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# CLOTHING AND EQUIPMENT, INDIVIDUAL, PROTECTIVE, CB.

Army Test and Evaluation Command
Aberdeen Proving Ground, Maryland

28 July 1972

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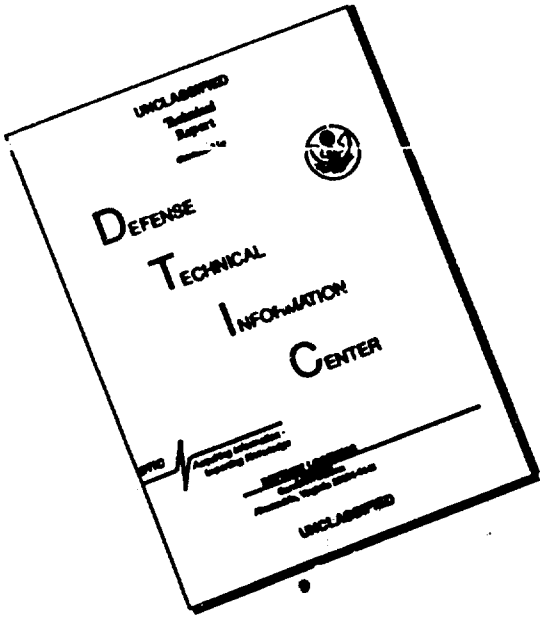


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13. ABSTRACT

Describes a method for evaluation of individual clothing and equipment protection characteristics relative to chemical agents. Identifies supporting tests, facilities, and equipment required. Provides procedures for physical characteristics, safety, personnel training, sizing, fitting, donning, doffing, compatibility with combat tasks, durability, reliability, maintainability, human factors, and value analysis.



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| Clothing | | | | | | |
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U. S. ARMY TEST AND EVALUATION COMMAND
EXPANDED SERVICE TEST - SYSTEM TEST OPERATIONS PROCEDURE

AMSTE-RP-702-107
Test Operations Procedure 8-3-041

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# CLOTHING AND EQUIPMENT, INDIVIDUAL, PROTECTIVE, CB




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## SECTION I
## GENERAL

1. Purpose and Scope.

a. This Test Operations Procedure (TOP) is prepared as a guide to assist in the preparation of a test plan to support the Expanded Service Test (EST) of individual clothing or equipment offered as protection against chemical agents. These items also provide protection against biological agents and radiological particles (fallout), but not against nuclear radiation (gamma). It outlines testing techniques designed to determine if a candidate item meets the criteria established in materiel needs documents and is suitable for use by the U.S. Army.

b. Selected subtests address the physical charactersitics, safety, training, fitting, functioning, durability and reliability, maintenance and decontamination, human factors engineering, and value analysis of a candidate item.

c. These procedures are limited to all individual clothing and equipment designed for CB protection except the mask, which is addressed in MTP/TOP 8-3-110, Mask, Field, Protective. The effects of an actual agent, a function of engineering and development-type tests, will not be evaluated in the EST.

2. Background.

a. Operations in a toxic environment require total body protection against chemical or biological (CB) agents in liquid, aerosol, or vapor form. Not only is it essential that adequate protection be provided, but the protection afforded must be as light, durable, reliable, and safe as technology can produce to ensure the soldier maximum comfort and freedom of movement.

b. The Army inventory presently includes impregnated cotton-sateen trousers and shirt, underwear, socks and gloves, boots treated with vesicant gas resistant leather dressing, liner, overgarment, mask and hood as protective items against chemical agents. The development trend is moving toward an elimination of the inner layers of clothing, and toward the improvement of a more efficient outer garment with complementing protection for the body extremities.

3. Equipment and Facilities.

a. Equipment.

(1) Test item and its maintenance and/or training package.

(2) Control item.

(3) Infantry unit with TOE weapons and equipment.

(4) Safety and first-aid equipment.

(5) Photographic equipment.

(6) Meteorological equipment.

(7) Communications equipment.

(8) Tactical vehicles - air and ground.

(9) Cleaning and decontaminating equipment.

(10) Leather dressing, vesicant, gas resistant.

(11) Foot measuring equipment.

(12) Ammunition.

(13) Weight measuring equipment.

(14) Linear measuring equipment.

b. Facilities.

(1) Field test site.

(2) Ranges (instrumented where possible).

(3) Classroom, office space, and storage area.

## SECTION II
## TEST PROCEDURES

4. Supporting Tests.

a. Proposed testing procedures are described in successive paragraphs but need not be conducted in order of their listing. Most will ber performed simultaneously with or overlapping the conduct of other test phases. The procedures are not intended to usurp the prerogatives of the test officer, whose specific and detailed test plan must be developed at the local level and which should reflect the expertise and experience of available guidance and the state-of-the-art at the time and place of testing.

b. Data must be acquired in sufficient quantities and must be of a quality necessary to support valid conclusions. This objective may be constrained by limited numbers of test and/or control items, a limited time frame to accomplish the test, or limitations of funds, manpower, or support facilities. To identify the best means of obtaining meaningful data within the limitations imposed and to establish the overall experimental pattern, the test officer should solicit the assistance of a statistician. Their consultation should determine the

optimum number of test troops required, the type and number of tests and control measures needed by phase, and the number of repetitions or replications required to produce statistically sound data. Additional guidance may be found in MTP/TOP 3-1-002, Confidence Intervals and Sample Size.

c. When the test item is compared with a control item, each must be subjected to as equal treatment as possible. Techniques will vary. In some instances, a soldier should alternately wear a test item and then a control item under the same conditions, while in another phase it may be more appropriate for a portion of the test troops to wear the test item while another portion wears the control item. To enhance valid comparison, each item must be subjected to the same conditions of weather, time, exposure, and effort. Additionally, control items should be new, or nearly new, to match the condition of the test clothing or equipment.

d. A log book should be maintained as a chronological record of remarks, events, observations, meteorological data, times, comparisons, and other pertinent data as they occur or are accrued. An accurate record will expedite the collation process required to support test findings. Photographs, motion pictures, charts, and graphs are recommended as supplemental evidence.

e. When risk analysis is directed, TECOM Reg 70-34, Risk Analysis for Suitability Tests, will provide adequate guidance.

f. Comm . MTP/TOP, the tests described in Section III, and other published documents to be considered in formulating an EST plan are listed in the reference appendix and as follows:

| | TEST SUBJECT TITLE | PUBLICATION NUMBER |
|---|---|---|
| (1) | Physical Characteristics (Refer to paragraph 5) | 8-3-500 |
| (2) | Safety (Refer to paragraph 6) | 8-3-506 |
| (3) | Personnel Training (Refer to paragraph 7) | 10-3-501 |
| (4) | Sizing and Fitting (Refer to paragraph 8) | |
| (5) | Donning and Doffing (Refer to paragraph 9) | |

| | TEST SUBJECT TITLE | PUBLICATION NUMBER |
|---|---|---|
| (6) | Compatibility with Combat Tasks (refer to paragraph 10) | |
| (7) | Durability and Reliability (refer to paragraph 11) | 8-3-503 |
| (8) | Maintenance (Evaluation of Chemical Items) (refer to paragraph 12) | 8-3-507 |
| (9) | Human Factors Engineering (refer to paragraph 13) | 8-3-509 |
| (10) | Value Analysis (refer to paragraph 14) | |

## SECTION III
## SUPPLEMENTARY INSTRUCTIONS

5. Physical Characteristics.

a. The objectives of this test are to verify the completeness of the test item and to compare its physical characteristics with the criteria established in appropriate materiel needs documents. A further objective is to determine that the item and each of its components are in a serviceable condition and suitable for testing.

b. In obtaining data to support test findings it is important to isolate the when, where, and why of the events in the process of arriving at the determination of what happened. It is possible that a failure attributed to expanded service testing may actually have been a by-product of poor shipping practices or improper handling of the item prior to its arrival at the test site. To assure accurate reporting, pre-test conditions of damage, deterioration, or deficiencies in manufacturing processes must be discovered and recorded during this phase.

c. The applicable procedures of MTP/TOP 8-3-500, Physical Characteristics, should be performed to obtain the necessary data to support a judgement in this area of interest.

6. Safety.

a. The applicable procedures of MTP/TOP 8-3-506, Safety, should be performed to determine the effectiveness of the test item's safety features, and to confirm the safety of each item received for testing.

b. During this phase, the test officer should identify any restrictions imposed by the safety release, directives, or local rulings which might influence the test results. Final reports should include a judgement of the test officer as to the extent of any influence detected.

c. TECOM Reg 385-6, Verification of Safety of Materiel During Testing, affords definitive guidance.

7. Personnel Training.

a. Training as outlined in the applicable procedures of MTP/TOP 10-3-501, Personnel Training, should be conducted to determine (1) the type and duration of instruction required to train test soldiers in the use of the test item, (2) whether the proposed program of instruction is adequate, and (3) if the item meets the training requirements of the applicable needs documents.

b. During this phase, test personnel must be thoroughly oriented on the characteristics of the test item, the conduct and procedures of testing, and their individual assignments and responsibilities. It must not be assumed that the participant is trained to use the standard item. Training must seek to make the soldier as familiar with the test item as he is with the control item in order to minimize possible prejudice.

c. In the event the proposed program of instruction is judged inadequate, recommendations for improvement or change should be made a matter of record.

8. Sizing and Fitting.

a. Objectives.

(1) To determine the adequacy of the tariff (test item) sizes to fit a representative soldier.

(2) To compare the item's compliance with size and fit criteria established in the appropriate needs documents.

b. Method.

(1) Each test participant should be fitted with both test and control items. Soldiers selected for fitting should be representative of the mass majority of required users as determined by the appropriate

height, weight, and configuration statistics available in Military Standard 1472A, Human Engineering Design Criteria.

(2) Size and fitting results should be compared with the applicable criteria established in materiel needs documents.

c. Data Required.

(1) A record of the tariff of sizes of the test items and the number of items by size furnished for testing.

(2) A record of the body measurements of each test soldier and the size test item with which he was fitted.

(3) A record of any difficulties encountered while fitting the test soldiers.

(4) A record of comments and observations of test participants which relate to the sizing and fitting of the test item.

d. Analytical Plan.

An analysis of the comments and observations bearing on the issue should be collated and prepared. This should be supported with pictorial evidence where appropriate.

9. Donning and Doffing.

a. Objectives.

(1) To determine the measure of effort required to put on and take off the test item under varying circumstances of time, environment, and conditions.

(2) To compare the donning and doffing characteristics with those established in materiel needs documents.

b. Method.

(1) A representative number of test soldiers, equipped with the test item, fighting load, armored vest, and ancillary CB equipment should be required to don the test item without assistance. Once on and adjusted to a proper position, the procedure should be reversed and the test item returned to its normal carry position. This exercise should be repeated several times and a mean time obtained for each phase. Test soldiers should wear and carry a variety of the clothing and equipment common to a tactical situation under differing conditions of weather, terrain, and mission.

(2) The same exercises should be conducted with test soldiers equipped with the control item.

c. Data Required.

(1) Any comments and observations related to the time and effort required to get into and out of the test and control items in the various situations created during the tactical exercises.

(2) The mean times required for soldiers to don and doff the test and control items in each phase of the exercise.

d. Analytical Plan.

(1) The test officer should collate the data and, in conjunction with available statistical personnel, prepare an appropriate evaluation of significant differences detected in the ease of donning and doffing the test and control items.

(2) The test officer should also prepare a comparison statement of the test item's adherence to the criteria established in the applicable needs requirements documents.

10. Compatibility with Combat Tasks.

a. Objectives.

This phase of testing should determine if the test item will function properly, and will be compatible with other items worn, carried, or be used by a soldier engaged in combat or combat-related tasks.

b. Method.

(1) Test soldiers, equipped with both test and control items, should participate in a series of tactical exercises conducted under the varying conditions of a combat environment to include:

(a) Road and cross-country marches, foot and motor.

(b) Crew served weapons drill.

(c) Individual and crew-served weapons firing (on instrumented ranges, if possible).

(d) Command post and observation post operations.

(e) Day and night patrolling actions.

(f) Unit attack, defense, and retrograde problems.

(g) Armored vehicle transported movements.

(h) Parachute and air mobile operations.

(i) Vehicle weapons, and other individual and unit maintenance.

(2) Ground exercises should be conducted over terrain which includes open, heavily wooded, marshy swamp areas, streams, and areas of thick underbrush. Particular note should be taken of the compatibility of the test item with the combat-type tasks of the soldier. Compatibility with other clothing and equipment should be noted as the soldiers walk, run, jump, and crawl while operating, handling, and carrying the variety of equipment required for the diversified missions.

(3) An instrumented Clothing and Equipment Test Facility (CETF), located at Fort Benning, Georgia, facilitates the collection of performance data as described in MTP/TOP 10-2-509. Most of the exercises are adaptable to local sites if access to the CETF is impractical.

(4) Appropriate exercises may be found in MTP/TOP 1-1-046, Field Combat Test Exercises.

c. Data Required.

(1) The type and the duration of each exercise performed.

(2) The weather during each phase, to include temperature humidity, wind conditions, and precipitation.

(3) The effects of the test item on the soldier's mobility, on his efficiency, and on his ability to perform combat related tasks.

(4) Any evidence of stress caused by high or low temperatures.

(5) An appraisal of man-weapon-ammunition compatibility.

(6) A record of any significant objectionable odor or noise detected.

(7) An evaluation of the compatibility of the test item with camouflage principles.

(8) An evaluation of the protection level afforded, to include all phases of the test exercises particularly in marshy, swampy, and wet conditions and thick underbrush without loss of those protective characteristics as established in materiel needs or other requirements documents.

(9) The mean times of comparison-type exercises.

d. Analytical Plan.

(1) Data obtained during the conduct of the exercises should be summarized, and charts and photographs should be used as appropriate.

(2) The observed functional performance of the test item should be compared with that of the control item and the criteria of applicable materiel needs documents. Any area of deficiency or shortcoming should be identified.

(3) A statement as to the adequacy of the test item is relationship to the functions tested should be prepared and suggestions for change or improvement should be made a matter of record. This statement should be founded on an appropriate analysis of both subjective and quantitative data obtained.

11. Durability and Reliability.

a. The applicable procedures of MTP/TOP 8-5-503, Durability and Reliability (CB equipment) should be performed to determine the probable service life of the test item and its adequacy to afford the soldier protection from the effects of a CB agent for a specified interval under stated conditions.

b. The durability and reliability of a test item of protective clothing or equipment should normally be established by data obtained during the conduct of other subtests. The procedures of the referenced MTP/TOP are designed to help the test officer identify the quantity and type of data required for a valid statistical determination of durability, of predicted reliability, and an associated confidence level.

12. Maintainability.

a. The guidance offered in MTP/TOP 8-3-507, Maintenance Evaluation of Chemical Items, should be followed to evaluate the test item's conformity to maintainability requirements as set forth in the approved requirements documents, as well as to determine the maintainability of the test item and the suitability of its associated maintenance package for U.S. Army use.

b. Ideally, protective clothing and equipment for the Army should have an extremely low or nonexistant failure rate and be readily repairable at the prescribed level of maintenance when a failure does occur. This phase of testing must determine the maintainability of the test item and identify potential maintenance problem areas so that corrective action may be taken prior to the Army accepting the item for use.

c. An important element in maintaining protective clothing and equipment is the decontamination process involved. The overall worth of an item will often depend on the ease with which a soldier can keep it in service, using resources available on the battlefield. Decontamination in the field may be conducted at three levels; individual, unit, or field. Individual decontamination is performed by each soldier on himself or his equipment in an effort to reduce the hazard sufficiently to allow him to continue his mission. Unit decontamination is performed at unit level under the supervision of trained CBR personnel, while field decontamination is performed by specially trained, specially equipped chemical or laundry units. Much of the decontaminating requirement will fall upon the individual soldier, who must keep the protective item in a serviceable condition until a higher echelon service is available. Varying individual procedures to this end should be noted, recorded, and evaluated throughout applicable phases of testing. Detailed decontamination information can be found in TM 3-220, Chemical, Biological, and Radiological (CBR) decontamination. NOTE: The overgarment is not designed to be decontaminated and reimpregnated for reuse.

13. Human Factors Engineering.

a. The applicable procedures of MTP/TOP 8-3-509, Human Factors Engineering, should be performed to determine the adequacy of the human factors engineering aspects of the test item and its compatibility with the skills, aptitudes, and limitations of the personnel who will use it.

b. Data to support a judgement in this area should be obtained throughout the conduct of other phases of expanded service testing. The results of observations, examinations, and measurements of specific design features, supplemented by the opinions of test personnel, should form a sound basis for the test officer to arrive at a conclusion relative to soldier efficiency when wearing or using the test item.

c. When available, human factors personnel should be consulted prior to the beginning of expanded service testing for assistance in the development of questionnaires, interview techniques, and preparation of pertinent human factors entries in plans and reports.

14. Value Analysis.

a. Objective.

To determine if the test item contains any unnecessary or costly features which might be eliminated without adversely affecting its performance, reliability, or safe use.

b. Method.

During all testing note should be made of any nonessential features which may be modified or deleted without compromising the protection offered by the test item.

c. Data Required.

Comments and observations of test personnel related to the subject.

d. Analytical Plan.

A narrative analysis of the information collected should be performed. It should be supported with graphic evidence where appropriate.

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