AD720570

US ARMY TEST AND EVALUATION COMMAND
COMMON TROPIC ENVIRONMENTAL TEST PROCEDURE

AVIATION EQUIPMENT AND AIRCRAFT ARMAMENT

1. OBJECTIVE

This document is a guide to test methods and techniques for determining the ability of aviation equipment and aircraft armament to function effectively within tropic environments.

2. BACKGROUND

Supplies and equipment can often be transported, stored and then operated effectively and efficiently in a temperate environment, but when similiarly exposed to tropic environmental conditions suffer degradation or become inoperative. Testing, therefore, is required to determine if new equipment after having met stated performance criteria in temperature and/or simulated tropic environments, will indeed function properly and maintain its operating efficiency when shipped to and operated in the tropics. (See Appendix A in MTP 2-4-003 for a detailed description of the environmental and meteorological conditions found in the tropics.) Since specific criteria for conducting tropic tests are frequently not provided, or is limited in scope, it is often necessary to compare the test item with a similar type item in the Army inventory. The resulting data are then presented as a comparison rather than a qualitative analysis.

3. REQUIRED EQUIPMENT

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

a. Airfield and support facilities.
b. Photographic equipment (still and motion).
c. Appropriate materials handling equipment (MHE).
d. Platform - type weighing scales.
e. Air-to-ground firing range.
f. Item under test (test item).
g. Suitable storage areas.
h. Reference or comparison item(s) as required.
i. Suitable targets for armament tests.
j. Camouflage equipment as required.

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4. REFERENCES

A. AR 70-38, Research, Development, Test, and Evaluation of Materiel for Extreme Climatic Conditions.
B. USAMC Regulation 385-12, Verification of Safety or Materiel

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C. USAMC Regulation 385-224, AMC Safety Manual.
D. USAMC Pamphlet 702-3, Reliability Handbook.
E. USAMC Pamphlet 706-134, Maintainability Guide for Design.
F. USATECOM Regulation 70-23, Equipment Performance Reports.
G. USATECOM Regulation 385-6, Verification of Safety of Materiel During Testing.
H. USATECOM Regulation 700-1, Value Engineering.
I. USATECOM Regulation 750-15, Maintenance Evaluation During Testing.
J. USAGETA Document, Human Factors Evaluation Data for General Equipment (HEDGE) Guidebook Supplement.
K. MIL-STD-129E, Marking for Shipment and Storage.
L. MIL-STD-794B, Part and Equipment, Procedures for Packaging and Packing of.
M. MIL-STD-1472A, Human Engineering Design Criteria for Military Systems, Equipment and Facilities.
N. TM 743-200, Storage and Materials Handling.
O. FM 31-35, Jungle Operations.
P. MTP 2-4-003, Tropic Environmental Test of Wheeled and Tracked Vehicles.
Q. MTP 3-3-517, Infantry Weapons and Ammunition Safety.
R. MTP 7-2-085, Helmets, Aviation.
S. MTP 7-2-086, Oxygen Masks, Aviation.
T. MTP 7-2-087, Clothing, Aviation.
U. MTP 7-2-501, Safety Evaluation of Aircraft Armament.
V. MTP 7-3-021, Aircraft, Suitability for Army Use.
W. MTP 7-3-500, Physical Characteristics.
X. MTP 7-3-506, Safety.
Y. MTP 8-4-004, Chemical Equipment.
Z. MTP 10-4-003, Tropic Environmental Test of General Supplies and Equipment.
AA. Specific Volume 3 and 7 MTP for items.
BB. TTC Regulation 705-4, Collection and Reporting of Meterological Data.

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 MTP's for the actual test procedures to be followed in assessing test item physical condition, technical characteristics, and operating performance. The primary intention of this MTP is to specify the environmental conditons under which such testing is to be performed, collection and analysis of data to determine the suitability of the test item for use in humid tropics.

5.1 SUMMARY

This materiel test procedure describes the following tests to be performed in a tropical environment on aviation, air delivery equipment and aircraft armament.

5.1.1 Preparation for Test

This section provides guidance for test project planning, a discussion of facilities and equipment required, instructions for test personnel training and familiarization and a typical mission scenario.

5.1.2 Test Conduct

a. Initial Inspection and Operating Characteristics - A determination of the test item upon its arrival and an assessment of its operating characteristics prior to conducting environment testing. This data will be used as a base for comparison with corresponding data developed during subsequent testing.

b. Individual and Organizational Clothing and Equipment - An evaluation of aircrewmen equipment to determine the suitability of the items for use in the tropics.

c. Aircraft Flight Evaluation - An evaluation to determine if stated performance criteria of the test aircraft can be achieved and maintained in the humid tropics.

d. Aircraft Armament - An evaluation to determine if the test items can meet stated performance criteria and continue to do so when operated in the humid tropics.

e. Short Term Storage - An evaluation of the ability of the test item(s) and/or components to be stored for short intervals in the humid tropics and not suffer loss of operability, efficiency, structural strength, or safety in operation.

f. Surveillance - An evaluation of the ability of the test item to withstand long term storage, while properly packed and packaged for storage in a humid tropical environment.

g. 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.

h. 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.

i. Safety - An evaluation to determine the safety characteristics and possible hazards of test item operation.

j. Human Factors - An evaluation to determine those design and performance characteristics affecting the test item user.

k. 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.

5.1.3 Test Data

This section details the raw data to be collected and recorded while completing the test procedures in paragraphs 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

a. The material presented in this MTP is limited to field testing in the humid tropics. Guidance for testing equipment in simulated environments or other induced tropic conditions has been intentionally omitted.

b. Procedures outlined in this MTP do not constitute detailed test plans. Tropic environment testing should be performed utilizing the guidance in this MTP, but each cognizant agency must determine the applicability of the procedures and how best to obtain the required data from the test item(s).

6. PROCEDURES

6.1 PREPARATION FOR TEST

6.1.1 Test Project Planning

The test project officer 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 testing is scheduled in test courses with both cleared and uncleared terrain in wet-warm and wet-hot environments. These environments are defined in paragraph 3 and Appendix A

of MTP 2-4-003. Testing should be scheduled in these areas during the peak of the wet season (October through November) and the dry season (January through March). Wherever applicable, testing should also be conducted in areas that cause salt-air and salt-spray exposure to the test item(s).

d. Prepare record forms and test logs for systematic entry of data, chronology of test, and evaluation in the final analysis for 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); include all applicable safety SOP's.

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

6.1.2 Test Personnel Training and Familiarization

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

b. Instruct personnel as follows:

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 environmental and meteorological conditions in which testing is to be conducted. f. The health precautions to be observed.

Table I. (continued)

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 meteorological conditions. f. The procedures to be followed when filling out checklists and questionnaires, and their purposes.
Test evaluators	a. The purpose and use of all checklists and questionnaires, and the methods to be used in their evaluation. b. The mathematical models to be used in evaluating the test data, and the calculations to be made.
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 recovery procedures to be used. d. The maintenance records to be written.

Table I. (continued)

Meteorological support	a. The calendar dates of all tests. b. The readings to be taken. c. Information contained in TTC Reg. 705-4.
General support	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 micro-biological inspection. c. The calendar dates of all inspections.

6.1.3 User Test

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

b. Prepare any additional mission scenarios required to 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 and description of expected environment to be found in each test course.

c. 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

NOTE: A detailed discussion of humid tropic test conditions is contained in MTP 2-4-003.

6.2.1 Physical and Operating Characteristics

NOTE: The physical and operating characteristics of each test item must be determined prior

to conducting environmental tests. This information shall be used as a base for comparison with subsequent data developed in completing the procedures of this MTP for two reasons:

1) To avoid attributing performance degradation or malfunctions to tropic testing when the condition was present upon test item receipt.
2) To determine precisely performance or structural degradation sustained by the test item as a result of testing.

a. Inspect the packaging and identification markings of item received in conformance with MIL-STD-794 for overseas shipment for level A or B, as applicable.

b. Unpack and remove all preservative coatings on test item(s). Inspect all surfaces for proper painting and other protective coatings. Take color photographs of all surfaces displaying roughness, corrosion or microbiological growths.

c. 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.

d. Determine the physical characteristics of the test item(s) in accordance with the appropriate procedures in the applicable Volume 7 MTP and in MTP 7-3-500. File an EPR for any damages detected.

e. Using the procedures in the applicable draft technical manuals, prepare the test item for normal operation; execute all functions of the test item in all normal modes and ranges of operation.

6.2.2 Individual and Organizational Clothing and Equipment

All individual and organizational equipment under test shall be worn and used while completing aviation type missions with accepted aircraft. Personal equipment shall be subject to normal cleaning and storage cycles experienced by similar items between missions. For personal equipment testing, refer to MTP 10-4-003. Wherever possible, reference articles selected from previously accepted stock shall undergo the same tests to derive control data.

6.2.3 Aircraft Flight Evaluation

Flight testing is conducted in the tropics to determine if the aircraft can satisfy its performance and maintainability requirements while operated in a hot-humid atmosphere, and in an environment conductive to microbiological growths, corrosion and insect penetration. The testing should be conducted in sites containing the specified environmental and meteorological conditions as described in MTP 2-4-003 for sufficient periods to obtain conclusive data for this evaluation and to accurately trace any structural or performance degradation as a function of the test period, conditions, and activity. The actual test procedures should be conducted in accordance with those specified in cancelled 7-3-021, and any other specific Volume 7 MTP required for the aircraft under evaluation.

6.2.4 Aircraft Armament

Aircraft armament testing is conducted to determine if the test items can perform satisfactorily and continue to do so when operated in the humid tropics. A comparison item will be used whenever applicable. A sufficient number of ground and inflight test cycles will be conducted commensurate with the aircraft/range availability. These tests should be conducted in accordance with the applicable guidance of the associated Volume 7 and/or Volume 3 MTP. Reference should also be made to MTP 3-3-517, 7-2-501, and 7-3-506 for applicable safety guidance.

These tests should provide sufficient data to evaluate fire power accuracy, concentration, stability, ability to penetrate single and double canopies, and ease of performing and maintaining control actions. Sufficient testing should be conducted to evaluate any structural or performance degradation of the armament systems as a function of the test period, vegetation density, meteorological conditions, and test actions performed.

6.2.5 Short Term Storage

Storage testing is conducted to determine if the test item(s) can withstand exposure to humid tropic environment for brief periods with a minimum of protection and not suffer structural or performance degradation. The tests are to be conducted consistent with normal practice for the commodity class as supplemented by 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 anlyze any growths detected.

c. At completion of the storage period, repeat procedures of paragraph 6.2.1 and the appropriate paragraph 6.2.2, 6.2.3 or 6.2.4 to determine any degradation resulting from storage testing.

6.2.6 Surveillance

Surveillance testing is performed on items that are subject to rapid deterioration of materials or performance. These items are stored and tested in the humid tropic environment on a continuing basis to determine the extent of deterioration as compared with the original requirements. Surveillance testing is of prime importance for equipment stowed in the aircraft and aircraft engines stored in containers.

a. Prepare the test item for long term storage as described in the draft technical manual.

b. Conduct surveillance testing in accordance with the applicable guidances supplied in MTP 8-4-004. As described therein, complete periodic inspections and perform the procedures of paragraph 6.2.1 and the appropriate paragraph 6.2.2, 6.2.3 or 6.2.4 to determine if any damaging effects have been induced in the test item by long term storage. Sample and analyze any microbiological growths detected.

6.2.7 Security from Detection

NOTE: This subtest should be conducted when specifically requested in the test directive.

a. Select as many forms of camouflage as would be used in field conditions. An aircraft, for example, may be camouflaged in shadows of large buildings, placed under trees, placed under artificial canopy hung between trees or poles or placed in a depression and covered by nets.

b. Place test item in designated site and use camouflage and combinations of camouflage forms selected to conceal test item. Place material about the 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.

6.2.8 Maintenance Evaluation

When maintenance actions are performed while completing operational performance testing, the following shall be recorded:

a. Scheduled maintenance:

NOTE: For the purpose of testing, scheduled maintenance is to be considered synonymous with preventive maintenance inspections and services.

1) If maintenance requirements reflect peculiarities of the course or test activity, provide a description of test course and test activity associated with maintenance performed.
2) Procedures and special tools (if any) required to complete maintenance actions.
3) Elapsed time since previous scheduled or unscheduled maintenance (whichever is shorter). Identity of previous maintenance performed (scheduled or unscheduled).
4) Parts required, if any.
5) Elapsed time required to complete maintenance actions.
6) Difficulties in completing maintenance actions.

b. Unscheduled maintenance:

1) Description of test course, environment and activity under which maintenance requirements developed.
2) Procedures and special tools (if any) required to complete maintenance actions.
3) Elapsed time since previous scheduled or unscheduled maintenance performed (whichever is shorter). Identity of previous maintenance performed.
4) Parts required, if any.
5) Elapsed time required to complete maintenance actions.
6) Difficulties in completing maintenance actions.

c. Time to complete related maintenance functions.

1) Supply delay time.
2) Administrative delay time.
3) Technical engineering investigation 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.
2) The adequacy of the OEM tools and repair parts.
3) The adequacy of the safety instructions.

e. Chargeable test item failures.

NOTES: 1. Consider simultaneous related malfunctions as one failure.
2. Do not consider as failures those malfunctions which would not affect mission performance.

Malfunctions which the operator/crew cannot remedy by an adjustment, repair or replacement action using the controls, OEM tools and OEM parts within the time established, and which causes, or may cause:

1) Failure to commence operation.
2) Cessation of operation.
3) Degradation of performance capability of the system/subsystem.
4) Damage to system/subsystem by continued operation.
5) Personnel hazards.
6) Test item component (not system) failures which cause accidents.
7) Incipient failures corrected by direct or general support maintenance.

f. Non-chargeable test item failures.

1) Test item failures which result from not following the prescribed operational and/or maintenance procedures dictated by the applicable technical manual, or which can be directly attributed to improper replacement of components or assemblies.
2) Test item failures which result from accidents.
3) Incipient failures detected and corrected during scheduled preventive maintenance inspections or services at the organizational level.

NOTE: Normal organizational maintenance performed during the scheduled preventive maintenance service and inspections should be sufficient to give reasonable assurance of trouble-free operation until the next scheduled service. Therefore, no active maintenance, other than operator/crew authorized maintenance, will be performed (if such maintenance affects the system performance) between the scheduled services and inspections unless such maintenance is accomplished to correct a chargeable system failure. Examples of permissible maintenance between scheduled services and inspections are --

a. Replacement of lamps.
b. Replacement of fuses.
c. Replacement of damaged tires.
d. Tightening of fasteners.
e. Minor body repair or painting which cannot be deferred.

f. Normal daily services, including before, after, and during operation checks and services called for in the operator's/maintenance manual.

6.2.9 Safety

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

b. Observe the proper safety precautions during testing noting any conditions that might present a safety hazard.

c. Observe procedures and complete safety evaluations as specified in the following documents:

1) The test item maintenance test package.
2) USATECOM Regulation 385-6.
3) FM 31-35.
4) Applicable portions of Appendix B in MTP 2-4-003 (Questionnaires).
5) Applicable portions of Appendix C in MTP 2-4-003 (Checklists).
6) Applicable portions of specific commodity Volume 7 MTP and MTP 7-3-506.
7) Applicable portions of munitions MTP's in Volume 3 and MTP 3-3-517.

d. Complete the following additional safety evaluations.

1) Presence and clarity of safety warnings on test item.
2) Adequacy of handling and operating procedures with regard to personnel safety.
3) Presence, sufficiency, and adequacy of safety devices.
4) Presence of sharp or projecting edges, controls or other hardware.
5) Accessibility of emergency cut-off controls.
6) Adequacy of emergency equipment and instructions, if applicable.
7) Adequacy of fire fighting equipment and procedures/hardware for handling and storage of munitions.

6.2.10 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 task may be derived

from USAGETA document "Human Factors Evaluation Data for General Equipment (HEDGE) Guidebook Supplement". Consult Appendix C in MTP 2-4-003, MIL-STD-1472, and the following for guidance in preparing a suitable checklist.

a. For all tasks the following factors will be considered:

1) Adequacy of instructions and tools to perform the task.
2) Mental and physical effort required.
3) Design of the test item as it affects the task.
4) Time required for the task.
5) Personnel required for the task.

b. Perform the following tasks for the HEDGE test functions given. The factors considered shall include, but not be limited to, those of subparagraph a. above.

1) Operability.

a) Assemble and set-up.

1. Assemble components and make all connections.
2. Make preliminary alignment, calibrate and adjust.

b) Prepare.

1. Check controls, fasteners, connectors.
2. Load expendables (lubricants, fuel, munitions, etc.).
2. Close covers, caps, etc.

c) Operate test item.

1. Energize engine.
2. Operate-manipulate controls; perform prime function(s).

2) Maintainability.

a) Perform scheduled maintenance.

1. Clean, add lubricants.
2. Remove and replace minor items.
3. Tighten fasteners, connectors.
4. Adjust, calibrate, align.

b) Perform nonscheduled maintenance.

1. Detection of malfunction by observing displays, noting visual or audible changes, or changes in operating effectiveness.

2. Isolate and identify causes by visual means or instrumentation.

c) Remove and replace.

1. Open, gain access to and remove component.
2. Replace or repair and reestablish proper operation.

3) Transportability.

a) Prepare for transport.

1. Place in the transit state by removals, collapsing, tightening, locking, apply protective cover.
2. Package/containerize, block/brace the test item accessories.

b) Load/unload.

1. Move test item to the carrier; use appropriate MHE and move test item accessories to the carrier.
2. Place test item and accessories into/onto the carrier.

c) Secure/unfasten.

1. Tie down or secure.
2. Remove test item from carrier.
3. Open container, unblock, remove and reinstall test item accessories.

c. For aircrewmen clothing and helmets perform the following additional evaluations:

1) Ease in donning and doffing clothing.
2) Ease in using fastening and adjusting mechanisms; suitability in number and range of adjustment devices provided.
3) Time required to complete donning and doffing tasks.
4) Comfort of clothing and helmet. (Light weight materials should be used; fit and adjustment mechanisms are satisfactory for comfort and freedom of motion. Clothing, wherever possible, should be vented and employ fabric that does not trap perspiration.)
5) Compatibility of clothing with standard field items and equipment such as individual weapons, parachutes, etc.
6) Protection offered test item wearer; agreement/disagreement with stated requirements.
7) Agreement of coloring with stated requirements.

8) Additional considerations as specified in MTP 7-2-085, MTP 7-2-086, and MTP 7-2-087.

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 noting 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 this evaluation.

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

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 results 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

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.

b. Indicate the accuracy of measuring devices employed.

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 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 B of MTP 2-4-003 (Questionnaires).

e. When evaluating test item degradation resulting from tropic environment testing, insure, as a minimum, that the following indications of deterioration are recorded as they apply:

1) Loss of calibration.
2) Destruction of thermal devices.
3) Evaporation or flow of lubricants.
4) Close or open of contacts due to warping under expansion.
5) Bind of mechanical parts due to differential expansion of dissimilar metals or to loss of lubricants.
6) Permanent set of packings and gaskets.
7) Adhesion of closure and sealing strips (due to partial melting) to contacting parts.
8) Discolor, crack, bulge, check, craze, or strength - reduction of materials.
9) Corrosion.
10) Crystallization of rubber components.
11) Microbiological growths, particularly on the following:

a) Textiles.
b) Wood and paper.
c) Rope and cordage.
d) Leather.
e) Cork.
f) Gaskets (fiber, felt, cork).
g) Electrical insulating material.
h) Adhesives.
i) Plastics and plasticizers.
j) Vinyl coverings.
k) Paints and varnishes.
l) Synthetic resins.
m) Sealing compounds.
n) Lens coatings and cements.
o) Glass (through etching).
p) Explosives and propellants.
q) Lubricants.
r) Rubber.
s) Secondary damage through decomposition of protective coatings or seals, thus admitting moisture leading to corrosion or deterioration of electronic components or instruments that were supposed to be hermitically sealed.

12) Moisture absorption, swelling, chemical decomposition, saturation of protective desiccants.
13) Electrical or electronic difficulties.
14) Accumulation of water due to condensation of moist air and/or rain.

6.3.1 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.

6.3.2 Physical and Operating Characteristics

Record the following:

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

b. Any omissions of components or equipment damage detected.

c. Physical characteristics of the test item as specified in the applicable Volume 7 MTP, and in MTP 7-3-500.

d. Instances of missing or improper protective coatings on test item. Identity of photographs illustrating roughness, corrosion or microbiological growths.

e. Description of operational condition of test item; provide enough details of tests performed and results obtained to evaluate the operating efficiency of the item in all modes, ranges, and speeds of operation.

6.3.3 Individual and Organizational Clothing and Equipment

Record the following:

a. Average durability achieved for various items. (Number of washings, number of times worn, total wear time.)

b. Effects of standard laundering of clothing. Suggestions for change of launder process.

c. Average shrinkage encountered; loss of coloring.

d. Comfort provided in fit, weight and porosity of clothing.

e. Appearance of clothing upon receipt and throughout its life.

f. Brief description of test conduct and conditions under which clothing evaluation completed.

6.3.4 Aircraft Flight Evaluation

Record the data required by the applicable MTP and the following:

a. A description of each test, prevailing meteorological conditions, and the period of test conduct.

b. Any difficulties encountered in completing test actions, unusual maintenance requirements, or instances wherein specified performance criteria not met. Provide sufficient test details for evaluation in final analysis of the suitability of the aircraft for use in the tropics.

c. For each instance wherein specified performance criteria not met, fully described actual performance achieved.

6.3.5 Aircraft Armament

Record the data required by the applicable MTP and the following:

a. A description of the aircraft armament under test, the test site(s) used, prevailing meteorological conditions, and performance obtained.

b. Results of ground testing.

c. Results of inflight testing.

6.3.6 Short Term Storage

Record the following:

a. Identity of test item.

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

c. Storage environment and average meteorological conditions.

d. Number of items involved.

e. Method and duration of storage of each item.

f. Results of all inspections made.

g. Maintenance and repairs made.

h. Extent of deterioration.

6.3.7 Surveillance

Record the following:

a. Identity of test item.

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

c. Storage environment and average meteorological conditions.

d. Number of items involved.

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

f. Results of all inspections made.

g. Maintenance and repairs made.

h. Extent of deterioration of operating characteristics.

6.3.8 Security from Detection

Record the following for each kind and/or group of camouflage used:

a. Characteristics of 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.

f. Time required and difficulty to complete camouflage actions.

g. Requirements for natural and/or man-made landmarks to complete concealment.

6.3.9 Maintenance Evaluation

Record the following and describe all procedures and special tools used in performing maintenance actions:

a. Total scheduled maintenance time consumed.

b. Total unscheduled maintenance time consumed.

c. Total operating time (in hours).

d. Total number of scheduled and unscheduled maintenance actions performed.

e. Total number of chargeable system failures.

f. Total unscheduled maintenance time expended on chargeable failures (in hours).

g. Adequacy of the technical manual to support the maintenance program.

h. Adequacy of the OEM tools and repair parts.

i. Adequacy of the safety instructions.

6.3.10 Safety

Record the appropriate data as required by the specific Volume 7 MTP for the test item, MTP 7-3-506, 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 and armament testing.

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

6.3.11 Human Factors Evaluation

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

6.3.12 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 item 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 two or more 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

Maintenance observations shall be summarized and presented in narrative form. Data recorded in paragraph 6.3.9 will be tabulated and the following computations will be made:

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

Sample Scenario

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

Exposure: Tropical Rain Forest

Simulated Combat Scenario: The 1st Platoon, Company A, 9th Aviation Battalion, 9th Infantry Division is assigned the mission of providing escort of a ground convoy.

General:

a. The threat of ambush to ground convoys is usually present in defensive or retrograde situations in restrictive terrain such as jungle, and in operations against an enemy adept at infiltration. Stability operations will frequently require aerial escort of ground convoys; general warfare operations will require convoy escort in the combat or communications zone when security is essential. The ambush threat can be greatly reduced by using an armed helicopter escort for the convoy.

b. Planning Considerations - The armed helicopter mission commander should conduct a thorough map reconnaissance of all proposed routes, alternate routes, and adjacent terrain. He should establish a system of checkpoints, phase lines, and holding areas to be used by his armed helicopter escort. These control measures must be coordinated with the ground convoy commander. A route reconnaissance should be made prior to conducting the convoy escort. Coordination for refueling and rearming must be effected if the escort of the convoy is expected to require more time than helicopter fuel endurance permits. After coordinating with the convoy commander, the armed helicopter mission commander should consider placing fuel and ammunition in the ground convoy. Other coordination with the convoy commander should include --

1) Number and type of vehicles in the column.
2) Radio frequencies, call signs, and/or visual signals.
3) Primary and alternate routes of advance.
4) Starting time, starting point, rest stops, and release points.
5) Armed helicopter and ground convoy prearranged actions, if attacked.

Scenario:

a. Conduct of the Mission - The mission may be conducted by an armed helicopter force employing one fire team as an advance reconnaissance element with the balance of the armed helicopters composing a strike force

positioned over the moving column. The reconnaissance elements should reconnoiter at an altitude based on the ability to observe the convoy, searching at least 1,500 meters on either side of the route. The reconnaissance effort should be directed toward determining the condition of the route, obstacles along the route, and enemy positions or terrain that dominate the route. The reconnaissance element relays all pertinent information to the armed helicopter mission commander, using the spot report technique. This includes negative reports at frequent intervals. The helicopter strike elements provide protection directly over and adjacent to the column. The strike force normally will fly in 360° orbits or S patterns over the column, reconnoitering terrain features immediately adjacent to the route. This force must be prepared to support both the aerial reconnaissance elements and the ground convoy.

b. When enroute and at a time and place previously selected, the armed helicopters should be given a fire mission. Other fire missions may be assigned, but a clear report should be given between missions.

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13. ABSTRACT

Procedures are described for determining the ability of aviation equipment and aircraft armament to withstand storage and operate effectively in a tropic environment.

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