenance package meets the military characteristics and performs the mission as described in QMR, SDR, and will provide a basis for recommendations on type classification.

3. REQUIRED EQUIPMENT

- a. Test Range
- b. Test transmitters and field radio sets
- c. Tactical vehicles
- d. Still and motion picture cameras and associated photographic equipment (black and white or color)
- e. Frequency meters/counters
- f. RF power meters/wattmeters
- g. Appropriate tools sets and test sets
- h. Fixed-wing and/or rotary-wing aircraft with test instrumentation capabilities (if required)

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DISCLAIMER NOTICE



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4. REFERENCES

- A. TM 11-476, Radio Direction Finding.
- B. TM 11-487D, Directory of U. S. Army Signal Equipments - Radio Direction Finding Equipment
- C. TM 11-629, Direction Finder Set AN/TRD-3
- D. TM 11-677, Direction Finder Set AN/PRD-1
- E. TM 11-688, Direction Finder Set AN/TRD-4A
- F. TM 11-5825-231-10, Direction Finder Set AN/TRD-15
- G. TM 11-298, Direction Finder Set AN/TRD-10
- H. MTP 3-1-002, Confidence Intervals and Sample Size
- I. MTP 6-3-523, Safety

5. SCOPE

5.1 SUMMARY

5.1.1 Technical Characteristics

The procedures outlined in this MTP provide general guidance for determining the degree to which the test item meets current military requirements for radio direction finding sets as expressed in the appropriate-QMR, SDR, or other applicable criteria. The cumulative test results together with the results of appropriate common service tests will allow an estimate to be made of the suitability of the equipment to meet the required military needs.

The specific tests to be performed, (as appropriate for a specific item), along with their intended objectives, are listed below:

a. Installation Space Requirements - The objective of this subtest is to determine installation space requirements for equipment and operator activity and to evaluate the degree of ease or difficulty associated with emplacing the item in tactical situations.

b. Operational Characteristics - The objective of this subtest is to determine the operational characteristics of the test item and its suitability for operation under field conditions.

c. Reliability - The objective of this subtest is to determine the mission reliability of the test item in terms of failure-free-operation time, mean time between failures, maintenance down time, and mean time for repair.

d. Adequacy of Vehicle, Van or Shelter - The objective of this subtest is to determine the adequacy and suitability of vehicle, van or shelter when provided or specified for use with the test item.

e. Maintainability - The objective of this subtest is to determine the accessibility and susceptibility of the test item to the accomplishment of the scheduled and non-scheduled maintenance tasks over the entire period of service testing, and to determine whether the instruction manuals conform to the applicable Army regulations and are suitable for training operating and maintenance personnel possessing the required basic skills.

5.1.2 Common Service Tests

Not included in this MTP are the following Common Service Tests which apply to these commodities:

- a. MTP 6-3-500, Physical Characteristics
- b. MTP 6-3-502, Personnel Training Requirements
- c. MTP 6-3-506, Durability
- d. MTP 6-3-509, Effects of Weather
- e. MTP 6-3-513, Qualitative Electromagnetic Interference
- f. MTP 6-3-524, Maintenance Evaluation
- g. MTP 6-3-525, Human Factors

5.2 LIMITATIONS

The capability of larger direction finding systems to provide intercept reception, spectrum analysis, communication reception, telephone communications, etc., are not considered herein. These subsystems are either covered in other commodity service test procedures, or are too specialized for a general treatise.

Radio receivers and transmitters provided as part of direction finding sets will normally be tested under the appropriate commodity MTP, only those features designed for adapting the radio to the direction finding role will be tested under this procedure.

6. PROCEDURES

6.1 PREPARATION FOR TEST

a. Select test equipment ideally having an accuracy of at least ten orders of magnitude greater than that afforded by the item under test, that is in keeping with the state of the art, and with calibrations traceable to the National Bureau of Standards.

b. Record the following information:

- 1) Nomenclature, serial number(s), manufacturer's name, and function of the item(s) under test.
- 2) Nomenclature, serial number, accuracy tolerances, calibration requirements, and last date calibrated of the test equipment selected for the tests.

c. Ensure that all test personnel are familiar with the required technical and operational characteristics of the item under test, such as stipulated in Qualitative Materiel Requirements (QMR), Small Development Requirements (SDR), and Technical Characteristics (TC).

d. Review all instructional materiel issued with the test item by the manufacturer, contractor, or government, as well as reports of previous tests conducted on the same types of equipment, and familiarize all test personnel with the contents of such documents. These documents shall be kept readily available for reference.

e. Prepare record forms for systematic entry of data, chronology of test, and analysis in final evaluation of the test item.

f. Prepare adequate safety precautions to provide safety for personnel and equipment, and ensure that all safety SOP's are observed throughout the test and that the item has successfully completed MTP 6-3-523, Safety.

g. Thoroughly inspect the test item for obvious physical and electrical defects such as cracked or broken parts, loose connections, bare or broken wires, loose assemblies, bent fragile parts, and corroded plugs and jacks. All defects shall be noted and corrected before proceeding with the test.

h. Prior to beginning any subtest, verify correct power source, necessary test instrumentation and inter-connection cabling, and that the equipment is aligned, if necessary, as specified in the pertinent operating instructions to ensure, insofar as possible, it represents as average equipment in normal operating condition.

i. Prepare a test item sample plan sufficient to ensure that enough samples of all measurements are taken to provide statistical confidence of final data in accordance with MTP 3-1-002. Provisions shall be made for modification during test progress as may be indicated by monitored test results.

j. Ensure that support aircraft (if required) are properly instrumented as required, that arrangements for supporting and participating agencies, activities, and facilities have been made, and that the authorization for RF radiation at specific frequencies, power levels, and modulations for required periods has been obtained.

6.2 TEST CONDUCT

6.2.1 Installation Space Requirements

a. Utilizing an average trained crew, place the test item complete and ready for operation in an applicable tactical situation in accordance with the instruction manual.

b. Observe and record the activities and times required to:

- 1) Dismount or otherwise make ready the test items, starting from the transportation configuration, and perform pre-operational adjustments.
- 2) Install the test items (if required)
- 3) Energize or otherwise prepare the test item for operation.

c. Repeat Steps (a) and (b) above, at least three times, utilizing a different crew for each trial.

d. Measure and record space required for:

- 1) Equipment (including integral and external antenna systems)
- 2) Power sources
- 3) Operator and maintenance activity

6.2.2 Operational Characteristics

NOTE: Select the operational test(s) applicable to the specific direction finding set under test.

a. Deploy a transmitter(s) at various distances and orientations with respect to the test item in a series of tests. The location of the transmitter(s) shall be unknown to the operator of the test item.

b. Operate the transmitter(s) which is to be located, tracked or homed upon at:

- 1) Frequencies appropriate for the direction finder.
- 2) Minimum-to-normal power outputs.
- 3) Typical modulations
- 4) Different antenna orientations and polarization, if available and appropriate.

c. Place a trained operating crew with the test item at a representative location and initiate a search for the transmitter. Observe and record:

- 1) Time required to obtain initial fix on transmitter
- 2) Loss of signal during search
- 3) Path taken to transmitter, as plotted on a grid map.
- 4) Problems encountered.

d. Repeat the search for the transmitter(s) with the direction finder mounted in a ground vehicle and/or in an aircraft. Record data as in step (c) above and include the altitude of the aircraft, when appropriate.

e. Mount the transmitter(s) in a ground vehicle or an aircraft and locate and track the moving transmitter with the test item. Prescribe aircraft and flight (vehicle) paths on map overlays or scaled diagrams showing the following minimum information:

- 1) Length and direction of data runs.
- 2) Time required to obtain fix on transmitter
- 3) Altitudes, ranges and antenna elevation angle.
- 4) Difficulties encountered.

6.2.3 Reliability

a. Starting with the initial assembly, set-up, and check-out of the test item upon receipt at the test agency, maintain a complete log of all assembly, installation, operation, disassembly, and maintenance activities for the purpose of reliability analysis. The log shall include the following information:

- 1) Number of times the test item is assembled and installed from the field transport configuration.
- 2) Number of times the test item is disassembled and repacked in the field transport configuration.
- 3) Hours of operation, daily and cumulative.
- 4) Equipment failures and malfunctions, including chronological data required to determine failure-free operating time, mean

time between failures, maintenance down time, and mean time for repair.

b. Ensure that the test item has been subjected to the appropriate tests in MTP 6-3-510.

c. Observe and record the incidence of defects in the test item and its components, including:

- 1) Inoperable electronic equipment (damaged enclosures, loose or broken connections, foreign material accumulations, damaged components).
- 2) Damaged or worn mechanical parts, to include component packaging, (bent or broken handles and fasteners, defective seals, sluggish or restrained mechanical action).

6.2.4 Adequacy of Vehicle, Van or Shelter

a. Throughout the entire testing period, monitor any vehicle, van or shelter provided as part of or specified for use with the test item with respect to its adequacy and suitability for the intended mission.

b. Record narrative comments obtained from all test personnel through daily observation, interview and questionnaire concerning the following:

- 1) Equipment arrangement and mounting
- 2) Ventilation, heating and air conditioning
- 3) Lighting and blackout provisions
- 4) Acoustical properties
- 5) Protective features (CBR)
- 6) Roadability and safety
- 7) Any other features which might affect the overall adequacy and suitability of the test item

6.2.5 Maintainability

a. Throughout the conduct of all testing as outlined in this MTP, maintain a record of performance of scheduled and unscheduled maintenance as prescribed in the appropriate draft publications.

b. Compare all replacement parts and components provided with the test item with anticipated and actual requirements, evaluating spare parts requirements under actual operating conditions.

c. Record the requirements for additional tools and instruments, shortcomings in authorized tools and instruments, and needs for specialized tools and instruments to accomplish assigned levels of maintenance.

d. Record all spare parts used, man hours and elapsed time required, and level of skill demanded.

e. Review all instruction manuals for compliance with applicable Army regulations, and utilize the manuals for classroom instruction and as references throughout the tests.

f. Record all deficiencies and inaccuracies noted in the instruction manuals.

6.3 TEST DATA

6.3.1 Preparation for Test

Data to be recorded prior to testing shall include but not be limited to:

- a. Nomenclature, serial number(s), manufacturer's name, and function of the item(s) under test.
- b. Nomenclature, serial number, accuracy tolerances, calibration requirements, and last date calibrated of the test equipment selected for the tests.
- c. Damages to the test item incurred during transit and/or manufacturing defects.

6.3.2 Test Conduct

Data to be recorded in addition to specific instructions listed below for each subtest shall include:

- a. A block diagram of the test set-up employed in each specified test. The block diagram shall identify by model and serial number, all test equipment and interconnections (cable lengths, connectors, attenuators, etc.) and indicate control and dial settings where necessary.
- b. Photographs or motion pictures (black and white or color), sketches, charts, graphs, or other pictorial or graphic presentations which will support test results or conclusions.
- c. An engineering logbook containing in chronological order, pertinent remarks and observations which would aid in a subsequent analysis of the test data. This information may consist of temperatures, humidity, pressures, and other appropriate environmental data, or other description of equipment or components, and functions and deficiencies, as well as theoretical estimations, mathematical calculations, test conditions, intermittent or catastrophic failures, test parameters, etc., that were obtained during the test.
- d. Test item sample size (number of measurement repetitions).
- e. Instrument or measurement system mean error stated accuracy.

6.3.2.1 Installation Space Requirements

a. Record times for accomplishment of test phases under assigned conditions in minutes.

b. Record all activities on motion picture film.

c. Record the following:

- 1) Type of installation (fixed, semi-fixed, mobile, etc.)
- 2) Mode(s) of operation
- 3) Measured space required for operating component
- 4) Measured space required for antenna system and power supply
- 5) Measured space required for operating and maintenance activity

6.3.2.2 Operational Characteristics

- a. Record mode(s) of operation and number of targets
- b. Record the following in appropriate form for each condition of transmitter-test operation:

- 1) Transmitter(s)

- a) Location and periods of operation
- b) Frequencies
- c) Power outputs
- d) Modulation (AM, FM, CW, ICW, etc.)
- e) Antenna orientations (azimuth and elevation/tilt)
- f) Antenna polarization(s)

- 2) Test Item

- a) Time required to obtain initial fix on transmitter
- b) Loss of signal during search
- c) Path taken to transmitter, as plotted on a grid map
- d) Problems encountered

6.3.2.3 Reliability

- a. Record log of all activities to include:

- 1) Number of times the test item is assembled and installed
- 2) Number of times the test item is disassembled and repacked
- 3) Hours of operation, daily and cumulative
- 4) Equipment failures and malfunctions, including chronological data required to determine failure-free operating time, mean time between failures, maintenance down time, and mean time for repair.

- b. Record incidence of defects in the test item and its components at specified intervals.

6.3.2.4 Adequacy of Vehicle, Van or Shelter

- a. Record types of vehicle, van or shelter and modification, if any,
- b. Record observations and comments of supervisory and operating personnel.

6.3.2.5 Maintainability

- a. Record requirements for additional tools and instruments, shortcomings, and needs for specialized tools and instruments to accomplish assigned levels of maintenance.
- b. Record spare parts used, man hours and elapsed time required, and level of skill demanded.
- c. Record all deficiencies and inaccuracies in the instruction manuals.

6.4 DATA REDUCTION AND PRESENTATION

Processing of raw test data shall, in general, consist of organizing, marking for identification and correlation, and grouping the test data according to subtest title. Test criteria or test item specifications shall be noted on the test data presentation to facilitate analysis and comparison. Where necessary, test data measurement units shall be converted to be compatible with units given by test criteria or specifications.

Pertinent data shall be extracted from daily activities logs and notes and collated for presentation in chart, graphic, and narrative form, as appropriate.

The data reduction process shall be accomplished by manual and/or automatic processes, employed as appropriate to the nature and form of the raw data. Insofar as possible, automatic data processing (ADP) methods and facilities should be used to facilitate extraction of data pertinent to various test parameters in different combinations. However, ADP methods may not be feasible or economical for small scale tests.

A written report shall accompany all test data and shall consist of conclusions and recommendations drawn from test results. The test engineer's opinion, concerning the success or failures of any of the functions evaluated shall also be included. In addition, equipment specifications that will serve as the model for a comparison of the actual test results should be included.

Equipment evaluation usually will be limited to comparing the actual test results to the equipment specifications and the requirements as imposed by the intended usage. The results may also be compared to data gathered from previous tests of similar equipment performed under similar conditions.

If the equipment is found to be unacceptable, reasons for its unacceptability shall be forwarded along with remedial suggestions for its improvement.