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28 November 1969

Matériel Test Procedure 10-4-009

U. S. Army Arctic Test Center

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

ARCTIC ENVIRONMENTAL TEST OF BODY ARMOR AND HELMETS

1. OBJECTIVE

The objective of the procedures outlined in this MTP is to provide a means of evaluating the performance, safety, and human factors engineering characteristics of body armor and helmets under arctic winter environmental conditions relative to criteria as expressed in applicable Qualitative Matériel Requirements (QMR), Small Development Requirements (SDR), Technical Characteristics (TC), or other appropriate requirements and documentation.

2. BACKGROUND

Engineering tests of equipment are conducted to determine the characteristics and performance of the equipment under various conditions of operation, and to ensure their compliance with specified requirements.

Testing in a natural arctic winter environment is used to substantiate or supplement data obtained from simulated tests conducted during the Engineering Design and Engineering Test phase. Testing in the arctic winter environment generally is not authorized until data from simulated environmental tests provides reasonable assurance that the test item will function satisfactorily when subjected to the conditions that would be encountered in the arctic.

3. REQUIRED EQUIPMENT

- a. Appropriate arctic winter uniforms.
- b. Weapons as required.
- c. Ammunition as required.
- d. Vehicles as required.
- e. Support aircraft.
- f. Drop zone.
- g. M1950 Parachutists individual weapons case (or latest standard containers).
- h. Skis and snowshoes as required.
- i. All general and special tools and ancillary items required to perform maintenance on the test item.
- j. Test equipment as required.
- k. Photographic equipment (black and white or color).
- l. Meteorological support instrumentation.
- m. Rate of fire recorder or stop watch.

4. REFERENCES

- A. AR 705-15, Operation of Matériel Under Extreme Conditions of Environment.
- B. AR 705-5, Army Research and Development.
- C. AR 70-8, Human Factors and Social Sciences Research.

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3

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arctic winter conditions.

- 3) Determine comfort and adequacy of fit of the test item throughout the conduct of the test.
- 4) Determine the ease of donning and doffing the test item while wearing cold-dry handwear.
- 5) Determine if the test items are safe for U. S. Army use under arctic winter conditions.
- 6) Determine the adequacy of sizing.

e. Maintenance Evaluation - The objectives of this subtest are to:

- 1) Determine whether the test items meet maintenance and maintainability requirements as defined by QMR, SDR, TC, MC, or other established criteria under arctic winter environmental conditions.
- 2) Derive information regarding expected service life and required logistical support under arctic winter environmental conditions.
- 3) Determine whether appropriate common and special tools and test equipment are suitable for their intended use and maintenance level under arctic winter conditions.
- 4) Determine if operation and maintenance instructions in technical manuscripts and manuals are adequate for the intended purpose and maintenance level under arctic winter conditions.

## 5.2 LIMITATIONS

The procedures described in this MTP are limited to the testing of body armor and helmets under Arctic Environmental conditions. Procedures for testing body armor and helmets are described in MTP 10-3-022.

## 6. PROCEDURES

### 6.1 PREPARATION FOR TEST

a. Upon establishing the scheduled availability of the test item, ensure that coordinated action is taken by the test officer and environmental engineer, as required to accomplish facility scheduling and implementation of test requirements to include personnel, equipment, maintenance support facilities, spare parts, and instrumentation with special attention to timely provision of additional supplies or equipment not readily available at the test site.

NOTE: Arctic winter environmental tests will normally be scheduled from October through March (6 months). Test, test comparison and support items must be delivered to the Arctic Test Center prior to 1 October.

b. Select test equipment ideally having an accuracy of at least ten orders of magnitude greater than that afforded by the item under test, that is

MTP 10-4-009  
28 November 1969

in keeping with the state of the art, and with calibrations traceable to the National Bureau of Standards.

c. Record the following information:

- 1) Nomenclature, serial number(s), manufacturer's name, and function of the item(s) under test.
- 2) Nomenclature, serial number, accuracy tolerances, calibration requirements, and last date calibrated of the test equipment selected for the test.
- 3) Grade, MOS, background, and training of all test personnel.

d. 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).

NOTE: 1. TDY personnel will be used to augment assigned personnel and will be representative of the troops who will use and maintain the test items under field conditions. These personnel will be briefed as to the nature of the test and instructed on the use and maintenance of the test items.

2. The assigned test personnel will be thoroughly trained in the operation to include all safety aspects and maintenance of the test items. They will be trained at military service schools and will attend factory schools for new equipment training as required. The assigned personnel will conduct training for all TDY test personnel. TDY personnel will be trained to the degree that they are as proficient as the school-trained troops.

e. Review all instructional material issued with the test item by the manufacturer, contractor, or government, as well as reports of previous similar tests conducted on the same types of equipment. These documents shall be kept readily available for reference.

f. Prepare record forms for systematic entry of data including the pretest equipment record, chronology of test, test results, and such observations and measurements that would be of value in analysis and final evaluation.

g. Prepare adequate safety precautions to provide safety for personnel and equipment, and ensure that all safety SOP's are observed throughout the test and that all safety requirements of the safety release have been met. Testing shall not be initiated until a safety release has been obtained.

h. Prepare a test item sample plan to ensure that enough samples of all measurements are taken to provide statistical confidence of final data in accordance with MTP 3-1-002. Provisions shall be made for sample plan modification during test progress as may be indicated by monitored test results.

i. Ensure that when not in use, all test and comparison items are stored and maintained in an unsheltered area and exposed to ambient air temperature and prevailing weather conditions.

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

MTP 10-4-009  
28 November 1969

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

## 6.2 TEST CONDUCT

NOTE: Performance assessment shall be accomplished throughout this test primarily 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 operators.

### 6.2.1 Preoperational Inspection and Physical Characteristics

a. Upon receipt, carefully inspect all test and comparison items and their shipping and/or packaging containers for completeness, damage, and general conditions. Photograph any damage or deterioration noted.

NOTE: Technical manuscripts, manuals, or other publications supplied with the items shall be used as guides for the inspection.

b. Record the following:

- 1) Inventory of all test items
- 2) Damage or deterioration noted

c. Measure and weigh each test and comparison item (or a representative number of them) and record the following:

- 1) Dimensions (length, width, height, etc.) and weight of the test and comparison items.
- 2) Identification photograph of test and comparison items.

d. Lubricate each test and comparison item with the applicable lubricant and check for proper mechanical operation to include all safety devices. Record the following:

- 1) Results of operational check
- 2) All discrepancies detected

### 6.2.2 Functional Suitability

NOTE: Throughout this sub-test, test and comparison items shall be subjected to the same test procedures. This test shall be

MTP 10-4-009  
28 November 1969

conducted in ambient air temperatures ranging from 0°F to the coldest available temperature. Attempts will be made to conduct 25 percent of all testing in temperatures of 0°F to -25°F, 50 percent in temperatures of -25°F to -45°F, and 25 percent in temperatures of -45°F to the lowest available temperature.

a. Cold-soak (outdoors for a period of at least 24 hours) all test and comparison items, at prevailing ambient air temperatures (from 0°F to the coldest available temperature).

b. Inspect each item for loose, damaged or missing parts, and place in the best possible serviceable condition.

c. Perform the following marches and exercises, utilizing test personnel dressed in the appropriate arctic winter uniform (see MTP 10-4-500), outfitted with individual field gear, and wearing the test items as prescribed in appropriate literature:

- 1) Snowshoe 16 miles through dense, snow-covered brush
- 2) Snowshoe 12 miles over snow-covered (cross-country) terrain
- 3) Ski 100 miles over cross-country ski trails
- 4) Vehicular marches:
  - a) 100 miles cross-country in tracked vehicles
  - b) 100 miles on secondary roads in wheeled vehicles
- 5) Four 4-day field training exercises consisting of attack, defense, patrol and retrograde operations which will require individual soldiers of the platoon/squad to use all TO&E equipment as well as special equipment issued for use under arctic winter conditions.

NOTE: A mortar squad (or gun crew) from the Indirect Fire Branch of the Infantry, Airborne and Individual Equipment Test Division shall wear the test and control items during preparation for and testing of indirect fire weapons and munitions.

d. Periodically during the conduct of Step (c) above, inspect the test and control items for loose, damaged or missing parts, and place in the best possible serviceable condition.

NOTE: At the end of each day of testing, the test soldiers shall complete the comparison-compatibility form (Appendix A). The opinion form (Appendix B) shall be completed by each soldier at the end of each field training exercise and at the end of the test.

e. Record the following data:

- 1) Damage attributed to environmental effects
- 2) Problems encountered

- 3) Damage due to wear, use, etc.
- 4) Temperature at test site
- 5) Completed comparison-compatibility forms
- 6) Completed opinion forms

#### 6.2.3 Aerial Delivery (Airdrop)

a. Cold soak (outdoors for a period of at least 24 hours) all test and comparison items at prevailing ambient air temperatures (from 0°F to lowest available temperature).

b. Carefully inspect each item for loose, damaged or missing parts, and proper functioning and place in the best possible serviceable condition.

c. Subject each test and comparison item to a minimum of three parachute jumps under the following conditions:

- 1) Each parachutist shall be equipped with standard equipment, wear the test items as prescribed by appropriate TM's, and shall jump in accordance with latest standard procedures. The test items shall be inspected before and after each jump.
- 2) Comparison items shall be jumped using identical procedures and under the same conditions as the jumps with the test items, i.e., temperature, wind, DZ conditions, etc.
- 3) Each parachutist shall complete a comparison-compatibility form after each jump (Appendix A), and an opinion form (Appendix B) at the end of the Aerial Delivery sub-test.

d. Record the following data:

- 1) Ambient air temperature
- 2) Results of inspections
- 3) Malfunctions of test and comparison items
- 4) Compatibility with parachute equipment
- 5) Completed comparison-compatibility forms
- 6) Completed opinion forms
- 7) Altitude, speed and type of delivery aircraft

#### 6.2.4 Human Factors Engineering and Safety

a. Throughout the conduct of all testing as outlined in this MTP, monitor and appraise all features and characteristics of the test items which are incompatible with the skills, aptitudes, and limitations of the soldiers who are using them. Particular attention shall be given to the operations of the test items to insure that they can be readily donned and doffed by personnel wearing the arctic winter uniform and cold-dry handwear.

b. Record the following data:

- 1) Desirable and undesirable characteristics
- 2) Indications of acceptability or unacceptability
- 3) Compatibility problems
- 4) Problems in donning and doffing the test and comparison items
- 5) Sizing and fitting problems



MTP 10-4-009  
28 November 1969

c. Throughout the conduct of all testing as outlined in this MTP, monitor all safety aspects associated with the test items, and record narrative comments obtained from all test personnel through daily observation, interview, and questionnaire concerning the following:

- 1) Confirmation of safety release under conditions as specified in USATECOM Regulation 385-6.
- 2) Analysis to establish that no foreseeable hazards are present during testing or operation of the test item.
- 3) Evaluation of any safety hazards associated with storage, transportation, operation, and maintenance of the test item.

#### 6.2.5 Maintenance Evaluation

a. Throughout the conduct of all testing as outlined in this MTP, maintain a record of performance of scheduled and unscheduled maintenance in accordance with prescribed publications.

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

b. Compare all replacement parts and components provided with the test item with anticipated and actual requirements, evaluating spare parts requirements under actual operating conditions.

c. Evaluate the requirements for additional tools and instruments, shortcomings in authorized tools and equipment, and needs for specialized tools and instruments to accomplish assigned levels of maintenance.

d. Appraise all repair parts used, man-hours and elapsed hours required, ease or difficulty of maintaining the test items and associated equipment, and level of skill demanded.

e. Starting with the initial checkout of the test items upon receipt at the test agency, maintain a complete log of all assembly, operation, disassembly, and maintenance activities for the purpose of reliability analysis. The log shall contain the following information:

- 1) Number of times the test item is assembled and installed from the field transport configuration.
- 2) Number of times the test item is disassembled and repacked in the field transport configuration.
- 3) Hours of operation, daily and cumulative.
- 4) Equipment failures and malfunctions, including chronological data required to determine failure-free operating time, mean time between failures, maintenance downtime, and mean time for repair.
- 5) Effect of failures on the operational test conduct.

f. Throughout the entire testing period, review all operations and maintenance manuals and/or any other technical manuscripts issued with the test items for compliance with applicable Army regulations. Utilize the manuals for classroom instruction and as references throughout the tests.

g. Record the following data:

- 1) A record of all scheduled and unscheduled maintenance of the test items and associated equipment.
- 2) Favorable and unfavorable aspects of maintenance.
- 3) Unsafe and inadequate aspects of maintenance operations.
- 4) Human factors engineering implications.
- 5) Comparison of reliability aspects for the test and control items.
- 6) Any malfunction, breakage or unusual occurrence as a result of testing.
- 7) Comments on reliability based on observations made throughout the test.
- 8) Tools and equipment used for maintenance operations.
- 9) Common and special tools and test equipment required, but not furnished in the maintenance package.
- 10) Tools and test equipment furnished but not required.
- 11) Accuracy and adequacy of maintenance publications.
- 12) Unclear instructions.
- 13) Inadequate PM procedures.
- 14) Special training requirements.
- 15) Desirable changes and comments.
- 16) Errors or omissions in nomenclature.

6.3 TEST DATA

All test data to be recorded shall 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

Size and weight data, adequacy of packaging, and completeness of shipment data shall all be compared with appropriate QMR's, SDR's, MC's, TC's, etc. Physical condition (damage) shall be compared with acceptable standards.

6.4.2 Functional Suitability

The suitability of the items under test in extreme arctic winter conditions shall be determined by comparison with previously accepted items of like nature and specifications. The compatibility of the test items with other items of clothing, individual equipment, and oversnow equipment required for combat and combat related activities shall be compared with accepted comparison

MTP 10-4-009  
28 November 1969

items.

#### 6.4.3 Aerial Delivery

The suitability of the item under test for airborne operations under arctic winter environmental conditions shall be determined by comparison with previously accepted items of like nature and specifications. The damage to and/or malfunctions of the items attributed to parachute jumps or environmental effects shall be compared with specifications contained in appropriate QMR and TC.

#### 6.4.4 Human Factors Engineering and Safety

The data obtained and observations made during performance of this subtest shall be compared with accepted standards of human engineering. Observations and evaluations of safety aspects associated with testing of the items under test shall be compared with those pertaining to accepted comparison items.

#### 6.4.5 Maintenance Evaluation

Time required for individual maintenance operations shall be examined to determine if the resulting downtime is considered excessive, based on experience with like-type items. The maintenance ratio shall be computed where; Maintenance ratio (M), is the number of active maintenance man-hours (TM), required to support each hour of operation (TD). The maintenance ratio reflects the frequency of failures of the system and the amount of time required to locate, repair and replace faulty components or parts. It reflects the overall maintainability of the test items. Instances of inadequacy of manuals and technical literature encountered during examination or observed during utilization shall be compared with accepted standards.

APPENDIX A

COMPARISON-COMPATIBILITY FORM

GENERAL: This form is to be completed by each individual after each day's use of the test or control item.

NAME: \_\_\_\_\_ DATE: \_\_\_\_\_

TEMPERATURE RANGE: \_\_\_\_\_

1. What type of exercise were you participating in?

☐ March ☐ Bivouac ☐ Airborne ☐ Tactical Exercise

Ski _____	Attack _____
Snowshoe _____	Defense _____
Foot _____	Patrol _____
Vehicular _____	Other _____
Type Parachute _____	_____

2. Which did you wear/use?

☐ Test ☐ Standard

3. Which outer garment did you wear?

☐ Flee Cap ☐ Steel Helmet

☐ Field Jacket w/Parka Hood ☐ Field Trousers

w/Liner ☐ Yes ☐ No w/Liner ☐ Yes ☐ No

☐ Parka w/Hood ☐ Parka w/Hood and Overwhites w/Liner

w/Liner ☐ Yes ☐ No ☐ Yes ☐ No

4. What problems or difficulties did you encounter while wearing/using the \_\_\_\_\_. (Check one or more and explain in paragraph 11.)

☐ Poor Stability ☐ Moisture ☐ Noise

☐ Restricted Head Movement ☐ Tight

MTP 10-4-009  
28 November 1969

- ☐ Restricted Breathing    ☐ Snow, Ice or Frost    ☐ Loose
- ☐ Cold    ☐ Too Warm
- ☐ Uncomfortable    ☐ Restricted Movement    ☐ Adjustments
- ☐ Other \_\_\_\_\_  
(problem)
- ☐ Other \_\_\_\_\_  
(problem)

5. I wore the \_\_\_\_\_ in conjunction with the following equipment:

- ☐ Skis
- ☐ Snowshoes    ☐ Other \_\_\_\_\_
- ☐ Weapon-M14, M16, M79, M60  
or other \_\_\_\_\_    ☐ Other \_\_\_\_\_
- ☐ Rucksack

6. I wore the \_\_\_\_\_ in or on:

- ☐ M116    ☐ 2 1/2 Ton    ☐ Other \_\_\_\_\_
- ☐ M113    ☐ 1/4 Ton    ☐ Other \_\_\_\_\_
- ☐ Tank    ☐ Aircraft

7. The \_\_\_\_\_ was or was not compatible with the following equipment:

<u>Equipment</u>	<u>Was</u>	<u>Was Not</u>
_____	<input type="checkbox"/>	<input type="checkbox"/>
_____	<input type="checkbox"/>	<input type="checkbox"/>
_____	<input type="checkbox"/>	<input type="checkbox"/>
ETC.		

## APPENDIX B

GENERAL: This form will be filled out by each individual at the conclusion of each field exercise, parachute jump and at the completion of the test.

NAME : \_\_\_\_\_ DATE : \_\_\_\_\_

(Exercise No. or period of time)

TEMPERATURE RANGE: \_\_\_\_\_

1. Check the \_\_\_\_\_ you wore/used during the period:

**Test**

☐ Standard

2. Write your opinion of the \_\_\_\_\_ you used:

TEST: \_\_\_\_\_

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There is no handwriting or other markings on the paper.

MTP 10-4-009  
28 November 1969

STANDARD: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

3. Rank by number your order of preference:

Test \_\_\_\_\_

Standard \_\_\_\_\_

4. Explain why you like the \_\_\_\_\_ rated no. 1.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

\_\_\_\_\_  
(Signature)

\_\_\_\_\_  
(Rank)

MTP 10-4-009  
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DD FORM 1473 (PAGE 1)  
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