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AD NUMBER
AD875688
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AUTHORITY
USATEC ltr, 14 Dec 1970

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AD 875688

22 July 1970 U. S. Army Airborne, Electronics and Special Warfare Board

U. S. ARMY TEST AND EVALUATION COMMAND
COMMODITY SERVICE TEST PROCEDURE

ANTENNAS, GENERAL

1. OBJECTIVE

This document is a guide to test methods and techniques for determining the suitability of antennas for use with given electronic equipment or systems as defined in the applicable QMR or SDR.

2. BACKGROUND

Antennas used with tactical communication-electronic equipment employed under combat conditions may be developed separately, either as a new or a product improvement item, or they may be developed concurrently with and as a component of new equipment. Such antennas are of multiple types possessing a variety of characteristics. Both directional and omni-directional types are required and all must be designed to be lightweight, durable, and as small in size as feasible. Many are required to operate over a wide band of frequencies. They are employed with man-pack operable items such as radio sets, on both wheeled and tracked vehicles, on mobile shelters, on indigenous objects such as trees, and on lightweight man-transportable masts that can be quickly erected or dismantled and prepared for transport. The most common tactical antenna configuration is the whip; other configurations include arrays, long wire, sloping wire and wire doublets. Applications involve the use of both ground and ionospheric electromagnetic wave propagation. Final proof of the suitability or unsuitability of any antenna for U. S. Army use is obtained through service testing where the antenna is used with specified equipment(s) operating under field conditions and performing the mission(s) for which it was designed.

3. REQUIRED EQUIPMENT

- a. Antenna under test (test item).
- b. Electronic equipment or systems with which the test item was designed to operate.
- c. Maintenance test package and other electronic test equipment required to align and operate designated electronic equipment; appropriate tools and equipment to facilitate antenna handling by installation personnel.
- d. Suitable field test sites.
- e. Equipment as specified in referenced MTP's.

4. REFERENCES

- A. USATECOM Regulation 70-23, Equipment Performance Reports (EPR's).
- B. USATECOM Regulation 70-24, Research and Development: Documenting Test Plans and Reports.
- C. USATECOM Regulation 700-1, Value Engineering.
- D. MTP 6-3-500, Physical Characteristics.

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MTP 6-3-020
22 July 1970

- E. MTP 6-3-501, Pre-Test Inspection for Service Test.
- F. MTP 6-3-502, Personnel Training Requirements.
- G. MTP 6-3-504, Installation and Operation.
- H. MTP 6-3-506, Durability.
- I. MTP 6-3-509, Effects of Weather.
- J. MTP 6-3-510, Transportability of Communication, Surveillance, and Electronic Equipment.
- K. MTP 6-3-512, Compatibility with Related Equipment.
- L. MTP 6-3-515, Reliable Communication Range.
- M. MTP 6-3-518, Operation During Travel.
- N. MTP 6-3-523, Safety.
- O. MTP 6-3-524, Maintenance Evaluation.
- P. MTP 6-3-525, Human Factors.
- Q. Technical Manuals, Manufacturers Installation, Operation, and Maintenance Information and Appropriate Engineering Test Data.

5. SCOPE

For an antenna to be suitable for Army use, it must be electrically and mechanically compatible with the equipment for which it is intended and be mechanically suitable for field use. To make these determinations, testing is conducted under field conditions by personnel representative of those who will operate the equipment when it is fielded. When an antenna under test may replace one or more current antennas, the standard should be subjected to applicable test procedures concurrently with the test item to develop the relative merits of each. In such cases the standard antenna is referred to as the control item.

5.1 SUMMARY

5.1.1 Preparation for Test

This section provides guidance for test project planning, requirements for facilities and equipment, and instructions for test personnel familiarization.

5.1.2 Test Conduct

The tests are arranged in a logical sequence of procedures to determine suitability of the test item for Army use. These tests are as follows:

a. Physical Characteristics and Test Item Inspection - This section provides procedures for obtaining test item physical characteristics and determining condition of the test item as received for test.

b. Personnel Training - Procedures are given for training test personnel in installation and operation of the test items as well as operator maintenance functions.

c. Reliable Range - Test procedures are given for operating the test item with specified equipment under various conditions of terrain and distance.

d. Installation and Operation - Installation and operation are

accomplished by representative user personnel and repeated as necessary to determine time, personnel and tools required.

e. Compatibility - Procedures are given for determining any lack of compatibility between the test item and equipment with which it is intended to operate.

f. Durability - This section contains procedures for determining capability of the test item to withstand the effects of handling and transporting under field conditions.

g. Operation During Motion - The procedures given are for determining significant performance differences between stationary operation and operation while traveling.

h. Transportability - This is an evaluation of provisions for transport of the test item and the effects resulting from transport as specified.

i. Weather - A determination of the effects of weather on the test item is made based on weather conditions encountered.

j. Maintenance - Throughout the conduct of all testing, maintenance actions are noted and reported. This includes all failures, manpower, tools and equipment required, suitability of maintenance instructions and the maintenance test package, mean time between failures and mean time to repair.

k. Safety - An evaluation to determine the safety characteristics and to provide safety confirmation.

l. Human Factors Evaluation - An evaluation of the man-item relationship under the prescribed test conditions to determine the ease of handling, using, and maintaining the test antenna.

m. Value Analysis - An evaluation directed at analyzing antenna components and features for the purpose of reducing antenna cost without compromising its performance, safety, and suitability for Army use.

5.1.3 Test Data

This section details the raw data to be collected and recorded while completing the test procedures in paragraph 6.2., Test Conduct.

5.1.4 Data Reduction and Presentation

This section provides instructions for analyzing and evaluating the raw data and presenting the results.

5.2 LIMITATIONS

These test procedures are applicable to ground mounted, vehicular mounted and man-pack operable antennas intended for use in tactical environment.

6. PROCEDURES

6.1 PREPARATION FOR TEST

6.1.1 Test Project Planning

The test project officer and other designated test personnel must:

MTP 6-3-020
22 July 1970

- a. Review the test directive to gain a clear understanding of test objectives and all accompanying instructions.
- b. Conduct a thorough study of stated requirements as contained in QMRs, SDRs, SORs, the Test Directive, or other appropriate documents to insure that complete and suitable test criteria are selected.
- c. Study thoroughly the characteristics of the test item and associated electronic equipment intended to be used with it.
- d. Determine test site and frequency requirements.
- e. Plan for and schedule all test personnel and any personnel training required.
- f. Review the listing of required equipment (paragraph 3) and data determined in paragraph 6.1.1c to determine support items required.

6.1.2 Required Equipment/Facilities Setup

- a. Test projects conducted at an established test facility will normally require minimum preparation with respect to equipment and facilities setup. Support items required are usually readily available but scheduling and planning for use are required.
- b. Antenna service test projects sometimes require the use of distant locations. When this occurs, use of test sites, frequencies, and facilities at these location(s) must be coordinated with appropriate agencies.

6.1.3 Test Personnel Familiarization

Instruct supervisory test team members in the safety precautions to be followed when conducting antenna tests. Issue copies of all appropriate technical manuals for equipment and antenna(s) used during testing. Include the following:

- a. Information on proper use of electronic equipment operated with the test antenna(s).
- b. Procedures to be followed in installing, aligning, using, and taking down the test antenna(s).
- c. Known hazards and safety precautions associated with test procedures and equipment.
- d. Data to be collected.

6.2 TEST CONDUCT

NOTE: All antenna damage either noted upon receipt or sustained during testing shall be reported in accordance with USATECOM Regulation 70-23 (ref 4A).

6.2.1 Physical Characteristics and Test Item Inspection

Determine the physical characteristics and the physical and operational condition of the test item as received for test using applicable portions of MTP 6-3-500 (ref 4D) and MTP 6-3-501 (ref 4E).

6.2.2 Personnel Training

Using applicable procedures in MTP 6-3-502 (ref 4F), conduct operator training. Instruct test personnel, having the proper MOS, in:

a. Installation of the test item. If the test item is one designed for use on a mast or other elevated means select a site in the field suitable for preparing (installing) the test item for operation and for preparing it for movement. Have test personnel repeat preparation for operation and preparation for movement procedures until proficiency sufficient for conduct of all other subtests has been gained.

b. Operation of the test item. Connect the test item to each equipment, in turn, with which it is intended to operate. Have test personnel make all adjustments required for proper operation. Repeat this procedure until test personnel are judged to be adequately proficient.

c. Operator maintenance.

6.2.3 Reliable Range

Using applicable procedures in MTP 6-3-515 (ref 4L) and the test item with specified equipment item(s), conduct extensive range testing over various types of terrain in various directions out to the required distances (as specified in OMR or SDR). If communication equipment is not involved, equipment functions must be performed under conditions of various terrain, directions, and distances in the same manner as for communication. Obtain sufficient quantities of data to determine performance completely; this includes directional properties and significant nulls, side and back radiation in event the test item is designed to be directional, or in the event it is designed to be omnidirectional but in fact is not.

6.2.4 Installation and Operation

Perform applicable portions of MTP 6-3-504 (ref 4G) to determine the ease of installation and disassembly of the test item and the ease of operation, if applicable. Test sites should be typical of tactical installations, incorporating a wide variety of terrain and vegetation. For this particular subtest, the test sites should be free from any electrical or electronic equipment items other than those required to operate with the test item.

6.2.5 Compatibility

Using applicable procedures in MTP 6-3-512 (ref 4K), obtain complete data on compatibility (such as electrical and mechanical of the test item for use with the equipment item(s) specified.

6.2.6 Durability

Perform applicable portions of MTP 6-3-506 (ref 4H) in order to determine if the test item has the requisite durability. A sufficient number of set-ups and tear-downs should be executed to simulate extended life usage.

6.2.7 Operation During Motion

MTP 6-3-020
22 July 1970

Perform applicable portions of MTP 6-3-518 (ref 4M) to determine test item performance during stationary operation and during operation while mobile. This includes both vehicular mounted antennas and man-pack operable antennas.

6.2.8 Transportability

Use applicable portions of the procedures in MTP 6-3-510 (ref 4J). Transport the test item, as appropriate, by man-pack means, in vehicles, and in aircraft. Evaluate the suitability of the transport means used and all test item accessories provided such as transport cases, racks and securing means, and load bearing equipment.

6.2.9 Effects of Weather

Perform applicable portions of MTP 6-3-509 (ref 4I) to determine the effects of weather encountered during the test period. Take advantage of every opportunity to subject the test item to weather extremes occurring during the test period.

6.2.10 Maintenance

Conduct maintenance evaluation using applicable guidance as outlined in MTP 6-3-524 (ref 4O).

6.2.11 Safety

Conduct the safety evaluation using applicable guidance as outlined in MTP 6-3-523 (ref 4N). In addition, if high-power transmit signals are being developed, exercise extreme care to keep all personnel away from the antenna-transmitter coupling devices and out of the near field radiation pattern of the transmit antenna during active test periods.

6.2.12 Human Factors Evaluation

Conduct the human factors evaluation using applicable guidance as outlined in MTP 6-3-525 (ref 4P).

6.2.13 Value Analysis

a. During the conduct of all tests, test personnel shall evaluate the test antenna(s) from a value versus cost standpoint. Record all pertinent comments concerning features or components which can be eliminated or modified to accomplish cost reduction without impairment of performance, reliability, quality, maintainability, or safety. The applicable portions of USATECOM Regulation 700-1 (ref 4C) shall be used for this evaluation.

b. Consideration shall be given to the topics listed below:

- 1) Mission Capacity - The test antenna(s) should be capable of accomplishing the specified task with only a reasonable

margin of excess capability. Excess capacity and unused capability normally results in unnecessary bulk, excessive weight and unwarranted costs.

- 2) Simplicity - Unnecessarily complex components, redundancy, and the use of unneeded parts will increase costs and maintenance efforts.
- 3) State of the Art - In many instances the use of recently developed, currently available, components and automated features will result in an overall product improvement and cost savings.
- 4) Standardization - The use of identical parts and parts currently in the military system will reduce the overall logistics burden.
- 5) Materials and Methods of Construction - Polished surfaces, overdone finishes, and the use of expensive materials will result in unnecessary costs if used inappropriately.
- 6) Tolerances - Excessively close tolerances are costly and result in difficulties and delays in accomplishing assembly, routine maintenance, servicing and repair.

6.3 TEST DATA

NOTE: In compiling the Test Data section, test personnel should expound upon those data which are other than quantitative in nature by recording narrative descriptions of events occurring during conduct of the test.

Record the following:

6.3.1 Physical Characteristics and Test Item Inspection

Data required by MTP 6-3-500 (ref 4D) and MTP 6-3-501 (ref 4E).

6.3.2 Personnel Training

Data required by MTP 6-3-502 (ref 4F).

6.3.3 Reliable Range

- a. Data required by MTP 6-3-515 (ref 4L).
- b. Antenna applications other than communications.
- c. Positional and directional relationship between the test item and a target, another test item, a transponder, or other type antenna during each transmission/reception event.

6.3.4 Installation and Operation

Data required by MTP 6-3-504 (ref 4G).

6.3.5 Compatibility

MTP 6-3-020
22 July 1970

Data required by MTP 6-3-512 (ref 4K).

6.3.6 Durability

Data required by MTP 6-3-506 (ref 4H).

6.3.7 Operation During Motion

Data required by MTP 6-3-518 (ref 4M).

6.3.8 Transportability

- a. Data required by MTP 6-3-510 (ref 4J).
- b. Provisions for transport.
- c. Disassembly required for transport packing.
- d. Time required for disassembly and reassembly for use.

6.3.9 Effects of Weather

Data required by MTP 6-3-509 (ref 4I).

6.3.10 Maintenance

Data required by MTP 6-3-524 (ref 4O).

6.3.11 Safety

Data required by MTP 6-3-523 (ref 4N).

6.3.12 Human Factors Evaluation

Data required by MTP 6-3-525 (ref 4P).

6.3.13 Value Analysis

- a. Appropriate comments for each of the topics listed below:

- 1) Mission capacity .
- 2) Simplicity .
- 3) State of the Art .
- 4) Standardization .
- 5) Materials and methods of construction .
- 6) Tolerances .

- b. Proposals for changes in the test antenna(s) with reasons therefore.

6.4 DATA REDUCTION AND PRESENTATION

6.4.1 Data Reduction

Organize, analyze and summarize all raw data as specified in each of the MTP's referred to in paragraph 6.2. Use tabulations and charts as appropriate. Make a succinct, unbiased, and independent analysis of test data to show:

- a. The degree to which the test item meets stated requirements (test criteria) in QMR's, SDR's or other approved documents.
- b. Deficiencies, shortcomings and suggested improvements.

6.4.2 Data Presentation

Evaluate and present a complete data summary indicating the results and address the following:

- a. Item characteristics such as performance, reliability, durability and human factors engineering.
- b. Comparison of test item characteristics with those of a similar item or standard (control item). Show whether the test item offers a significant improvement (or not) over the control item or only a minimal and perhaps costly improvement.
- c. Maintenance and maintainability characteristics.
- d. Safety characteristics and safety confirmation. All aspects of safety must be evaluated to determine if safety confirmation can be given or must be withheld pending correction of any hazards found.
- e. Conclusions and recommendations on overall test objectives and the suitability or unsuitability of the test item for Army use.

MTP 6-3-020
22 July 1970

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MTP 6-3-020
22 July 1970

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Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) US Army Test and Evaluation Command (USATECOM) Aberdeen Proving Ground, Maryland 21005		2a. REPORT SECURITY CLASSIFICATION Unclassified	
		2b. GROUP -----	
3. REPORT TITLE U. S. Army Test and Evaluation Command Materiel Test Procedure 6-3-020, Commodity Service Test Procedure, - "Antennas, General".			
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Final			
5. AUTHOR(S) (First name, middle initial, last name) -----			
6. REPORT DATE 22 July 1970		7a. TOTAL NO. OF PAGES 12	7b. NO. OF REFS 17
8a. CONTRACT OR GRANT NO. DA-18-001-AMC-1045(R)		9a. ORIGINATOR'S REPORT NUMBER(S) MTP 6-3-020	
b. PROJECT NO. AMCR 310-6		9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) -----	
c. d.			
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11. SUPPLEMENTARY NOTES -----		12. SPONSORING MILITARY ACTIVITY Headquarters US Army Test and Evaluation Command Aberdeen Proving Ground, Maryland 21005	
13. ABSTRACT This Army Service Test Procedure describes test methods and techniques for evaluating the performance and characteristics of Antennas for Tactical Communication-Electronic Equipment, and for determining their suitability for service use by the U. S. Army. The evaluation is related to criteria expressed in applicable Qualitative Materiel Requirements (QMR), Small Development Requirements (SDR), Technical Characteristics (TC), or other appropriate design requirements and specifications.			

DD FORM 1473 (PAGE 1)
1 NOV 65
S/N 0101-807-6811

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A-31408

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FORM 1473 (BACK)
1 NOV 65
0101-907-6421

8-21402

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