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23 July 1970

Materiel Test Procedure 7-4-008
U. S. Army Arctic Test Center

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

ARCTIC ENVIRONMENTAL TEST OF AVIATION SUPPORT EQUIPMENT

OBJECTIVE

The objective of the procedures outlined in this MTP are to evaluate the performance, compatibility, safety and human factors engineering and maintenance characteristics of aviation support equipment under arctic winter environmental conditions.

BACKGROUND

Aviation support equipment (ground handling, maintenance, support, etc.) is evaluated and tested against criteria contained in applicable Qualitative Materiel Requirement (QMR), Small Development Requirement (SDR), Technical Characteristic (TC), or other requirements as specified in test directives. Testing for use in an arctic winter environment is used to substantiate or supplement data obtained from simulated tests conducted during the Engineer Design and Engineering Test phase.

Environmental arctic testing is generally not authorized until data from simulated environmental and temperate zone testing provides reasonable assurance that the test item will function satisfactorily when subjected to the conditions that would be encountered in the arctic. Environmental hangar testing is used to determine operational performance characteristics of all components down to -65°F.

REQUIRED EQUIPMENT

- a. Appropriate arctic winter uniforms as stated in MTP 10-4-500.
- b. One aircraft of the type the equipment is designed to support.
- c. Supply of test item repair parts for the duration of the test period.
- d. Special tools required by the particular aircraft and test equipment.
- e. Support equipment maintenance package (technical publications or draft manuscripts).
- f. Photographic equipment, still and motion picture cameras (black and white, or color).
- g. Precision measuring devices.
 - 1) Thermocouples for heat producing equipment.
 - 2) Voltmeters and loadmeters for electrical power producing equipment.
 - 3) Pressure recording instruments for hydraulic support equipment.
- h. Meteorological equipment.
- i. Special test equipment as required.

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j. Vehicles, as required.

- NOTE: 1. Existing runways, ramps and hangar areas at the Arctic Test Center (ATC) are adequate to support testing of aviation support equipment currently in the Army inventory or under development.
2. Requirements for special facilities to support testing will have to be anticipated early enough to allow construction to be completed prior to the test season.

4. REFERENCES

- A. AR 70-10, Test and Evaluation During Research and Development of Materiels.
- B. AR 70-38, Research, Development, Test and Evaluation of Materiel for Extreme Climatic Conditions.
- C. AR 385-63, Regulations for Firing Ammunition, for Training, Target Practice and Combat.
- D. AR 705-25, Reliability Program for Materiel and Equipment.
- E. USATECOM Regulation 350-6, Training in New or Modified Equipment and Training Devices.
- F. USATECOM Regulation 385-6, Verification of Safety of Materiel During Testing.
- G. USATECOM Regulation 750-15, Maintenance of Supplies and Equipment.
- H. TM 9-207, Operation and Maintenance of Army Materiel in Extreme Cold.
- I. TM 9-1300-206, Care, Handling, Preservation, and Destruction of Ammunition.
- J. MTP 7-1-001, Testing Aviation Equipment.
- K. MTP 7-2-055, Aircraft Ground Support Equipment.
- L. MTP 7-2-057, Tools (Aviation).
- M. MTP 7-2-065, Sights, Runway.
- N. MTP 7-2-070, Mat Sets, Landing.
- O. MTP 7-2-105, Tractor, Wheeled, Aircraft, Towing.
- P. MTP 7-3-055, Heaters, Auxiliary Power Units, and Service Kits (Aviation).
- Q. MTP 7-3-065, Lights, Runway.
- R. MTP 7-3-066, Approach Systems, Aircraft.
- S. MTP 7-3-070, Mat Sets, Landing.
- T. MTP 7-3-100, Tiedown, Cargo, Aircraft.
- U. MTP 7-3-105, Tractor, Wheeled, Aircraft, Towing.
- V. MTP 7-3-501, Personnel Training.
- W. MTP 7-3-506, Safety.
- X. MTP 7-3-507, Maintenance.
- Y. MTP 7-3-508, Reliability.
- Z. MTP 7-3-509, Compatibility with Related Equipment.
- AA. MTP 7-3-510, Human Factors.
- AB. MTP 7-3-514, Adequacy of Technical Manuals.
- AC. MTP 7-4-001, Desert Environmental Test of Aviation Equipment.
- AD. MTP 10-4-500, Arctic Environmental Test, Preoperational

STATEMENT #2 UNCLASSIFIED

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attn: AMSTE-TS 23 July 1970

Aberdeen Proving Ground, Md. 21005

Inspection, Physical Characteristics, Human Factors, Safety and Maintenance Evaluation.

5. SCOPE

5.1 SUMMARY

The procedures outlined in this MTP are designed to determine and evaluate the physical characteristics of aviation equipment in arctic environmental conditions and provide guidance for the conduct of arctic environmental testing of aviation support equipment. Specific subtests include:

- a. Preoperational Inspection and Physical Characteristics
- b. Operational Suitability
- c. Human Factors
- d. Safety
- e. Maintenance Evaluation
- f. Reliability

5.2 LIMITATIONS

The procedures described in this MTP are general in nature and limited to the testing of aviation support equipment. Specific procedures and testing requirements will be determined by the characteristics and performance criteria of the test item.

Those procedures that duplicate testing that has been conducted at other facilities and are not peculiar to an arctic winter environment will not normally be conducted.

6. PROCEDURES

6.1 PREPARATION FOR TEST

a. Since arctic winter environmental tests are normally scheduled from October through March (6 months), ensure that the test items are delivered to the Arctic Test Center prior to 1 October. Any delay in the test schedule will be reported to TECOM headquarters and a revised schedule requested. The test schedule will reflect an estimate of net testing time required for each subtest.

b. TDY personnel will be used to augment assigned personnel and will be trained to the degree that they are as proficient on the test item as the troops who will use the equipment. Assigned personnel will prepare the plan of test, supervise and conduct the test, gather test data, and report the results of the test.

c. Ensure that all test personnel are familiar with the required technical and operational characteristics of the item under test, such as stipulated in Qualitative Materiel Requirements (QMR), Small Development Requirements (SDR), and Technical Characteristics (TC), and record this criteria in the test plan. A familiarization class will be given to all test personnel by the test officer as required.

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d. Review all instructional materiel issued with the test item by the manufacturer, contractor, or government, as well as reports of previous tests conducted on the same type of equipment, and familiarize all test personnel with the contents of such documents.

e. Record the grade, MOS, background, and training of all test personnel and ensure that all personnel receive New Equipment Training (NET) as referenced in 4.E., and general training as specified in MTP 7-3-501.

f. Record the following information:

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

g. Select test equipment ideally having an accuracy of 10 times greater than that of the function to be measured.

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

i. Prepare adequate safety precautions to provide safety for personnel and equipment, and ensure that all safety SOP's are observed throughout the test. Ensure that a Safety Release has been obtained prior to test conduct.

Test and subtest plans and procedures will ensure performance in the safest manner consistent with accomplishing the mission. The cardinal principle is to limit exposure of a minimum of personnel, for a minimum time, to a minimum amount of hazardous material consistent with safe and efficient operations. Plans will include safety procedures, precautions, protection including immunization of personnel, and emergency procedures as necessary. Technical information on the hazards and safety characteristics of the test item as provided by the safety release and other pertinent information will be included. Such information will include evaluation of potential hazards, analysis of risks, limitations, and precautions including special test equipment and techniques that should be incorporated in test plans and procedures.

A specific individual shall be charged with responsibility for safety of each test. He will be familiar with the construction and operation of the test item and its critical components, have full knowledge of the hazards and safety aspects of the test, and review test procedures for evaluation of hazards and recommend control measures.

All personnel who participate in, or observe the tests, will be briefed on the proper test methods and procedures, and the hazards involved.

j. Outfit all personnel in appropriate arctic winter uniform as described in MTP 10-4-500, and with individual field equipment, during all testing.

k. Record the prevailing meteorological conditions during the storage phase as well as during the conduct of this test, to include:

- 1) Temperature

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- 2) Humidity, relative or absolute
- 3) Temperature gradient (during test only)
- 4) Atmospheric pressure (during test only)
- 5) Precipitation
- 6) Solar radiation
- 7) Wind speed and direction
- 8) Frequency of readings
- 9) Source of data

1. Upon notice of arrival of the test item(s) or the estimated time of arrival, select and schedule the use of testing sites, facilities and equipment as required by the applicable subtest and/or the corresponding MTP.

6.2 TEST CONDUCT

- NOTE:
1. During testing 25% of all tests will be conducted in the ambient temperature range of 0°F to -25°F, 50% of all tests will be conducted in the range of -25°F to -50°F, and 25% of all tests will be conducted in the ambient temperature range of -50°F to the lowest available ambient temperature. The length of cold-soak periods and ambient air temperatures during cold-soak periods will be recorded during each subtest as appropriate.
 2. Still and motion pictures will be taken as appropriate to illustrate test results.
 3. All testing, operations, maintenance and servicing of the test item will be in accordance with instructions contained in appropriate technical manuals or other publications.
 4. Personnel engaged in the operation and maintenance of the test item out-of-doors will wear the mitten set, arctic, unless the degree of dexterity required is such that anticontact gloves must be worn. Suitable warming shelters will be provided near the operating and maintenance sites.
 5. Throughout the conduct of the test, a determination will be made of any unnecessary, costly, or nice-to-have features that may be eliminated without adversely affecting essential performance requirements, reliability, quality or safety.
 6. Subtests shall be conducted concurrently with other subtests whenever possible for more efficient utilization of personnel and resources available and to minimize test time, and duplication of data.

6.2.1 Preoperational Inspection and Physical Characteristics

a. Upon receipt carefully inspect all test and comparison items and their shipping or packaging containers for completeness, damage and general condition, in accordance with the applicable reference MTP's.

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NOTE: If the equipment is a standard item for which records of physical characteristic verifications exist at other test installations, it is not necessary to repeat these measurements unless so directed by higher headquarters.

- b. Note the physical characteristics of the test item and/or any components thereof in all obtainable configurations.
- c. Record the nomenclature and manufacturer's name of the test items.
- d. Take photographs of the test item, if required.
- e. Note all discrepancies, corrective action necessary, and other information pertaining to the discrepancies.
- f. Ensure test item is properly assembled, secured, cleaned, and correctly adjusted. Record any necessary corrective action.

6.2.2 Operational Stability

- a. Connect the test item to the support aircraft and cold-soak until all components reach the ambient air temperature.
- b. Operate each test item or system a minimum of ten times in each ambient temperature range specified in paragraph 6.2. Note 1. If the test item can be altered to a different configuration by changing components, test each configuration ten times in each ambient temperature range.
- c. Operation, maintenance and servicing of the test item will be accomplished by trained military personnel in accordance with instructions contained in appropriate technical publications and draft manuscripts.
- d. Record the following information:
 - 1) Test equipment used.
 - 2) Meteorological conditions.
 - 3) Difficulties encountered in installing, attaching, loading, disconnecting, moving or storing the equipment or components.
 - 4) Degree of completeness of design requirements.
 - 5) Operation malfunctions and failures.
 - 6) Features of the test item(s) that enhance or detract from specific mission performance.
 - 7) Still photograph and motion picture coverage as required.

6.2.3 Human Factors

- a. Conduct all human factors tests in accordance with applicable sections of MTP 10-4-500 and MTP 7-3-510.
- b. Conduct this subtest concurrently with operational subtests in this MTP.
- c. Determine if the test item is compatible with the skills, aptitudes, and limitations of personnel who will operate and maintain this equipment under arctic winter environmental conditions.
- d. Determine if all accessories and components of the test item and the test item as a whole, enable or allow easy operation by test personnel wearing the appropriate arctic winter uniform.
- e. Observe and record any and all major or minor tasks that are

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difficult or impossible to accomplish on or with the test item under arctic winter environmental conditions.

6.2.4 Safety

- a. Conduct all safety tests in accordance with applicable sections of MTP 10-4-500, USATECOM Regulation 385-6, and MTP 7-3-506.
- b. Conduct this subtest concurrently with operational subtests in this MTP.
- c. Determine if the test item is safe for United States Army use under arctic winter environmental conditions.
- d. Prepare adequate safety precautions to provide safety for personnel and equipment, and ensure that all safety SOP's are observed throughout the test. Ensure that a safety release has been obtained prior to test conduct.
- e. Determine if all accessories and components of the test item and the test item as a whole can be operated safely by test personnel wearing the appropriate arctic winter uniform.
- f. Observe and record any and all major or minor tasks that are difficult or impossible to accomplish safely on or with the test item under arctic winter environmental conditions.

6.2.5 Maintenance Evaluation

NOTE: Classifications and definitions of malfunctions shall be as approved and commonly defined by all USATECOM testing agencies.

- a. Conduct all maintenance evaluation tests in accordance with applicable sections of MTP 10-4-500, USATECOM Regulation 750-15, TM 9-207, and MTP 7-3-507.
- b. Conduct this subtest concurrently with operational subjects in this MTP.
- c. Throughout the conduct of all testing as outlined in this MTP, maintain a record of performance of all scheduled and unscheduled maintenance as prescribed in the appropriate draft publications.

NOTE: Whenever possible, maintenance shall be performed under prevailing arctic environmental conditions. Reasons why this is not possible shall be recorded.

- d. Continuously monitor all maintenance operations for human factors, safety implication, and to determine if ease of maintenance has been included in the design of the equipment.
- e. Compare all replacement parts and components, provided with the test item, with anticipated and actual requirements, evaluating spare parts requirements under arctic environmental conditions.
- f. Record the following information:

- 1) Scheduled and unscheduled maintenance performed, to include lubrication, adjustments, repairs, and replacement of parts.
- 2) Favorable and unfavorable aspects of maintenance.

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- 3) Unsafe and inadequate aspects of maintenance operations.
- 4) Mean time between failures (MTBF) and the mean time to repair (MTTR) the test items and associated equipment.
- 5) Repair parts usage.
- 6) Human factors implications.
- 7) Suitability of associated equipment.

g. During performance of maintenance, utilize all common and special tools and test equipment furnished with the items under test, and record the following data:

- 1) Maintenance operations for which special tools are required.
- 2) Common and special tools and test equipment required, but not furnished in the maintenance package.
- 3) Tools and test equipment furnished but not required.

h. Thoroughly analyze all publications provided with the test items for clarity and simplicity of maintenance instructions, and completeness of preventative maintenance procedures.

i. Monitor all maintenance operations to determine if instructions and the sequence of operations are adequate for the level of training possessed by appropriate maintenance personnel, or if added or special training is required.

j. Record the following data:

- 1) Accuracy and adequacy of maintenance publications.
- 2) Requirements for special training and maintenance category requiring special training.
- 3) Errors and omissions in nomenclature and part numbers on repair parts lists.
- 4) Unclear and inadequate maintenance instructions.
- 5) Inadequate safety instructions for personnel and equipment, including environmental protection during operation and maintenance.
- 6) Desirable changes and comments.

6.2.6 Reliability

a. Conduct all reliability tests in accordance with applicable sections of AR 705-25 and MTP 7-3-508.

b. Conduct this subtest concurrently with operational subtests in this MTP.

6.3 TEST DATA

All test data to be recorded will be as specified in the individual subtests of this MTP.

6.4 DATA REDUCTION AND PRESENTATION

Processing of raw test data shall, in general, consist of organizing,

marking for identification and correlation, and grouping the test data according to test title.

Specific instructions for the reduction and presentation of individual test data are outlined in the succeeding paragraphs.

6.4.1 Preoperational Inspection and Physical Characteristics

Preoperational inspection and physical characteristics data shall be reduced and presented in accordance with MTP 10-4-500.

6.4.2 Operational Stability

a. Examine the recorded information as specified in paragraph 6.2.2 above and evaluate the suitability of the performance of the test item(s) in an arctic winter environment by determining:

- 1) If specified requirements are met
- 2) Compatibility with support aircraft
- 3) Ease of operation of the test item(s)

b. Prepare a comprehensive report on the findings of the above evaluations.

6.4.3 Human Factors

Human factors data shall be reduced and presented in accordance with MTP 10-4-500.

6.4.4 Safety

Safety data shall be reduced and presented in accordance with MTP 10-4-500.

6.4.5 Maintenance Evaluation

Maintenance data shall be reduced and presented in accordance with MTP 10-4-500.

6.4.6 Reliability

Data shall be reduced and presented in accordance with the applicable statistical methods for determining reliability.

APPENDIX A

HUMAN FACTORS EVALUATION CHECKLISTS

1. CREWMEMBERS (PILOT AND COPILOT)

Record any difficulty encountered in operating the test special equipment.

- | | | |
|-------------------------|-----|----|
| a. Preflight checks | YES | NO |
| b. In-flight operation | YES | NO |
| c. Emergency procedures | YES | NO |

Area _____

Item No(s) _____

Explain _____

2. OPERATOR

a. Record any human factors engineering difficulties encountered during installation, operating, and maintaining the equipment by completing the following checklist at the end of each day's activity.

b. Were any difficulties encountered in performing the required preventive maintenance checks and services? YES NO

Explain _____

c. Were any difficulties encountered in performing unscheduled maintenance on the item? YES NO

Explain _____

d. Were any difficulties encountered during installation or attachment of the item? YES NO

Explain _____

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e. Were any difficulties encountered in operating the equipment?
YES NO

Explain _____

f. Were any discrepancies encountered in results obtained from the operation of the equipment? YES NO

Explain _____

g. Were any difficulties encountered in removing or detaching the item? YES NO

Explain _____

h. Were any safety hazards detected during the installation, operation, or maintaining of equipment? YES NO

Explain _____

i. If any other human factors engineering difficulties not covered by one of the preceding checklist items were encountered, explain in the space provided.

Explain _____

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13. ABSTRACT This Environmental Test Procedure describes test methods and techniques for evaluating the performance and characteristics of Aviation Support Equipment under Arctic winter environmental conditions. The evaluation is related to criteria expressed in applicable Qualitative Materiel Requirements (QMR), Small Development Requirements (SDR), Technical Characteristics (TC), or other ap- propriate design requirements and specifications.		

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