

UNCLASSIFIED

Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

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| 1. ORIGINATING ACTIVITY (Corporate author) U.S. Army Test and Evaluation Command Aberdeen Proving Ground, Maryland 21005 | 2a. REPORT SECURITY CLASSIFICATION Unclassified |
| | 2b. GROUP |

3. REPORT TITLE
U.S. Army Test and Evaluation Command
Expanded Service Test - System Test Operations Procedures
Combat Uniforms

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

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

| | | |
|--------------------------------|------------------------------|-----------------------|
| 6. REPORT DATE 14 June 1972 | 7a. TOTAL NO. OF PAGES 14 | 7b. NO. OF REFS 13 |
|--------------------------------|------------------------------|-----------------------|

| | |
|--|---|
| 8a. CONTRACT OR GRANT NO. b. PROJECT NO. AMSTE-RP-702-109 c. d. | 9a. ORIGINATOR'S REPORT NUMBER(S) TOP 10-3-021 |
| | 9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) |

10. DISTRIBUTION STATEMENT
Approved for public release; distribution unlimited

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

13. ABSTRACT
Final Report

Describes a method for evaluation of combat uniform operational and functional characteristics. Identifies supporting tests, facilities, and equipment required. Provides procedures for preoperational inspection, physical characteristics, safety, personnel training, sizing, fitting, issue, functional suitability, durability, maintainability, human factors, and value analysis.

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AD 74 8091

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| KEY WORDS | LINK A | | LINK B | | LINK C | |
|--|--------|----|--------|----|--------|----|
| | ROLE | WT | ROLE | WT | ROLE | WT |
| Uniform Clothing Combat Clothing Personal Equipment | | | | | | |

Security Classification

U. S. ARMY TEST AND EVALUATION COMMAND
EXPANDED SERVICE TEST - SYSTEM TEST OPERATIONS PROCEDURES

AMSTE-RP-702-109
*Test Operations Procedure 10-3-021

14 June 1972

COMBAT UNIFORMS

AD 748091

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SECTION I
GENERAL

1. Purpose and Scope.

a. This document provides procedures for testing combat uniforms. It establishes test methods and procedures to determine if the tested uniform meets the criteria described in applicable requirements documents and if it is suitable for use by the U.S. Army.

b. The Qualitative Materiel Requirement (QMR) for a System of Lightweight Individual Combat Clothing and Equipment (LINCLOE) establishes the requirement for combat clothing. The basic approach

*This TOP supersedes MTP 10-3-021, 8 July 1970, including all changes.

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will be to develop a lightweight shirt and trousers similar to the Coat and Trousers, Combat, Tropical. This uniform (shirt and trousers) will be the temperate zone combat uniform and will serve as the basic garments for cold-wet and cold-dry uniforms, supplemented by items of cold weather clothing as required. The test procedures herein apply to only the basic combat uniform, consisting of shirt and trousers. Headwear, underwear, belt, socks, and footwear are excluded.

2. Background.

a. Combat uniforms are designed to provide a functional, efficient covering to protect the body of the combat soldier in all climatic and physical environments, to provide him a degree of protection against enemy imposed hazards such as flame, flash, and chemical/biological agents, and to provide some security from detection (by camouflage characteristics). The uniform should minimize physiological stress in climatic extremes, facilitate natural ventilation and removal of body moisture, be durable, and be easily laundered in the field.

b. The Expanded Service Test is performed to determine the suitability of test item for use by the U.S. Army, and to provide a basis for recommendations on type classification.

3. Equipment and Facilities.

a. Equipment.

- (1) Test item.
- (2) Control item, when applicable.
- (3) Photographic equipment, still and motion.
- (4) Linear and weight measurement tools.
- (5) Meteorological equipment.
- (6) Safety and first aid kits.
- (7) Communications equipment.
- (8) Tactical vehicles, ground and air.

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| | | | | REF. SECTION |

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- (9) Parachutes and related equipment.
 - (10) Stopwatches.
 - (11) Administrative materials (data forms, rating questionnaires, pencils, marking pens, etc.).
 - (12) Safety Release or Safety Statement.
 - (13) Ammunition.
 - (14) Test troop unit, with TOE weapon and equipment.
- b. Facilities.
- (1) Firing ranges.
 - (2) Field training areas.
 - (3) Instrumented test facilities, if available.
 - (4) Classroom, storage area, and office space.
 - (5) Laundry facilities.

SECTION II TEST PROCEDURES

4. Supporting Tests.

a. The procedures outlined in this Test Operations Procedure (TOP) provide general guidance for the conduct of expanded service testing. Detailed specific procedures will be dependent upon the characteristics of the combat uniform being tested and the stated requirements in the applicable requirements documents.

b. During each subtest, sufficient data should be collected to arrive at valid conclusions. In determining the best way to collect sufficient data, the test officer should realize his statistical objectives may be constrained by limited numbers of test items, limited time, limited manpower, and a limited amount of support and control equipment.

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It is advantageous for the test officer to consult with the statistical analyst and with an experimental psychologist or test engineer prior to preparing the test plan or conducting the test to develop the experimental pattern. A proper pattern for the test will aid in the control of bias and in the measurement of precision, will simplify the requisite calculations of the analysis, and will permit the clear estimation of the effects of the factors. The statistician can advise and assist the test officer in determining appropriate techniques for random sampling, sample size required to estimate the true performance, estimating average performance (or variability of performance) from a sample, comparing materials or products with respect to average performance (or variability of performance), number of test soldiers needed, and the number of replications required for a specific operation. Statistical guidance is found in TOP 3-1-002, Confidence Intervals and Sample Size, and in National Bureau of Standards Handbook 91, Experimental Statistics.

c. Common Service TOPs, the tests defined in Section III, and other published documents to be considered in formulating an expanded service test plan are as follows:

| <u>TEST SUBJECT TITLE</u> | <u>PUBLICATION NO.</u> |
|--|------------------------|
| (1) Preoperational Inspection and Physical Characteristics | 10-3-500 |
| (2) Safety | |
| (3) Personnel Training | 10-3-501 |
| (4) Sizing, Fitting, and Issue | |
| (5) Functional Suitability | |
| (6) Airdrop Operations | 7-3-511 |
| (7) Durability and Maintainability | |
| (8) Human Factors Evaluation | 10-3-505 |
| (9) Value Analysis | TECOM Reg 700-1 |

SECTION III
SUPPLEMENTARY INSTRUCTIONS

5. Preoperational Inspection and Physical Characteristics.

a. The objectives of this subtest are to verify completeness of the test item shipment, to determine the physical characteristics of the test item and compare with those stated in applicable materiel requirements documents, and to determine if the test item is in proper condition for operational testing.

b. The procedures of TOP 10-3-500, Preoperational Inspection and Physical Characteristics should be accomplished. When applicable, an evaluation of the finished measurements of the test uniform should be included to determine the conformance with the finished measurements and tolerances as specified in the manufacturing specifications.

c. It is essential that all possible data concerning the test item be determined prior to the start of testing operations. In the collection of data and reporting of test results it is of utmost importance to know when and why something happens. In some cases the cause of failure might occur prior to arrival of the test item at the test site, yet unrealistically be reported as a test failure. Data of this nature must, in order to ensure valid reporting, be discovered and recorded during the preoperational inspection phase of the test.

6. Safety.

a. Objective. To determine if the test item is safe for its intended use.

b. Method. Test soldiers should be observed and interrogated throughout the testing program to determine if there are any indications of skin irritation, allergic reaction, or any other adverse physiological or dermatological conditions that may be related to the test uniform. The test officer should also observe closely for any indications of test item susceptibility to fire or heat, particularly when the uniform is being worn in situations where the test soldier may accidentally

contact open flame or hot metal, such as vehicle exhaust manifolds or hot weapon barrels. Any unsafe conditions or illness which may be related to wearing or maintaining the test uniform should be recorded.

c. Data Required. Description of any unsafe condition or illness observed or reported during the test. The procedures in TOP 10-3-507, Safety, may be accomplished to obtain the data needed for this subtest.

d. Analytical Plan. The test data should be subjectively analyzed to deny or confirm the test uniform as safe for wear and maintenance.

7. Personnel Training. The objectives of this subtest are to familiarize test participants with all aspects of wearing and maintaining the test uniform, and to ensure that everyone understands what is to be accomplished by the testing. Any special instructions relative to the wearing or maintenance of the test uniform should be evaluated for correctness and adequacy. The applicable procedures of TOP 10-3-501, Operator Training and Familiarization, may be used to accomplish this subtest.

8. Sizing, Fitting, and Issue.

a. Objectives.

(1) To determine if the test item is provided in a tariff of sizes sufficient to accommodate the intended users.

(2) To determine if the proper sizes of uniform to fit the test soldiers can be readily predicted from body measurements taken of the individual soldiers.

(3) To apply identification markings to the test items, and to issue assigned sizes to test soldiers for prescribed wear periods.

b. Method.

(1) The test item should be arranged by model, component, and size, and displayed in some logical order of storage for easy and quick selection of sizes during the fitting of personnel. Each separate part or component of the test item should be marked for identification, and a record should be maintained to show which test item is issued to each test soldier.

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criteria in requirements documents and test directives. When control items are provided, each individual in the using troop unit should be issued a test uniform and a control uniform. A record should be maintained as to which uniform is being worn by each individual at all times. All participants should be instructed that under no condition will any component of the test uniform be tailored or altered to obtain a "better fit" or to "improve appearance."

(2) The test soldiers should be required to accomplish practical and realistic procedures to determine how the test item affects the soldier's ability to perform normal combat tasks, such as loading, firing and reloading a weapon; performing crew-served weapon drill; using fire control equipment; operating military vehicles; observing, detecting, locating, and identifying hostile targets; maneuvering; marching; throwing hand grenades; digging hasty fighting positions; preparing and using cover, camouflage and concealment; using communications electronic equipment; and other activities related to combat tasks.

(3) Test soldiers equipped with fighting and existence loads, as appropriate, should perform these combat tasks under simulated combat conditions. When control items are provided, comparative data for the test item and control item should be obtained.

(4) These test exercises should be conducted during both daylight and darkness, and during any inclement weather that occurs during the test period. Appropriate portions of the tactical exercises should be conducted on ranges where the test soldiers can fire their weapons and the results of firing can be recorded.

(5) Many applicable procedures that may be accomplished to evaluate the effects of the test item on the individual soldier's combat effectiveness are described in MTP/TOP 10-2-509, Combat Effectiveness Test Facility. An instrumented clothing and equipment test facility located at Fort Benning facilitates the collection of this type performance data. The procedures described in MTP/TOP 10-2-509 are adaptable to other test sites if access to Fort Benning facilities is impractical.

(6) During the conduct of test exercises, test soldiers should be subjected to a simulated CB attack, requiring them to don individual CB protective equipment. The soldiers should continue to perform their assigned tasks. Any indications of incompatibility between the test uniform and the CB protective equipment should be noted.

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(7) During conduct of test activities, the test officer should determine by observation, questionnaires, or interrogation of test soldiers if the test uniform:

- (a) Permits free head movement, and whether or not it restricts breathing, hearing, talking, smelling, or field of vision.
- (b) Permits ease of donning and doffing, and provides a simple means to permit body eliminations. Closures should permit easy opening and closing while wearing appropriate handgear.
- (c) Permits simple adjustment or adaptation without assistance to various levels of physical activity, body functions, and environmental conditions.
- (d) Provides some security from detection, by camouflage characteristics.

(8) Meteorological data (temperature, relative humidity, atmospheric pressure, wind speed and direction, and the amount and type of precipitation) should be recorded during all phases of the wearing tests.

c. Data Required.

- (1) A detailed description of test exercises conducted, to include date, time, and location.
- (2) Meteorological data for period of each exercise.
- (3) Performance data (time required, weapon firing score, amount of material moved, distance traveled, etc.) for each test activity.
- (4) Record of any difficulties in performance of tasks that is attributable to the test item.
- (5) Evaluation of test item camouflage characteristics.
- (6) Comments, observations, or other evidence describing the effects of the test uniform on the actions and activities of test participants.

d. Analytical Plan.

(1) A comparison analysis, using appropriate statistical methods, should be performed to determine any significant difference between the test and control items, or between the test item and established criteria. Comparison results should indicate whether the test item is worse than, equal to, or better than the control item or the established criteria.

(2) The results of comments, observations, or other unquantified data should be analyzed to determine subjectively if applicable criteria have been met.

10. Durability and Maintainability.

a. Objectives.

(1) To evaluate the durability of the test item.

(2) To determine whether laundering in field or fixed laundry facilities causes any degradation of the protective or functional characteristics of the test item.

b. Method.

(1) Throughout the conduct of the other tests, and especially during the functional suitability test exercises, all failures or occurrences which pertain to durability should be noted. Particular attention should be given to the ability of the test uniform to withstand rough usage on all types of terrain without tearing, fabric failure, or other evidence of lack of durability.

(2) Durability of uniforms is related both to design and workmanship. Design includes the selection of materials (cloth, buttons, sewing thread), fabrication processes (cutting the material to prescribed patterns, stitching seams, attaching fasteners or closure devices), and the size, shape, and position of components (sleeves, cuffs, pockets, lapels). Workmanship is the quality measure of effort put forth to produce the item. If either of these aspects receive improper or inefficient effort, the result probably will mean the end item may have poor durability characteristics.

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(3) During rest periods in the functional suitability test exercises, the test soldier should launder his uniform, employing methods normally used in the field. Any adverse effects on the uniform should be observed. In addition, test uniforms should be laundered in a post Quartermaster laundry and reissued to the test soldiers (original wearer). The test soldier should be instructed to report any evidence of shrinkage, stretching, or discoloration.

(4) The test and control uniforms should be inspected for serviceability after each laundering, and the location and description of any defects (e.g., broken buttons, missing buttons, inoperative zippers, torn seams, torn fabric, worn areas) recorded. Minor repairs, such as button replacement or resewing seams, may be accomplished and the repaired uniform continued in the testing. Uniforms that become unserviceable or require extensive repairs (costing 50 percent or more than the initial cost of the garment) may be withdrawn from further testing, but the circumstances should be included in the test report.

(5) Test soldiers should be instructed to report their comments relative to the comparison of the test uniforms and the control uniforms.

(6) Tactical field exercise conducted to evaluate durability should be of sufficient time length to determine if the life expectancy for the test item, as stated in applicable requirements documents, has been met.

c. Data Required.

(1) Record of any failures, damages, degradation of functional characteristics, or other incidents relating to durability. The date, time, location, and conditions under which the incident occurred should be included. These data should be summarized by uniform model and component to ascertain the number of wear days as related to the rate of failure.

(2) Record of laundrerings of test uniform, to show date, time, and method of laundering used.

d. Analytical Plan. A comparison analysis, using appropriate statistical methods, should be performed to determine any significant differences between test and control items, or between test item and established criteria. Comparison results should indicate whether the test item is worse than, equal to, or better than the control item or the established criteria.

11. Human Factors Evaluation.

a. The applicable procedures of TOP 10-3-505, Human Factors Evaluation, should be accomplished to determine if the test item is suitable for U.S. Army use from the standpoint of compliance with human factors principles. TOP 10-3-505 is intended for use in planning and conducting human factors evaluation for general supplies and equipment. Specific criteria and test procedures for the test item must be determined only after appraisal of pertinent requirements documents.

b. The test item's design, composition, and physical characteristics should be reviewed to ensure that complete and realistic criteria are selected and that the methodology is in keeping with field conditions of the units affected. This evaluation can normally be carried out in conjunction with other testing. The primary objective is to obtain adequate data describing the man-item relationship while the test item is being used or worn by typical soldiers confronted with the organizational mission and climatic conditions representing the scope of intended Army use.

12. Value Analysis.

a. Objective. To determine if the test item has any features which might be eliminated without adversely affecting performance, durability, or safety.

b. Method. During the conduct of all tests, the test item should be examined from a value standpoint, and comments concerning any features which can be eliminated without degrading the test item in performance, durability or safety should be recorded.

c. Data Required. Comments of test soldiers and test supervisory personnel should be recorded, to include a description of the feature, the recommended change to be made, and reason for recommendation. Recorded comments should be in narrative form and should provide full details of conditions or events occurring during conduct of the test.

d. Analytical Plan. All data collected during the test should be summarized and the results presented in narrative form supplemented with charts and photographs as appropriate. Where the opinions of test soldiers or judgments of test supervisory personnel are presented, these should be identified as such, and separated from factual data.

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Accumulated data should be subjectively analyzed to determine if appropriate criteria are met. The test officer should conclude with a recommendation of specific changes to be made to the test item.

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APPENDIX
REFERENCES

1. AR 70-10, Test and Evaluation During Development and Acquisition of Materiel.
2. FM 5-20, Camouflage.
3. TM 10-227, Fitting of Man's Uniform.
4. SB 10-523, Size Tariff for Clothing, Equipage, and Footwear.
5. U.S. Bureau of Standards Handbook 91, Experimental Statistics.
6. TECR 70-23, Equipment Performance Reports.
7. TECR 70-24, Documenting Test Plans and Reports.
8. TECR 310-6, TECOM Test Operations Procedures.
9. TECR 385-6, Verification of Safety of Materiel During Testing.
10. TECR 700-1, Quality Assurance; Value Engineering.
11. MTP/TOP 3-1-002, Confidence Intervals and Sample Size.
12. MTP/TOP 10-2-509, Combat Effectiveness Test Facility.
13. MTP/TOP 10-3-507, Safety.