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

AIR DEFENSE SYSTEMS, ELECTRONICS

1. OBJECTIVE

The objective of this Materiel Test Procedure (MTP) is to compare, under actual or simulated field conditions, the mission performance of air defense systems electronic equipment with the requirements of applicable Qualitative Materiel Requirements (QMR) or Small Development Requirements (SDR, and to demonstrate its suitability for Army use.

2. BACKGROUND

Air defense systems are predominately electronic in nature, due to their relationship with elctronic target data gathering devices such as radars. The effective instrument of air defense, a warhead-carrying missile, typically operates in an environment which is generated, maintained, and influenced by masses of elctronic equipment. Many of the individual subsystems and major components of air defense systems are service tested in accordance with separate procedures, which aid in determining the salient characteristics of the respective item. However, comprehensive service tests will be required of the electronic environment generated by these and other items of equipment, operating together as the non-missile portions of air defense systems.

3. REQUIRED EQUIPMENT

a. An Installation or Facility comprising the Test Item
b. Maintenance Test Packages
c. Maintenance Support Facilities
d. Suitable Operational Areas and Sites
e. Independent Reference Facilities (Radar, Monitoring, Optical, Communication)
f. Cameras and Film (Still and Motion Picture)
g. Voice Recorders and Recording Medium
h. Event Recorders
i. Data Recorders
j. Meteorological Instrumentation
k. Suitable Transport Vehicles
l. Aerial Targets and Target Operating Facilities
m. Elapsed Time Recorders (Stopwatches)

4. REFERENCES

A. Applicable QMR/SDR
B. Applicable TOE for the Air Defense System
C. Army Regulation 40-583, Control of Potential Hazards to Health from Microwave Energy

D. Army Regulation 70-10, Army Materiel Testing
E. Army Regulation 320-5, Dictionary of United States Army Terms
F. USATECOM Regulation 385-6, Verification of Safety of Materiel During Testing
G. USAMC Regulation 385-224, AMC Safety Manual
H. USATECOM Regulation 705-4, Equipment Performance Report
I. Army Regulation 705-15, Operation of Materiel under Extreme Conditions of Environment
J. USATECOM Regulation 705-24, Management of Test and Test Support Aircraft
K. USATECOM Regulation 705-25, Reliability Program for Materiel and Equipment
L. USATECOM Regulation 705-26, Maintainability Program for Materiel and Equipment
M. USATECOM Regulation 705-35, Criteria for Air Transportability and Air Drop of Materiel
N. USAMC Regulation 750-15, Maintenance of Supplies and Equipment
O. MTP 5-3-501, Battlefield Mobility, Tactical Flexibility and Portability
P. MTP 5-3-502, Manuals and Technical Literature
Q. MTP 5-3-509, Adequacy of Lighting, Ventilation, Air Conditioning, and Heating Equipment
R. MTP 6-3-500, Physical Characteristics
S. MTP 6-3-501, Technical Inspection
T. MTP 5-3-502, Personnel Training and Equipment
U. MTP 6-3-505, Emplacement, Action, and March Order
V. MTP 6-3-509, Effects of Weather
W. MTP 6-3-510, Transportability of Communications, Surveillance, and Electronic Equipment
X. MTP 6-3-512, Compatibility with Related Equipment
Y. MTP 6-3-513, Qualitative Electromagnetic Interference
Z. MTP 6-3-514, Qualitative Frequency Accuracy and Stability
AA. MTP 6-3-518, Operation During Motion
AB. MTP 6-3-523, Safety
AC. MTP 6-3-524, Maintenance Evaluation
AD. MTP 6-3-525, Human Factors
AE. MTP 6-4-001, Desert Environmental Test of Communication, Surveillance, and Avionic Electronic Equipment
AF. MTP 6-4-002, Arctic Environmental Test of Communication, Surveillance, and Avionic Electronic Equipment
AG. MTP 6-4-003, Tropic Environmental Test of Communication, Surveillance, and Avionic Electronic Equipment
AH. MTP 7-3-512, Air Drop Capability (Suitability of Materiel for)
AI. MTP 7-3-515, Air Transport, Internal (Suitability of Materiel for)
AJ. MTP 7-3-516, Air Transport, External (Suitability of Materiel for)
AK. MTP 10-3-501, Operator Training and Familiarization
AL. MTP 10-3-504, Maintenance Evaluation

5. SCOPE

5.1 SUMMARY

a. The tests described in this MTP enable comprehensive service testing of ground-based air defense systems electronic equipment, whether covered by individual MTP or not. Electronic equipment functioning in the air defense role as elements of autonomous weapons systems will be tested as described in this MTP.

Weapons systems electronic elements perform the following functions:

1) Data gathering (e.g., radars)
2) Data transmission
3) Data processing
4) Displays
5) Communications
6) Control and coordination (e.g. battery terminal equipment, BTE)
7) Fire distribution
8) Missile guidance, including target illumination
9) Telemetry
10) Electronic counter-countermeasures
11) Training (e.g., engagement simulators)
12) Testing (e.g. checkout equipment)
13) Power supply (e.g., generator units)

b. Tests of electronic equipment performing air defense functions include the following as applicable for the test item:

1) Pre-Test Operations, consisting of:

a) Preoperational Inspection and Physical Characteristics - a study to verify the physical dimensions configuration, and technical characteristics, weights, of the test item; to determine its arrival condition; its completeness and readiness for testing; and the completeness of its maintenance test package, including manuals and technical literature, tools and test equipment, and spare parts.
b) Safety Release - a review of the safety documentation from engineer tests, and release for service testing.
c) System Checkout - a determination that the internal components of the test item are functional as a system.

2) Operational Characteristics, consisting of:

a) Emplacement and March Order - a determination of the

times required and necessary skills and personnel assignments for emplacing the test item, preparing for action, and march ordering.

b) Mobility - a study of the capability of the test item for deployment and maneuver in applicable theaters of operations, and for operation while in motion.

c) Functional Performance - a determination of the capabilities of the test item for accomplishing, as applicable, the following functional missions:

1) Target data acquisition and processing
2) Communications
3) Control, coordination, pre-distribution
4) Missile guidance and telemetry
5) Vulnerability to countermeasures

d) Compatibility with Related Equipment - a study of the test item in conjunction with interconnected or interrelated systems to determine compatibility.

3) Special Operations, consisting of:

a) Air Transportability - a study of the capability of the test item for transportation by air and delivery by air drop.

b) Surface Transportability - a study of the capability of the test item for transportation by carriers other than aircraft.

c) Environmental Suitability - a determination of the capability of the test item for operation in regions of extreme environmental conditions.

4) Full-Test Performance, consisting of:

a) Maintenance Evaluation - a determination of the capability of average trained personnel to maintain the test item in the field; of the adequacy and suitability of manuals and technical literature, tools and test equipment, and spare parts; and of the test item's reliability.

b) Human Factors - a study of the interaction between test item and using personnel to determine whether adverse factors exist which cause personnel malfunction.

c) Internal Environment - a study of the adequacy of provisions inside enclosed vans or trailers for lighting and air conditioning.

d) Safety - a study of hazards to personnel during transportation, operation, or maintenance of the test item.

5) Post-Test Operations - a repeat of the preoperational inspections to determine effects of service testing on the test item.

5.2 LIMITATIONS

The tests described in this MTP are limited to electronic equipment functioning in air defense weapons systems environments. However, the tests may be adapted for service testing of electronic equipment items as separate commodities when not otherwise covered by MTP, provided that such items fulfill air defense roles.

6. PROCEDURES

6.1 PREPARATION FOR TEST

6.1.1 Scheduling

6.1.1.1 Personnel

a. Prior to the arrival of the test item, ensure that adequate numbers of service personnel organized into appropriate units and trained as prescribed in applicable sections of MTP 6-3-502 and MTP 10-3-504, are assigned for the test.

b. Record for all service personnel details of identity, training, and experience.

6.1.1.2 Facilities and Equipment

a. Select and schedule suitable weapons system emplacement sites and maneuvering areas in appropriate types of terrain and at representative environmental locations as required by Test Directive applicable MTP.

b. Upon establishing the scheduled availability of the test item, coordinate the availability of the following:

1) Pertinent reports and data from Engineer Test, including engineering safety confirmation if available.
2) Maintenance support facilities and personnel
3) On-site location of spare parts basic load
4) Required equipment, special facilities, instrumentation, and supplies
5) Assistance of other U.S. Army test agencies and activities for conduct of test operations requiring their respective specialties.

6.1.2 Pre-Test Operations

6.1.2.1 Preoperational Inspection and Physical Characteristics

Accomplish in accordance with applicable sections of MTP 6-3-500 and MTP 6-3-501, including the following:

a. Inspect for shipping damage

b. Measure, weigh, and photograph major components

c. Verify test item technical characteristics

d. Inventory the shipment against shipping documents, including equipment items, and maintenance test package, consisting of:

1) Manuals and Technical Literature (refer to MTP 5-3-502)
2) Tools and Test equipment
3) Repair parts

6.1.2.2 Safety Release

Review safety release to determine whether or not test procedure and plans are adequate.

6.1.2.3 System Checkout

Conduct a qualitative examination of the test item to verify that its component units are functional together as a subsystem of the respective air defense weapons system.

6.2 TEST CONDUCT

Observe the following:

a. Safe test procedures will be followed throughout all phases of testing. All test operations will be observed by cognizant test project personnel, and any unsafe or potentially unsafe conditions shall cause testing to be suspended until all safety hazards are understood and remedied.

b. Safety warnings will be observed, and safe operating instructions in technical manuals will not be violated.

c. The Plan of Test should contain provisions for modification of procedural steps and scheduling time allocations, within the framework of the Test Directive, to accommodate additional testing required to document unusual instances of test item performance, either of a deficient or superior nature.

d. Tests will be conducted concurrently or in conjunction with other test whenever possible, to minimize project elapsed time and to maximize use of other facilities including instrumented ranges and target aircraft.

e. Test conditions will be established and maintained as closely as possible in accordance with those specified in this MTP and the applicable referenced MTPs.

NOTE: Electronic equipment major items, such as radar sets and control station trailers, as well as the basic weapons system, may be covered by separate service test MTPs. The tests of this MTP will be coordinated with such separate MTPs in each instance.

6.2.1 Operational Characteristics

6.2.1.1 Emplacement and March Order

Accomplish in accordance with applicable sections of MTP 6-3-505, including the following, as applicable:

a. Emplaced, prepare for action, and march order the test item at each site or installation of the respective weapons system.

b. Record times required by full crews and reduced crews to accomplish emplacement, preparation for action, and march ordering.

c. Record any difficulties encountered with the equipment or with instructions in technical manuals.

6.2.1.2 Mobility

Accomplish in accordance with applicable sections of MTP 5-3-501, including the following, as applicable:

a. Transport the test item by authorized carrier across tactical type terrain, and over secondary roads and trails, for times and distances consistent with the use cycle of the respective weapons system.

b. Record times for transmit of terrain and safe speeds attainable.

c. Record all instances of equipment malfunction or failure attributable to maneuvering in the field.

d. Refer to MTP 6-3-518 and record difficulties or malfunctions connected with operation of the test item during motion.

6.2.1.3 Functional Performance

As applicable for the test item, conduct air defense operations and accomplish the following:

a. Target Data Acquisition and Processing - Record times required and effectiveness for target engagement operations, including:

1) Detection of aerial objects
2) Identification of friendlies and hostiles, precision of IFF, ease of changing modes and codes.
3) Tracking and ranging
4) Detection and tracking envelopes

b. Communications - Record times required, or number of attempts, and effectiveness of communications organic to the weapons system, including:

1) Establishment of radio and/or wire nets
2) Alerting operations - command centers and fire units
3) Engagement operations
4) Displacement and restoration of service

c. Control, Coordination, Fire Distribution - Record times required and effectiveness of activities concerned with target data manipulation, including:

1) Designation of hostile targets
2) Transfer of target assignment
3) Traffic handling capacity during Multiple attacks

d. Missile Guidance and Telemetry - Record effectiveness of operations concerned with control of missiel flight to target, including:

1) Target illumination for semi-active homing
2) Stability and precision of guidance signals
3) Clarity of signals returned from missiles
4) Accuracy of guidance to intercept

e. Vulnerability to Countermeasures - Record the degrees of success or difficulty experienced by personnel conducting electronic counter-countermeasures (ECCM) operations. Record observations concerning adequacy and suitability of special ECCM equipment. Record observations concerning the vulnerability to jamming of communications and guidance links.

6.2.1.4 Compatibility with Related Equipment

Accomplish in accordance with applicable sections of MTP 6-3-512, including the following:

a. During mobility tests, observe and record any delays or difficulties associated with physical mis-match of the test item with authorized vehicles, cables and connectors, contiguous equipment.

b. During air defense operations, observe and record any dif-

ficulties or inaccuracies resulting from incompatibilities of circuitry, frequencies, phasing, or other features between the test item and associated subsystems and components, including missiles, launchers, communications nets, control and terminal equipment.

6.2.2 Special Operations

6.2.2.1 Air Transportability

Accomplish in accordance with applicable sections of MTP 7-3-515 and MTP 7-3-516. Determine the capability of the test item for participation in air drop operations in accordance with applicable sections of MTP 7-3-512.

6.2.2.2 Surface Transportability

Accomplish in accordance with applicable sections of MTP 6-3-510 with respect to transportation by motor and rail transportation. As applicable, determine the capability of the test item for participation in logistics over-the-shore operations in accordance with applicable sections of MTP 2-3-520.

6.2.2.3 Environmental Suitability

As applicable, repeat the operation characteristics tests of section 6.2.1 under conditions associated with:

a. Desert test sites (refer to MTP 6-4-001)

b. Arctic test sites (refer to MTP 6-4-002)

c. Tropic test sites (refer to MTP 6-4-003)

6.2.3 Full-Test Performance

6.2.3.1 Maintenance Evaluation

Accomplish in accordance with applicable sections of MTP 10-3-504 and MTP 6-3-524 with respect to maintenance operations on the test item, and in accordance with applicable sections of MTP 5-3-502 with respect to the maintenance test package literature, with attention to the following:

a. Perform organizational, direct support, and general support maintenance in accordance with the Maintenance Allocation Chart (MAC). Record times required for performance of each task, difficulties encountered, adequacy of instructions and materiels. Complete a Maintenance Data Sheet (Appendix A, MTP 10-3-504), for each task.

b. Evaluate the common and special tools and test equipment supplied for use with the test item, including need for special items not

supplied, or excessive supplies, and the adequacy and simplicity of tools and test equipment used.

c. Evaluate the test item literature package for appropriate level of task assignment; simplicity, clarity, and completeness of instructions, illustrations, and lists, consistency with skill levels of assigned personnel; and any delays or difficulties caused by inadequate instructions.

d. Record the maintenance experiences necessary for determination of test item reliability parameters. Identify for each malfunction:

1) Failing component and accumulated operating times on component and test item.
2) Down time and corrective maintenance elapsed time and manhours.
3) Other parameters as required by Test Directive
4) Repair parts usage and life in hours or cycles, time to obtain parts

NOTE: Reliability parameters to be computed will include mean time between failures (MTBF, mean time between maintenance mean down time, availability - inherent, achieved, operational, and reliability.

6.2.3.2 Human Factors

Accomplish in accordance with applicable sections of MTP 6-3-525, including the following:

a. Record any human performance difficulties associated with arrangement of equipment, legibility of labels, visibility of displays and indicators, or ambiguity of control shape or direction of operation.

b. Record any difficulties in performance of functions due to interference by vibration, noise, or extraneous illumination.

c. Record unusual instances of stress, fatigue or needs for special training attributable to test item design.

6.2.3.3 Internal Environment

Accomplish in accordance with applicable sections of MTP 5-3-509. Determine the adequacy of environment control in enclosed spaces of the test item, considering:

a. Lighting - controllable intensity, freedom from reflections and glare

b. Ventilation - frrdom from excessive noise, contamination

c. Air Conditioning - adequate capacity with full crew and traffic

d. Heating - adequate capacity for applicable cold exposure

6.2.3.4 Safety

Accomplish in accordance with applicable sections of MTP 6-3-523, including the following:

a. Confirmation of safety release with reference to conditions specified in the release, in accordance with USATECOM Regulation 385-6.

b. Inspection for high voltage hazard control.

c. Survey for microwave energy hazards.

d. Record safety hazards observed or predicted during transportation, installation, operation, and maintenance of the test item.

6.2.4 Post Test Operations

Refer to MTP 6-3-500 and MTP 6-3-501, and conduct post-test inspections of the test item. Record any deterioration in physical condition or technical performance attributable to the cycle of service test exposures in the field.

6.3 TEST DATA

Record data as collected under applicable MTPs. Use still and motion picture photography, with color film when lighting permits, to record conditions and events of significance. Use magnetic recording (videotape) to record electronic performance data.

NOTE: Uniform reporting considerations require that distance, dimensions, and weights be reported in metric units (kilometers, centimeters, millimeters, kilograms). Measurements taken in other conventional or convenient units will be converted as necessary into the appropriate metric units.

6.3.1 Preparation for Test

6.3.1.1 Personnel

a. Record data on training of personnel with the test item as collected under applicable sections of MTP 6-3-502 and MTP 10-3-504.

b. Record the following for all service personnel:

1) Rank and identifying number
2) MOS
3) Training time in MOS, weeks
4) Experience in MOS, months
5) Training time with test item, weeks

6.3.1.2 Facilities and Equipment

Record identities of testing areas and details of site locations. Record nomenclature, model number, serial number of vehicles or equipment used with the test item.

6.3.1.3 Pre-Test Operations

6.3.1.3.1 Preoperational Inspection and Physical Characteristics

Record data as collected under applicable sections of MTP 6-3-500 and MTP 5-3-502. Complete a Maintenance Package Literature Chart (Appendix V, USATECOM Reg. 750-15).

6.3.1.3.2 Safety Release

Record document reference numbers and dates.

6.3.1.3.3 System Checkout

Record functional data at nominal values for the test item in on-th-air condition.

6.3.2 Test Conduct

6.3.2.1 Operational Characteristics

6.3.2.1.1 Emplacement and March Order

Record data as collected under applicable sections of MTP 6-3-505, including still and motion picture coverage of operations, times required in minutes, comments concerning adequacy of instructions in manuals.

6.3.2.1.2 Mobility

Record data as collected under applicable sections of MTP 5-3-501, including nomenclature, model number, serial number, and mileage of transport vehicles; descriptions of terrain supported by photographs; distances in kilometers, transit times in hours, speeds in kilometers per hour; narrative comments concerning difficulties with mobility operations and with operation of the test item during motion.

6.3.2.1.3 Functional Performance

Record data from the test item's functions as necessary to define shortcomings. Record external data (target tracks, command inputs, etc.) as necessary to document conditions relating to shorcomings. Record narrative comments, supported by recordings of operators' observations and photographs, detailing difficulties, malfunctions, or failures of the test item or operating personnel to accomplish each phase of the mission assigned.

6.3.2.1.4 Compatibility with Related Equipment

Record nomenclature, model number, serial number, or part number or other identification of any related equipment or part causing difficulty in aligning, mating, interconnecting, or phasing. Record narrative comments, supported by photographs or magnetic recordings, describing the difficulty and its effect on operation of the test itme and associated systems.

6.3.2.2 Special Operations

6.3.2.2.1 Air Transportability

Record nomenclature, model number, serial number, and accumulated hours of transport aircraft. Record data as collected under applicable sections of MTP 7-3-515 and MTP 7-3-516, including comments, supported by photographs, concerning difficulties with loading, tieing down, and unloading. Record air drop data as collected under applicable sections of MTP 7-3-512.

6.3.2.2.2 Surface Transportability

Record data as collected under applicable sections of MTP 6-3-510 and MTP 2-3-520. Record details of identification of transport vehicles, motor, rail, and ocean. Record narrative comments, supported by photographs, concerning difficulties with loading, tieing down, unloading, and landing over the shore.

6.3.2.2.3 Environmental Suitability

Record data as collected under applicable sections of MTP 6-4-001, MTP 6-4-002, and MTP 6-4-003. Record ambient conditions affecting the test item:

a. Temperature, degrees F

b. Relative humidity, percent

c. Wind direction, degrees, and velocity, km per hour

d. Precipitation (rain, snow), inches

e. Presence of dust, blowing sand, fog, etc.

6.3.2.3 Full-Test Performance

6.3.2.3.1 Maintenance Evaluation

Record data as collected under applicable sections of MTP 10-3-504 and MTP 5-3-502. Enter maintenance data on the appropriate forms. Record narrative comments concerning maintenance problems or difficulties, supported by photographs and recorded observations of operators. Record observations concerning the completeness and adequacy of authorized tools and test equipment, and repair parts. Record comments concerning problems or difficulties attributable to instructions, illustrations, or lists in technical manuals.

6.3.2.3.2 Human Factors

Record data as collected under applicable sections of MTP 6-3-525. Photograph any component, control, label, or indicator eshibiting deficiencies with respect to use by personnel. Record narrative comments concerning personnel malfunction due to environmental noise or vibration, or ambiguity of instructions.

6.3.2.3.3 Internal Environment

Record data as collected under applicable sections of MTP 5-3-509. Record narrative comments, supported by photographs and recorded comments of operators, regarding inadequacies in equipment for lighting, ventilation, air conditioning, or heating.

6.3.2.3.4 Safety

Record data as collected under applicable sections of MTP 6-3-523. Record summary statements describing actual or potential hazards to personnel arising from high voltage, microwave energy, transportation, and maintenance of the test item.

6.4 DATA REDUCTION AND PRESENTATION

Summaries of the service test finding will be prepared to indicate the serviceability of the air defense systems electronics item in its role in the overall system. Accounts of deficiencies, shortcomings, or usggested improvements will be referred to their respective influence on operation of the system.

Data-including observations and comments of operators - obtained under each test conduct section of this TMP will be summarized, compared, and evaluated according to procedures described in the individual referenced common or commodity MTPs, or as described in this MTP, or according to equivalent current practice when not covered by MTP. Appropriate charts, graphs, and tables will be used to display summaries and comparisons of test data.

Coordinates and other features of charts, graphs, and tables will be selected for clarity and uniformity with like presentations in other reports.

Special consideration will be given to any condition or circumstance which may have significantly influenced test results. Data collected under adverse weather conditions will be separately compared with data collected during normal weather conditions.

Calculations will be performed as specified in the referenced MTPs and other references, or in accordance with equivalent current practice when not otherwise specified. All photographs, motion picture film, oscillograms, recorder tapes, audio tapes, and other records will be esplicitly identified and referenced; significant frames, transcriptions, and samples will be selected for illustrative purposes. All illustrations will be completely identified.

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13. ABSTRACT

Procedures are defines for evaluating the effectiveness of ground based electronic equipment used with air defense systems. Tests described include functional performance, transportability by both air and surface equipment, compatability with related equipment, mobility, safety, maintenance and effects of environment.

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