4 January 1971

U. S. ARMY TEST AND EVALUATION COMMAND
COMMON TROPIC ENVIRONMENTAL TEST PROCEDURE

COMMUNICATION, SURVEILLANCE AND AVIONIC ELECTRONIC EQUIPMENT

1. OBJECTIVE

This document serves as a guide to the test methods and techniques to be used in determining the capability of communication, surveillance and avionic electronic equipment to withstand exposure to, and function effectively within, humid tropic environments. A principal of tropic testing is to compare data obtained before and after dynamic tests, and before and after static storage tests.

2. BACKGROUND

Communication, surveillance and avionic electronic equipment and accessories (hereinafter called test items) perform a vital role in gathering and propagating military information. Since Army operations are worldwide, there is a need for determining whether these test items will meet specified performance requirements when they are exposed to natural wet-warm or wet-hot tropic environment conditions. Such testing is usually not conducted until previous tests made under simulated conditions have provided reasonable assurance that the test item will function satisfactorily when it is exposed to actual tropic environment conditions. (see Appendix A in MTP 2-4-003 for a detailed description of typical environmental conditions found in those Panama Canal Zone areas which are available for testing, and in Rio Hato Training Area).

Electronic communication systems include types that range from tactical radio nets to semi-mobile, mobile and fixed station complexes. The traffic carried covers every functional area: command and control, logistics, intelligence, weather and administration, and it may be in the form of voice, telegraph, teletypewriter, facsimile, or data, and it may employ analog or digital signals or both. Radio communication may be either surface-to-surface or avionic (air-to-surface or air-to-air). Communications using sound or light waves are used to a limited extent. Surveillance operations may employ search, tracking or airborne mapping radar, ground-ground or air-to-ground infrared mapping or detection systems, or laser beam or sound ranging systems.

3. REQUIRED EQUIPMENT

One or more of the following items and/or facilities may be required to obtain data during the various evaluation.

a. Facilities and measuring and recording devices listed under paragraph 3., "REQUIRED EQUIPMENT", in the specific MTP for the item under evaluation.

b. Reference or comparison items as required.

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4. REFERENCES

A. AR 70-38, Research and Development: Research Development, Test and Evaluation of Materiel for Extreme Climatic Conditions.
B. USATECOM Regulation 70-23, Research and Development of Materiel: Equipment Performance Reports (EPRs).
C. USATECOM Regulation 385-6, Verification of Safety of Materiel During Testing.
D. USATECOM Regulation 700-1, Quality Assurance: Value Engineering.
E. USATECOM Regulation 750-15, Maintenance of Supplies and Equipment: Maintenance Evaluation During Testing.
F. USAGETA Document, Human Factors Evaluation Data for General Equipment (HEDGE) Guidebook Supplement.
G. MIL-STD-129, Marking for Shipment and Storage.
H. MIL-STD-794, Parts and Equipment, Procedures of Packaging and Packing of.
I. MIL-STD-1472, Human Engineering Design Criteria for Military Systems, Equipment and Facilities.
J. TM 743-200, Storage and Materials Handling.
K. FM 31-30, Jungle Training and Operations.
L. MTP 2-4-003, Tropic Environmental Test Procedure, Wheeled, Tracked and General Purpose Vehicles.
M. MTP 3-4-003, Tropic Environmental Test Procedures, Armament and Individual Weapons.
N. MTP 6-2-500, Physical Characteristics.
O. MTP 6-3-501, Pretest Inspection for Service Test.
P. MTP 6-2-502, Human Factors Engineering.
Q. MTP 6-3-502, Personnel Training Requirements.
R. MTP 6-3-523, Safety.
S. MTP 8-4-004, Long Term Surveillance/Environmental Testing of CBR Munitions, Weapons and Equipment.
T. Specific Volume 6 MTP for commodity item under evaluation.

5. SCOPE

This MTP is intended to be used as a guide in conjunction with the MTP for the specific commodity item(s) undergoing service tests. Reference is made to other MTPs for the actual test procedures to be followed in assessing the test item's physical condition, technical characteristics, and operating performance. The primary intention of this MTP is to specify the conditions under which such testing is to be performed and collection and analysis of data to determine the suitability of the test item for use in the humid tropics.

5.1 SUMMARY

This MTP describes the following tests to be conducted on communication, surveillance and avionic electronic equipment and their accessories.

5.1.1 Preparation for Test

This section provides guidance for test project planning, including a discussion of the facilities, documentation, calibration, test scheduling, and equipment required, test personnel training and familiarization, statistical planning, and the preparation of an appropriate mission scenario.

5.1.2 Test Conduct

a. Initial Inspection and Operation - A determination of the condition of the test item upon its arrival at the installation site, and an assessment of its operating characteristics before it has been exposed for any appreciable length of time to the tropic environment in which it will be used.

b. Operational Performance - An evaluation to determine the capability of the test item to perform its intended mission. This test is conducted during both dry and rainy seasons when the test schedule permits.

c. Short Term Storage - A determination of any deterioration in the test item occurring during and after short term storage.

d. Surveillance (Long Term Storage) - A determination of any deterioration in the test item occurring during and after long term storage, when properly packed and packaged for storage in the humid tropic environment.

e. Maintenance Evaluation - An evaluation to determine the maintenance characteristics of the test item and the suitability of the maintenance test package in a humid tropic environment.

f. Safety - An evaluation to determine the safety characteristics and possible hazards to which the test item is exposed.

g. Human Factors - An evaluation to determine those design and performance characteristics effecting the test item user which are peculiar to the tropic environment.

h. Security from Detection - An evaluation to determine the capability of the test item to avoid detection when stored or operated in a humid tropic environment.

i. Value Analysis - An evaluation directed at analyzing the primary function and features of the test item for the purpose of cost reduction without compromising performance, reliability, quality, maintainability or safety.

5.2 LIMITATIONS

a. The material presented in this MTP is limited to field testing. Guidance for testing equipment in simulated environments, or other induced wet-warm or wet-hot conditions has been intentionally omitted.

b. Procedures outlined in the MTP do not constitute detailed test plans. A test plan for tropic environmental testing of an item may be prepared using the guidance given in this MTP, but each test activity preparing environmental test plans must make its own judgment as to the applicability of each procedure, and must determine how best to obtain the required data from each item under test.

c. These procedures are limited to tasks which require exposure to those combinations of weather and terrain conditions, described in Appendix A of MTP 2-4-003, which are available in the Panama Canal Zone or in the Rio Hato Training Area. It is assumed that the test can be appropriately conducted in a temperate climate to determine if the test item meets the criteria.

To reduce the number of variables to a minimum, all test items must be chosen from the same production lot, and they must be so identified, when more than one test item is involved.

6. PROCEDURES

6.1 PREPARATION FOR TEST

NOTE: The quantity of test items received for test should be greater than the quantity specified in the statistical plan, except when it is known that the shipment contains no non-repairable items, in which case adequate quantity of repair parts or subassemblies should be included with the maintenance package.

6.1.1 Test Project Planning

The test project office and other designated personnel must:

a. Conduct a thorough study of stated requirements as contained in QMRs, SDRs, TCs and the test directive to insure that complete and suitable test criteria are selected.

b. Review all instructional material issued with the test item by the manufacturer and reports of previous tests conducted on similar equipment.

c. Prepare a detailed test schedule showing proposed time periods allotted for each test. Insure that cross-country testing is scheduled for test courses with both cleared and uncleared terrain in wet-warm and wet-hot environments. These environments and test courses are defined in paragraph 3 and Appendix A of MTP 2-4-003. Testing should be scheduled to take place in the peak of the wet season (October through November) and in the dry season (January through March. Wherever applicable testing should also be conducted in areas that expose the test item to salt laden air and salt-spray.

d. Prepare record forms and test logs for systematic entry of data, chronology of test, and evaluation in the final analysis of the test item's suitability for use in the humid tropics.

e. Review the safety release. Tabulate the safety precautions that must be followed to insure safe operation of the test item(s); and include all applicable safety Standing Operating Procedures (SOPs).

f. Verify that test facilities, equipment, and accessories are available, operational and properly calibrated with the time limit. Power sources shall be checked to ensure correct outputs.

g. Final arrangements for supporting or participating agencies, activities, and facilities shall be made.

i. Since short-term storage should last not less than six months, and should include both wet and dry seasons, it is desirable to start all testing during the dry season and to end it later during the wet season.

j. Plan the utilization of photographic techniques where necessary to record and document test results.

6.1.2 Test Personnel and Training and Familiarization

a. Evaluate the adequacy of all draft technical manuals and safety instructions used by the test personnel. This evaluation shall continue throughout the course of the test.

b. Instruct personnel as shown in Table I.

Table I. Personnel Instructions

Personnel	To be instructed in
All	a. The purpose of the test. b. The characteristics of the test item. c. The characteristics of the reference item, if any. d. The kind of data to be obtained. e. The terrain(s) in which testing is to be conducted. f. The health precautions to be observed in the terrain(s).
Test and reference item operators	a. The test item (and reference item, when used) operating characteristics and limitations. b. The expected test item performance. c. The safety precautions to be observed. d. The kind and extent of all maintenance actions to be taken under all specified environmental conditions. e. All operating procedures to be followed under all environmental and terrain conditions. f. The procedures to be followed when filling out checklists and questionnaires, and their purpose.
Test evaluators	a. The purpose and use of all checklists and questionnaires, and the methods to be used in the evaluation. b. The calculations to be made in evaluating test data.

Table I. (Continued)

Topographical analysis support	a. Physical terrain features to be measured, including water velocity and terrain slopes. b. Vegetation features to be noted and described.
Maintenance support	a. The scheduled maintenance requirements to be met. b. The procedures, equipment and material to be used to make emergency repairs and unscheduled maintenance. c. The kind of recovery vehicle to be used. d. The recovery procedures to be used. e. The maintenance records to be written.
Meteorological support (TTC Reg. 705-4)	a. The terrain areas which will be used. b. The calendar dates of all tests. c. The readings to be taken.
Soil analysis support	a. The nature and location of major terrain soils to be encountered during test conduct. b. The kind and extent of all soil analysis to be performed.
Storage and surveillance test	a. Storage, handling, layout, spacing, pest control, fire protection, security, and inspection procedures to be followed. b. Required organizational maintenance to be performed, including cleaning and microbiological inspection. c. The calendar dates of all inspection.

c. Consult MTP 6-3-502 for the personnel training requirements to be met.

d. When a reference item is used for comparison purposes, subject the reference items to the procedures described under Steps a., b., and c.

6.1.3 Statistical Plan

Establish a statistical plan in accordance with the procedures contained in paragraph 6.1.4 of MTP 3-4-003 with the following changes:

a. Substitute the word "operations" or "operate" in place of the words "firings" or "fire", respectively.

b. Substitute the word "device" in place of the word "weapon".

c. Unless it is known, or unless it can be reasonably assumed, that the time-to-failure follows an exponential or other known distribution, cross-country mission reliability should be expressed as a probability of success, using the "attributes" approach (binomial distribution) wherein the mission (or "experiment"), if satisfactorily completed, is called a success, and if the mission (or "experiment") is not satisfactorily completed, it is called a failure.

d. When the "attributes" approach is used, the preciseness of the probability figure obtained increases as the number of "experiments" increases. For example, if only one "experiment" or mission is conducted, and no failure occurs, a probability of success of 10%, at a lower 90% confidence level, is the best that can be claimed when the "experiment" is repeated with the same, or another identical test item. If, however, five identical "experiments" are successfully completed, the probability of success becomes 63.1% at a lower 90% confidence level when another identical "experiment" is made. Therefore, when the "attributes" approach is used, the number of identical "experiments", or missions (NxT) should be made as large as possible. The decision regarding the number of test items, N, to use, and the number of identical experiments, T, to make, should form an essential part of the statistical plan.

e. When a reference item is used for comparison purposes, follow the procedures described under steps a. through c.

f. To obtain the maximum amount of useful information, use the same test personnel in both the wet season and in the dry season.

g. Follow the instructions in AMCP 702-3 when calculating test item reliability, and unless otherwise specified, use a lower confidence level of 90% in these calculations.

6.1.4 User Test

a. The user test will describe the tests to be conducted under simulated field conditions by personnel who would use the equipment in the field. The mission scenario (ref. Appendix C) will describe the test areas and operations that will be used for evaluating the use of the test item.

b. Unit missions, where possible, will include both defensive and offensive operations as they apply to the type of item being tested, i.e., an individual hand-held item will be evaluated as a defensive weapon for a battalion perimeter, and then as a part of an attack force securing an enemy position.

c. The mission scenario should include, as a minimum, the following:

1) Details of test item prime function(s) to be performed in each condition of environment and terrain.
2) Sketch map, or photomap of the test area(s) and a description of the environment(s) to be found therein.
3) Number of test items and personnel.
4) Actions or movements to be used.
5) Number of support equipment to be used.

d. When test items are evaluated during tactical training exercises, the test item use will be documented from the operation orders, scenarios used in conjunction with training problems, situation outlines and Army Training Tests.

6.2 TEST CONDUCT

NOTES:
1. Insure that a safety release statement has been received from USATECOM before making any tests.
2. Observe all specified safety requirements at all times.
3. Performance assessment shall be accomplished by observers equipped with the means of recording visual, aural, and judgmental observations and related time factors. Observer activities shall not interfere with, or influence in any manner, the functions of the test item or operators. Subtests shall be conducted concurrently or in conjunction with other subtests whenever possible, so that time taken to collect the required data will be minimized. Testing shall be conducted under the applicable conditions prevailing during the test period.
4. When the test item meets specified operational tests during the course of an assigned mission, the test item performance is defined as being a mission success.

6.2.1 General Requirements

a. Conduct all tests under prevailing weather conditions, except that wind speed and direction requirements are to be met when performance tests are being made on sound ranging or public address equipment.

b. When a reference or comparison item is used, subject it to the same tests concurrently with the test item.

c. When the test item will be exposed to the shock, vibration, vegetation, terrain and weather conditions encountered during a cross-country mission, observe the following:

1) Travel over the test course during daytime and nighttime unless safety requires only daytime testing.
2) Travel over grass lands during both dry and wet seasons.
3) Verify that the test course includes the terrain and vegetation conditions in which the test item was designed to be operated.
4) When a reference or comparison item is to be carried cross-country, take it over a course parallel to that taken by the test item, and trail it behind the test item a sufficient distance to avoid the danger of it becoming damaged by the same terrain feature which could damage the test item.

d. Note the ambient temperature, relative humidity, rain, cloud cover, wind speed and direction for each test.

e. Conduct all initial inspections, maintenance actions, and operations as specified in the applicable draft technical manuals.

f. At the end of each operational test, ask the test personnel to fill out a questionnaire giving their opinion regarding the performance of their own test item, and its relative merits or demerits.

NOTE: All questionnaires will be reviewed by human factors personnel.

6.2.2 Initial Inspection

Perform the following immediately upon receipt of the test item.

a. Inspect and record the condition and identification markings of all packages and packing and their conformance to MIL-STD-794 for overseas shipment for Level A or Level B, as applicable.

b. Weight and measure the individual package(s) for each packaged test item component, or a sample package, if identical components are contained in several packages. Unless otherwise specified, the minimum sample size shall be as shown in Table II.

Table II. Minimum Sample Size

Number of Items	Minimum Sample Size
1-4	all
5	4
6	4
7	5
8	5
9	6
10	6
11-15	7
16-40	8

c. Unpack and remove all preservative coatings on test item(s).

d. Verify completeness of the test item, associated components, and maintenance test package as specified in the Basic Issue Item List (BIIL), and file an Equipment Performance Report for any damages or omissions, if required.

e. Determine the physical characteristics of the test item(s) in accordance with the appropriate procedures in the applicable Volume 6 MTP, and in MTP 6-2-500. File an EPR for any damages detected.

f. Inspect all surfaces for proper painting and other protective coatings. Take color photographs of all surfaces displaying roughness, corrosion or microbiological growths. When available, include a calibrated color patch standard.

g. Conduct an operator preoperational inspection in accordance with the draft technical manual and MTP 6-3-501, and repair or replace all test items or test item components which do not pass this inspection.

6.2.3 Initial Operation

a. Assemble and/or emplace or position the test item in the physical environment in which it will be used.

b. If the test item has not been previously "burned-in", operate it for the specified "burn-in" period before making any performance tests. Replace all components which fail during this period with components which have been "burned in".

c. Operate the test item as described in the applicable Volume 6 MTP in all specified modes and ranges of operation under the prevailing meteorological conditions, and determine its effectiveness.

NOTE: It is preferable to perform initial operation tests during the dry season. This will provide the best performance standard against which all other operational tests can be compared.

6.2.4 Operational Test

Perform tests during the dry season, which normally starts in January and ends in mid-April; and during the rainy season, which normally starts in mid-April and ends in December.

a. Perform the tests described in paragraph 6.2.3 c. for a sufficient number of missions to obtain a suitably precise measure of the test item's probability of mission success. (See paragraph 6.1.3). When specified, these tests shall include subjecting the test item to the shock, vibration, weather, water immersion and vegetation conditions encountered during cross-country, secondary road or airborne operations, as applicable.

b. During mission operation, verify that no terrain conditions or obstacles exceed the limits allowed for the test course, and measure and/or estimate the water velocities and depths at all stream and river crossings.

6.2.5 Short Term Storage

Storage of the test item and/or components shall be consistent with normal practice for the commodity class of the test item as supplemented by the applicable information in the draft technical manual.

a. Place the test item and/or components in the area designated for short term storage. Unless otherwise specified, minimum use of preservatives should be made.

b. Periodically inspect the test item for evidence of corrosion or microbiological growths. Sample and identify any growths detected.

c. At completion of the storage period, repeat the procedures of paragraph 6.2.3 to determine if any deleterious effects have been induced in the test item by storage.

6.2.6 Surveillance (Long-Term Storage) Test

NOTE: Unless otherwise specified, the requirements of MTP 8-4-004 shall be met throughout this test.

Perform and record the following:

a. Unless otherwise specified, store all items in their normal long-term storage containers as specified in the draft technical manual.

b. Determine the kind of inspections to be made on the test items during the total storage period. Unless otherwise specified, the number of inspections to be made shall be eight, and the "cycle number" dates when these occur shall be as specified in Figure 1, MTP 8-4-004.

c. Determine at which "cycle number" dates (month, day and hour) the specified number of test items are to be operated. Unless otherwise specified, the number of test items to be operated at each specified "cycle" number operating date shall be not less than the value of N determined as described under paragraph 6.1.3 d.

d. Store the test items in the specified environment, using the applicable procedure described in TM 743-200, unless otherwise specified. Note the particular half month, and the day and hour in which this storage takes place and denote this as the "cycle No. 1" date.

e. At each of the "cycle number" dates, perform the following on each test item in the test group:

1) Visually examine it, and take color photographs of all corrosion and fungus growth areas.
2) Make a microbiological analysis of all materials which display evidence of microbiological attack.
3) Perform all specified operator maintenance and repairs needed.
4) When an operational test is to be made, transport the specified number of test items (see paragraph c. above) to the operating site, perform the operational test described in paragraph 6.2.3 and determine to what extent the operating characteristics of the test items have deteriorated during the storage period.

f. Observe all of the safety precautions specified in MTP 6-3-523 and in AMCR 385-224 during the entire storage interval.

6.2.7 Maintenance Evaluation

Data expressing system maintenance factors are collected in preparing for and completing active testing. If, at the completion of testing, very little maintenance has been performed, representative samples of the maintenance procedures in the applicable Volume 6 MTP and draft technical manual should be completed to determine the ease in performing these actions with emphasis on the following:

1) Organizational (O), Direct Support (F), and General Support (H) maintenance requirements.

2) Operator through General Support Maintena e Literature.
3) Repair parts.
4) Tools.
5) Test and handling equipment.
6) Calibration and maintenance facilities.
7) Personnel skill requirements.

6.2.8 Safety

a. Do not begin testing until a safety release is received from USATECOM.

b. Observe the proper safety precautions during testing, and record any conditions that might present a safety hazard, the cause of the hazard, and the steps which were taken to alleviate the hazard.

c. Observe and record all of the applicable precautions specified in the following documents.

1) The test maintenance packages.
2) AMCR 385-224.
3) USATECOM Regulation 385-6.
4) FM 20-32.
5) FM 24-18.
6) FM 31-30.
7) MTP 6-3-523.
8) Applicable portions of Appendix A (Questionnaires).
9) Applicable portions of Appendix B (Checklists).
10) Applicable portions of specific commodity Volume 6 MTP.

d. After completing all testing, prepare a safety confirmation for inclusion in the final report if the test item was determined safe for use. If the test item was found to be unsafe, a detailed explanation should be provided.

6.2.9 Human Factors Evaluation

Develop task/item checklists reflecting the human factors design considerations for the test item. These checklists will allow test supervisory personnel to compare test item features against appropriate criteria and record comments to evaluate the suitability of the man item interface with particular emphasis on operations under adverse weather conditions. Detailed criteria and human factors considerations for each may be derived from USAGETA document "Human Factors Evaluation Data for General Equipment (HEDGE) Guidebook Supplement". Consult Appendix B, MTP 6-2-502 and MIL-STD-1472 for guidance in preparing a suitable checklist.

6.2.10 Security from Detection

a. Position test item in designated test site.

b. Use natural material, nets, tarpaulins, and any other prescribed camouflage material to conceal test item. Place material about site as required to enhance concealment qualities.

c. Make ground and aerial observations of concealed item at various times of the day and at various distances from the item.

d. Repeat foregoing steps in each test site of interest.

6.2.11 Value Analysis

a. During the conduct of all tests, test personnel shall evaluate the test item 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 shall be used for evaluation.

b. Consideration shall be given to the topics listed below. Record appropriate comments for each topic.

1) Mission Capacity.

The test item should be capable of accomplishing the specified task with only a reasonable margin of excess capability. Excess capacity and unused capability normally result in unnecessary bulk, excessive weight and unwarranted costs.

2) Simplicity.

Unnecessarily complex components and systems, 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.

Inadequate tolerances will result in difficulties and delays in accomplishing post arrival assembly, routine maintenance, servicing and repair.

6.3 TEST DATA

6.3.1 General Requirements

a. When measuring attributes which are subject to small deviations, make at least two, and preferably four, different measurements under identical test conditions, and record each measurement, as well as the arithmetic mean of these measurements. Also, record the percentage accuracy of the measuring device used.

b. Indicate the accuracy of the measuring device employed when recording measurements which must be made accurately, and also record the calibration data when applicable.

c. When progressive degradation is observed on any part, describe and/or photograph the degradation, and show the "before" and "after" condition together when recording.

d. When applicable, show terrain profile and a vegetation and density description in the test operation log.

e. When two or more persons are asked to fill out a questionnaire giving their opinion regarding specified features in a particular test, show the scoring values used, and the scoring results obtained, in tabular form as described in Appendix A (Questionnaires). When an analysis of variance is used to test for the significance of the variation in the scoring results, state the results of this analysis.

f. Meteorological data.

6.3.2 Test Project Planning

Record the following:

a. Detailed test schedule for each test.

b. Types and lengths of all cross-country test courses to be used.

c. The record forms and test logs to be employed.

d. Details of the safety release.

e. All safety precautions to be followed, including applicable safety SOPs.

f. Test facilities, equipment, accessories and their operating instructions available for use.

g. Arrangements concluded with supporting or participating agencies.

h. Month, day and hour of the start and finish of the short term and the long term (surveillance) storage periods.

i. Photographic facilities to be used.

6.3.3 Test Personnel Training and Familiarization

Record the following:

a. For all test personnel:

1) MOS and skill level.
2) Rank.
3) Unit.
4) Experience.
5) Previous training.

b. Adequacy of draft technical manual for supporting personnel training.

c. Requirements for training aids.

d. Difficulties encountered in completing training program.

6.3.4 Statistical Plan

Record the following:

a. Whether the "attributes" approach is to be used in determining probability of mission success or what other statistical method used.

b. The number of identical "experiments" or missions (NxT) to be used.

c. The reference item to be used for comparison purposes.

d. The personnel to be used in the various tests.

6.3.5 User Test

Record the following:

a. The test areas and operations to be used for evaluating the use of the test item.

b. A sketch map, or photomap of the test area(s) and a description of the environment to be found therein.

6.3.6 Initial Inspection

Record the following:

a. Conformance with specified packing, packaging, preserving, identification and marking criteria.

b. Any omissions of components or equipment damage detected, and repairs made.

c. Physical characteristics of the test item as specified in the applicable Volume 6 commodity MTP, and in MTP 6-2-500.

d. Missing or improper protective coatings on the test item, and photographs of roughness, corrosion or microbiological growths.

6.3.7 Initial Operation

Record the following immediately upon assembling and/or emplacing or positioning the test item in the physical environment in which it will be used.

a. The "burn-in" period and any components replaced during this period.

b. The performance characteristics obtained in all specified modes and ranges of operations under the prevailing meteorological conditions.

6.3.8 Operational Test

Record the following:

a. The performance characteristics described under paragraph 6.3.7 b. during the dry season and rainy season for all of the "experiments" or missions performed.

b. The terrain conditions encountered, including water velocities at stream or river crossings.

6.3.9 Short Term Storage

Record the following:

a. Condition of the test item(s) just prior to storage, and the storage preparations made, including (if applicable) the shipping containers used.

b. Storage environment and daily meteorological conditions.

c. Number of items involved.

d. Method and duration of storage of each item, and the calendar dates of all inspections.

e. Results of all inspections made.

f. Maintenance and repairs made.

g. Extent of deterioration of operating characteristics.

6.3.10 Surveillance

Record the following:

a. The condition of the test items just prior to storage, and the storage preparations made, including all containers and packaging used.

b. Storage conditions and daily meteorological conditions.

c. Number of items involved.

d. Method and duration of storage of each item and the calendar dates of all inspections.

e. Results of all inspections made.

f. Maintenance and repairs made.

g. Extent of deterioration of operating characteristics.

6.3.11 Maintenance Evaluation

Record the following:

a. Scheduled maintenance:

1) Description of test activity, environment, and meteorological factors associated with maintenance performed.

2) Procedures and special tools (if any) required to complete maintenance-actions; description of maintenance performed.
3) Component or feature involved.
4) Elapsed time since previous scheduled or unscheduled maintenance performed (whichever is shorter). Identity of previous maintenance performed (scheduled or unscheduled).
5) Parts required, if any.
6) Elapsed time required to complete maintenance actions.
7) Difficulties in completing maintenance actions.
8) Total scheduled maintenance time consumed in hours.

b. Unscheduled maintenance:

1) Description of test conduct, environment and meteorological conditions under which maintenance requirements developed.
2) Procedures and special tools (if any) required to complete maintenance actions; description of maintenance performed.
3) Elapsed time since previous scheduled or unscheduled maintenance performed (whichever is shorter). Identity of previous maintenance performed.
4) Parts required, if any.
5) Difficulties in completing maintenance actions.
6) Component or feature involved and method used to determine it.
7) Damage caused to associated parts of the system by failure, if applicable.
8) Reason for maintenance required, if ascertainable.
9) Recommendations to prevent recurrence of maintenance requirements.
10) Elapsed time to identify and locate fault.
11) Elapsed time to rectify fault.
12) Total unscheduled maintenance time consumed in hours.

c. Time to complete related maintenance functions.

1) Supply delay time.
2) Administrative delay time.
3) Technical engineering investigations or inspections related to analysis of cause of failure or detection of suspected incipient failures.
4) Initial and final technical inspections.

d. For all maintenance performed.

1) The adequacy of the draft technical manual and maintenance information provided.

2) The adequacy of the OEM tools and repair parts.
3) The adequacy of the safety instructions.

e. Total operating time in hours.

f. Identify each maintenance action as either a chargeable or nonchargeable failure in accordance with definitions and illustrations provided in USATECOM Regulation 750-15.

1) Total number of chargeable failures.
2) Total number of nonchargeable failures.

6.3.12 Safety

Record the appropriate data as required by the specific Volume 6 MTP for the test item, MTP 6-3-523, and the following:

a. A tabulation of all safety features and/or devices.

1) Type of feature/device.
2) Purpose of the feature/device.
3) Suitability of the feature/device.
4) Adequacy of the feature/device.
5) Proper operation of the feature/device.

b. Adequacy of warning plates, instructions and markings in content, clarity, sufficiency and location.

c. Any condition that did or might present a safety hazard, including cause and corrective action required to alleviate the condition.

d. Presence and adequacy of fire fighting equipment and suitability of stowage and control location.

e. Adequacy of ventilating systems to prevent operator exposure to noxious fumes.

f. Satisfactory/unsatisfactory noise level during period of engine operation.

g. Suggestions to improve safety features, safety measures and/or precautions.

6.3.13 Human Factors

Complete the task/item checklists by rating the inclusion of each design consideration as satisfactory or unsatisfactory.

6.3.14 Security from Detection

Record the following:

a. Characteristics of the terrain in which observations were made.

b. Implements used to make observations (field glasses, aircraft, etc.).

c. Distances from which test item observations were made.

d. Time of day and sky conditions when observations were made.

e. Type(s) of material used.

6.3.15 Value Analysis

a. Record 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. When making recommendations for changes in test features or components, record the following:

1) The feature or component under consideration.
2) Recommended change(s).
3) Reason(s) for recommended change(s).

6.4 DATA REDUCTION

6.4.1 General

Summarize all data using tabulations and/or charts as appropriate. Analyze and compare the data collected against specific criteria stated in governing documents. Provide a narrative description of the degree of suitability of the test item for use in the tropics. If the item is not suitable for use in the tropics, provide a complete description (including test results) of why the item is so adjudged.

6.4.2 Questionnaires

When a group of persons are asked to fill out a questionnaire giving their opinion regarding specified features in a particular test, and

an analysis of variance is used to test for the significance of the variation in the scoring results, perform this analysis as specified in Appendix B of MTP 2-4-003.

6.4.3 Checklists

Group the answers to all checklist questions under the applicable headings, such as safety, accessibility, and human factors, and arrange the answers in the order of their relative importance.

6.4.4 Maintenance Evaluation

Calculate the maintenance indicators as follows: Reference is made to USATECOM Regulation 750-15 for information as to the meaning and use of these indicators in assessing system maintenance.

a. Mean Time Between Failures (MTBF).

$$MTBF = \frac{\text{Total operating time (in hours)}}{\text{Total number of chargeable system failures}}$$

b. Mean Time Between Maintenance (MTBM).

$$MTBM = \frac{\text{Total operating time (in hours)}}{\text{Total number of scheduled and unscheduled maintenance actions performed}}$$

c. Mean Active Maintenance Downtime ($\overline{M}$).

$$\overline{M} = \frac{\text{Total scheduled and unscheduled maintenance time (in hours)}}{\text{Total number of scheduled and unscheduled maintenance actions}}$$

d. Mean Time to Repair (MTTR).

$$MTTR = \frac{\text{Total unscheduled maintenance time expended on chargeable failures (in hours)}}{\text{Total number of chargeable system failures}}$$

e. Inherent Availability (A_i)

$$A_i = \frac{MTBF}{MTBF + MTTR}$$

f. Achieved Availability (A_a).

$$A_a = \frac{MTBM}{MTBM + M}$$

APPENDIX A

Preparation and Use of Questionnaires

Follow the procedures described in Appendix B, MTP 3-4-003, substituting the words "item", "operational", "operates", and "mission" for the words "weapon", "firing", "fires", "fire", and "course traversal", respectively.

APPENDIX B

Checklists

The following checklist questions are presented under two categories. The first category, entitled "Tropic Environment Considerations", deals with those features which are emphasized in a tropic environment. The second category, entitled "General Considerations", deals with those features which are substantially independent of the kind of climate involved. Under this category, documents are referenced in which such general checklist questions can be found.

1. TROPIC ENVIRONMENT CONSIDERATIONS

a. Is protection provided when the temperature of surfaces with which personnel may come in contact exceeds 115°F?

b. Is adequate protection provided on vehicular-mounted test item to protect it from overhanging limbs and lianas?

c. Are provisions made on the test item to protect the operator/crew from the effects of prolonged exposure of the test item to the direct rays of the sun?

d. Is contact between corrodible metal parts and anti-fungus-treated materials avoided whenever possible?

e. Are drain holes provided to prevent moisture traps?

f. Are materials used to the greatest extent possible for their noncorrosive and non-hygroscopic characteristics, as well as their ability to resist fungus growth?

g. Are materials used which inhibit fungus growth rather than materials which include a fungistatic or fungicidal treatment?

h. Are metallic parts designed without recesses, cups or traps where liquids can accumulate, and are metals in contact chosen as close together as possible in the electromotive force series or adjacent groups?

i. Are exposed surfaces completely covered with some form of protective coating or surface plating?

j. Are corrosion inhibitors or preservative materials used where necessary or possible?

k. Are synthetic rubbers which are resistent to both microbiological and ozone deterioration, used wherever possible?

l. Are precautions taken to avoid damage resulting from moisture, fungi, or insects?

m. Wherever possible, is the radio antenna located in clearings on the edge farthest from the distant station?

n. When incervening jungle growth or terrain masks the straight line radio transmission path to the receiving station, is the antenna oriented slightly off-course, particularly when the offset course path is unobstructed?

o. If the radio antenna site is located directly behind an intervening terrain mask, is the radio set tied to the top of a tree and operated from that location by remote control, when feasible?

p. Are radio antenna site locations between stretches of high jungle growth avoided as much as possible?

q. Are electrical conductor cables and connectors kept off the ground to lessen the effects of moisture, fungi and insects?

r. Are horizontally polarized radio antennas used wherever possible when transmitting and receiving in or near tall vegetation?

s. Is jungle growth cleared from radio antenna sites so that no vegetation touches the antenna?

t. When mobile shelters are not available, do tents or shacks erected to house electronic equipment, have a raised floor to hold the equipment off the damp ground and away from moisture, fungi, and insects?

u. To minimize moisture condensation on electronic equipment caused by high relative humidity, is the equipment kept turned on, or are lighted electric bulbs placed in or near it, or are appropriate dessicants and indicators used?

v. Are surfaces of optical elements such as lenses or mirrors kept clean of organic deposits such as finger marks, to avoid the development of fungus growths on them?

w. Is daily maintenance performed on electronic equipment to maintain it in an operational status?

x. Are daily checks made for fungus on the edges of insulators, keys, jacks, switches and connectors, and for the presence of small animals such as lizards and rodents?

y. Is special care and attention given to the condition of all electric batteries?

II. GENERAL CONSIDERATIONS

Consult the following documents for the indicated checklist subject:

A. MIL-HDBK-472

Checklist Number	Subject	Pages
A-1	Access (External)	A3-33
A-2	Latches and Fasteners (External)	A3-34,35
A-3	Latches and Fasteners (Internal)	A3,35,36
A-4	Access (Internal)	A3-36,37
A-5	Packaging	A3-37,38
A-6	Units - Parts (Failed)	A3-38
A-7	Visual Displays	A3-39
A-8	Fault and Operation Indicators (Built-in Test Equipment)	A3-39,40,41
A-9	Test Points (Availability)	A3-41
A-10	Test Points (Identification)	A3-42
A-11	Labeling	A3-42,43
A-12	Adjustments	A3-43,44
A-13	Testing (In Circuit)	A3-44,45
A-14	Protective Devices	A3-45,46
A-15	Safety (Personnel)	A3-46,47
B-1	External Test Equipment	A3-47,48
B-2	Connectors	A3-48,49
B-3	Jigs or Fixtures	A3-49
B-4	Visual Contact (with other team members)	A3-50
B-5	Assistance (Operations Personnel)	A3-50,51
B-6	Assistance (Supervisors or Contractor)	A3-51
B-7	Assistance (Supervisors or Contractor Personnel)	A3-51,52

B. AMCP 706-134

Table Number	Subject	Pages
5-2	Mechanical/Functional Checklist	5-3,4
9-11	Controls and Displays	9-29,30
12-2	Accessibility	12-10,11
13-4	Identification	13-9,10
14-1	Interchangeability	14-2
15-3	Safety	15-9,10,11
16-3	Servicing	16-9,10
21-1	Fasteners	21-12,13
23-2	Equipment Units	23-15,16,17
23-3	Cabling and Connectors	23-25,26
23-4	Test Points	23-30,31
23-5	Test Equipment	23-34,35

C. MTP 6-2-502 "Human Factors Engineering"

Subject	Paragraph No.
Control-Display Relationships	6.2.1
Visual Displays	6.2.2
Auditory Warning Devices	6.2.3
Controls	6.2.4
Labeling	6.2.5
Workspace, Design and Layout	6.2.6
Operator Comfort and Lack of Interference	6.2.7
Special Observational Tests	6.2.8

D. MTP 6-2-165 Appendix C "Laser Safety Guide"

Section	Subject
A	Policy
B	Exposure Control
C	Variation in Laser Systems
D	Request for Technical Assistance
E	Warning Signs

E. MIL-STD-1472 (Human Engineering)

Control-Display Integration	5.1
Visual Displays	5.2
Auditory Displays	5.3
Controls	5.4
Labeling	5.5
Anthropometry	5.6
Ground Workspace Design Requirements (Non Airborne)	5.7
Environment	5.8
Design for Maintainability	5.9
Design of Equipment for Remote Handling	5.10
Small Systems and Equipment	5.11
Hazards and Safety	5.13
Man Transpo. tability	5.14

APPENDIX C

Sample Scenario

Location: U. S. Army Tropic Test Center, Fort Clayton, Canal Zone (79° 57'30"W, 9° 21'30"N)

Exposure: Tropical Rain Forest

Simulated Combat Scenario: An infantry squad consisting of a squad leader and twelve riflemen are assigned the task of observing a trail from a fixed position. The briefing has described the trail as a possible source of supply to a hostile force to the south and that a group so engaged is expected to pass during the next twenty-four hours. The squad is informed that the supply operation personnel are part of a tactical unit and that they are not to be engaged in combat unless it cannot be avoided. The squad leader is to report to radio communications all activities that take place with regard to movement of supplies.

General: As a reconnaissance patrol, communication is especially important and must be reliable. To ensure the ability to provide intelligence by electrical means, a backup system of field wire and a field phone should be part of the squad's equipment in addition to the personnel transportable radios to be used as the primary means of communications. The squad leader ensures that each member of the squad has all the items of individual and organizational equipment required for the period of the exercise. He also ensures that he has the call signs and primary and alternate frequencies for a period beyond the duration of the exercise to provide for any contingency. All training and planning must be accomplished to ensure personnel are briefed on the mission and properly equipped.

Scenario: a. The squad moves out from the platoon position and moves undetected to its predetermined position to observe the trail. The field wire is laid during the movement.

b. The squad leader assigns areas of responsibility for observation of the trail and fields of fire for all-around protection of the squad position.

c. The squad leader selects his position and checks out both means of communication.

d. All squad members take up their positions and camouflage them to provide protection from observation.

e. The scout of the security force for the supply group is detected by the squad leader who reports this information by radio back to his platoon leader. This information is relayed back to Battalion Headquarters.

f. A short time later personnel with "A frames" loaded with ammunition boxes are observed on the trail. This information is also relayed back to the parent organization.

g. The squad leader receives a message to direct an air strike on the supply column. The message is authenticated and carried out. The results of the strike are relayed back to the platoon leader by land line.

h. Squad leader receives a message to return to the platoon position.

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)* U.S. Army Test & Evaluation Command 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
Common Tropic Environmental Test Procedure "Communication, Surveillance and Avionic Equipment"

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*

Final

5. AUTHOR(S) *(First name, middle initial, last name)*

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6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
4 January 1971	33	20

8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
b. PROJECT NO. AMCR 310-6	MTP 6-4-003
c. d.	9b. OTHER REPORT NO(S) *(Any other numbers that may be assigned this report)* ---

10. DISTRIBUTION STATEMENT

Distribution of this document is unlimited

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
---	Headquarters U.S. Army Test and Evaluation Command Aberdeen Proving Ground, Maryland 21005

13. ABSTRACT

Worldwide operations of the Army require that communication-electronic equipment be capable of performing in a humid tropic environment. Subsequent to testing in temperate climates and simulated environments, field testing is conducted by personnel representative of those who will utilize the equipment in an operating situation. This document describes the procedures for conducting the field tests in the actual tropic environment.

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Communications						
Electronics						
Tropic						