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GARMENTS, OUTER (WET WEATHER)

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Army Test and Evaluation Command
Aberdeen Proving Ground, Maryland

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13 ABSTRACT Describes a method for evaluation of wet weather clothing operational and functional performance characteristics. Identifies supporting tests, facilities, and equipment required. Provides procedures for preoperational inspection, physical characteristics, safety, personnel training, functional suitability, durability, reliability, maintainability, human factors, and value analysis.		
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U. S. ARMY TEST AND EVALUATION COMMAND
EXPANDED SERVICE TEST - SYSTEM TEST OPERATIONS PROCEDURES

AMSTE-RP-702-109

Test Operations Procedure 10-3-215

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GARMENTS, OUTER (WET WEATHER)

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SECTION I
GENERAL

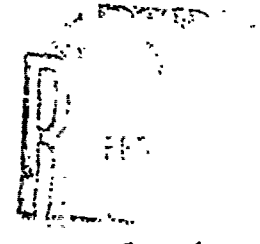
1. Purpose and Scope.

a. This Test Operations Procedure (TOP) is a guide to assist in the preparation of a plan to support the service test of wet weather clothing. It identifies common TOPs, military standards, and other supporting tests which will provide the methodology for determining if test garments meet the criteria of requirements documents and are suitable for use by the US Army.

b. These procedures address; (1) preoperational inspection and checks of the physical characteristics and safety of a test item, (2) tests for compatibility, reliability, and maintainability, and (3) an examination of the human factors and value engineering aspects of wet weather gear.

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c. The tests of this procedure are applicable to the service testing of candidate ponchos, headwear, parkas, trousers, raincoats, handwear, and footwear designed to be worn as an outer layer of clothing, in a temperate climate, for protection against moisture. Certain items may require companion testing in other climatic categories as specified in AR 70-38, Research, Development, Test and Evaluation of Materiel for Extreme Climatic Conditions.

2. Background.

a. In 1964, the US Army Combat Developments Command (USACDC) published a report entitled "A Study to Conserve the Energy of the Combat Infantryman." The report stressed the necessity for reducing the weight of the load carried by a soldier in combat. As a result of the study, the Lightweight Individual Combat Clothing and Equipment Qualitative Materiel Requirement (LINCLOE QMR) was established, providing basic characteristics for the development of a variety of new clothing and equipment.

b. Outer garments to protect the wearer against rain, snow, and other forms of wet weather were included in the LINCLOE QMR and developers began to produce wet-weather clothing from a number of new materials. Products such as polyurethane, neoprene, and polyvinyl were used to coat lightweight nylons and cottons, producing a garment much lighter than existing items. Several of these, notably, a neoprene-coated nylon parka and trousers, a polyvinyl chloride plastic-coated cotton glove, and a unicellular blown polyvinyl chloride molded overshoe is being subjected to expanded service testing. These procedures will provide basic methodology for examining wet-weather garments judged ready for service testing.

3. Equipment and Facilities.

a. Equipment.

- (1) Test item.
- (2) Control item (if used).
- (3) Weighing scales.
- (4) Measuring equipment.
- (5) Photographic equipment.
- (6) Meteorological instruments.

- (7) First aid and safety equipment.
- (8) Communications equipment.
- (9) Tactical vehicles, air and ground.
- (10) Other items required by referenced Common IOPs.

b. Facilities.

- (1) Suitable field area for tactical exercises.
- (2) Clothing and Equipment Test Facility (CETF).
- (3) Quick-fire range.
- (4) Classroom, office, and storage space.

SECTION II
TEST PROCEDURES

4. Supporting Tests.

a. Although the test procedures are described in successive paragraphs, some may overlap or be conducted concurrently. The subtests are designed so as to allow an opportunity to tailor a plan to the precise characteristics and requirements of a specific item and the state-of-the-art and methodology at the time and place of testing.

b. Data must be obtained in sufficient quantities to support valid conclusions. These objectives may be constrained by limited numbers of test and/or control items; limited time for testing; or shortages of funds, manpower, or support facilities. To identify the best means of securing meaningful data within the limitations imposed, the test officer should utilize available statistical and human factors expertise. The statistician can assist in selecting an overall experimental pattern or design and helping to fix requirements such as the number of test soldiers required, the number of items to be tested, and the number of repetitions required of specific operations. Human factors representatives will supply guidance toward the development and presentation of questionnaires, techniques of interviewing, and the human factors input needed in plans, procedures, and reports. Additional statistical guidance may be obtained from TOP 3-1-002, Confidence Intervals and Sample Size.

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c. The maintenance of a log book for entering pertinent comments and observations, meteorological data, times, comparisons, and other specific and applicable information will aid in the collation of test data to support findings. Photography, motion pictures, charts, graphs, and other pictorial or graphic supplements should be used when appropriate.

d. Valuable data can be accumulated throughout the course of testing by comparing the test item with a standard or control item. Normally, the control garment will be selected from the current inventory and will be related as close, characteristically, to the candidate test clothing as possible. To aid in obtaining a fair comparison, the control item should be new or near-new condition and should be subjected to the same fitting, use, and maintenance standards as those imposed upon the test garment.

e. Common Service TOP's, the tests defined in Section III, and other published documents to be considered in formulating an EST plan are listed in the reference appendix or below:

<u>TEST SUBJECT TITLE</u>	<u>PUBLICATION NO.</u>
(1) Preoperational Inspection and Physical Characteristics (refer to para 5)	10-3-500
(2) (refer to para 6)	10-3-507
(3) Personnel Training (refer to para 7)	10-3-501
(4) Functional Suitability and Compatibility (refer to para 8)	
(5) Durability/Reliability (refer to para 9)	10-3-502
(6) Maintainability (refer to para 10)	10-3-504
(7) Human Factors Engineering (refer to para 11)	10-3-505
(8) Value Analysis (refer to para 12)	

SECTION III
SUPPLEMENTARY INSTRUCTIONS

5. Preoperational Inspection and Physical Characteristics.

a. The applicable procedures of TOP 10-3-500, subject as above, should be performed to (1) verify the completeness of the test garment, (2) compare its physical characteristics with the criteria stated in the appropriate requirements documents, and (3) determine that the candidate test items are in a serviceable condition and suitable for subsequent testing.

b. In collecting data to support test findings, it is important to isolate the when and where of events in addition to the ultimate judgment of what resulted. A shortcoming or failure, attributed to the mechanics of testing, may have actually originated as a fault of inadequate product control during manufacturing, poor handling or shipping practices, or pretest deterioration. Any such substandard condition, if it exists, must be discovered during this preliminary phase, identified, and properly recorded if subsequent test reports are to be credible.

6. Safety.

a. The appropriate procedures of TOP 10-3-507, Safety, should be applied to determine the effectiveness of the safety features which may be incorporated in the design of the test article and to confirm all safety measures associated with the conduct of the expanded service test.

b. Safety will be considered throughout the conduct of the service test and, to the extent possible, will be evaluated concurrently with or as an adjunct to other subtests. The safety area of concern applies to the existing and potential hazards of the test item itself and to its relation to any combination of items with which it may be used. Particular note will be given to the verification of safety limitations and compilation of data relevant to the safety confirmation required by TECOM Reg 385-6, Verification of Safety of Materiel During Testing.

7. Personnel Training.

a. This subtest should be conducted in accordance with the applicable procedures of TOP 10-3-501, Operator Training and Familiarization, to determine the adequacy of the program of instruction proposed for test garment familiarization, and to orient test personnel with the scope, objectives, and mechanics of the EST.

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b. To minimize bias and achieve a higher degree of validity during comparison tests, sufficient training will be conducted with the test wet-weather garment to produce a test soldier equally familiar with both test and control items.

c. Test soldiers should be selected as representative of the user population. Generally, participants will represent the 5th through 95th percentile in height, weight, and body configuration as identified in the applicable portions of Military Standard 1472A, Human Engineering Design Criteria. Additionally, left-handers and eyeglass-wearers should be represented.

8. Functional Suitability/Compatibility.

a. Objectives. The objectives of this supporting test are to determine (1) the degree to which the test garment provides adequate wet weather protection to a soldier performing combat and combat related tasks, and (2) whether the test item meets the criteria stated in the applicable requirements documents.

b. Method.

(1) A substantial portion of the planned subtests will be conducted during the range of adverse environmental conditions which occur naturally during the course of a service test. Schedules must be sufficiently flexible to permit taking timely advantage of periods of precipitation and high humidity. Specific plans will be made to include designated state of test equipment readiness and test personnel to be on call in order to take advantage of wet weather occurring during the test period. When naturally occurring wet weather is insufficient to satisfy requirements, field expedients may be used to simulate required conditions, e.g., sprinklers, water hoses.

(2) Each test soldier should be issued a test garment and a control item fitted to the individual in accordance with applicable instructions. The wet weather gear will then be exposed to the elements while being worn by test soldiers participating in a series of exercises which should include the following:

(a) Infantry oriented tactical field exercises conducted in wet weather to test the protection provided by the wet weather gear, and to evaluate its compatibility with the combat related tasks of the soldier as he participates in:

1. The preparation of a field fortification area (day and night).

2. Navigating cross-country (day and night).
3. An assembly, attack, assault-phased exercise.
4. Patrolling, foot and motorized (day and night).

(b) Tactical field exercises requiring the use of tracked combat vehicles; e.g., tanks or armored personnel carriers.

(c) Crew served weapon drills appropriate to:

1. Mortars.
2. Machine guns.
3. Missiles.
4. Recoilless weapons.
5. Artillery.

(d) A motor march (20 miles or more) in various tactical and administrative vehicles over primary, secondary, and unimproved routes. Frequent mounting and dismounting should be required.

(e) A foot march (5 miles or more).

(f) Range firing to include a quick fire course with a basic small arm.

(g) Traversing an obstacle course.

(h) Air mobile suitability. On and off-loading exercises using helicopters on the ground with engines running, and helicopters hovering 4-6 feet above ground.

(3) Test soldiers should have equal opportunity to wear both test and control wet weather garments during the conduct of the above exercises. A credible comparison can only be obtained if the test soldier can experience the influence each garment has on the accomplishment of his assigned tasks under similar conditions and requirements.

(4) Field testing and selected range firing exercises should be integrated to the maximum extent feasible with appropriate tactical exercises selected from TOP 1-1-046, Field Combat Test Exercises.

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(5) The comments and observations of test participants should be solicited by means of personal interview and questionnaires tailored to each appropriate exercise. Questionnaires should be prepared and administered in accordance with basic human factors principles in coordination with available human factors personnel.

(6) A Clothing and Equipment Test Facility (CETF) located at Fort Benning, Georgia and operated by the Infantry Board will provide excellent compatibility-with-tasks data. The instrumented CETF should be utilized if possible but many of its stress-producing exercises are suitable for adaptation at other locales if access to the Benning facility is not feasible. (See Appendix B, TOP 1-1-046, Field Combat Test Exercises.)

c. Data Required.

The comments and observations related to the wet-weather protection provided by the test and control items during the conduct of tactical exercises and other tests conducted during the course of the service test should be recorded. The data should include:

- (1) Type of exercise undertaken.
- (2) Weather conditions experienced during the exercise.
- (3) Degree of protection against wet weather provided by test and control garments when worn under like conditions.
- (4) Relative wear comfort, test and control items.
- (5) Influence of garment on soldier mobility.
- (6) Compatibility of garment with the tasks undertaken by the soldier.
- (7) Ease of fitting, donning, and doffing.
- (8) Mean times, where the influence of the test and control items on soldiers tasks is measurable.
- (9) Results of questionnaires used.
- (10) CETF results.

d. Analytical Plan.

(1) A subjective analysis of data assembled as a results of comments, observations, interviews, and/or questionnaire results should be prepared.

(2) An appropriate statistical analysis of the measures of effectiveness examined to determine any significant difference between test and control items, or test items and requirements criteria should be conducted. This analysis should include:

- (a) Relative protection afforded.
- (b) Relative comfort provided.
- (c) Mean times in time-measurable areas.
- (d) Accuracy and distance measurements (from CETF results).

(3) A cumulative judgment narrative should indicate whether the test wet weather garment shows evidence of protection and compatibility less than, equal to, or greater than the same qualities found in the control item and the criteria expressed in the applicable requirements documents.

9. Durability and Reliability.

a. The applicable procedures of TOP 10-3-502, Durability, should be performed to determine the degree to which the test item will survive a projected service life and provide adequate wet weather protection for a specified time under stated conditions.

b. The characteristic of item durability will be evaluated during the course of a service test by conducting a trial wear period of sufficient duration to develop a history of test garment deterioration, degradation, and maintenance requirements under conditions representative of those the item will be subjected to in a user environment. The extent and duration of this accelerated wear period will be determined by the specific durability criteria expressed in the applicable requirements documents.

c. Upon completion of all tests, the candidate wet weather garment should be carefully examined for evidence to support a reliability/serviceability judgment. The number of serviceable items, compared to

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the total items tested, will provide pertinent data. Overall durability/reliability will be evaluated by examining failures, where a failure is defined as any weakness or discrepancy that renders the wet weather garment less than fully functional or otherwise incapable of protecting a wearer from moisture.

10. Maintainability.

a. The applicable procedures of TOP 10-3-505, Maintenance Evaluation, will be applied to (1) determine if the instructions for use that accompany the test garment are adequate, (2) compare the relative maintenance required of test and control items, and (3) compare actual maintenance requirements with those stated in the appropriate requirements documents.

b. Maintenance requirements will be examined throughout the conduct of the service test. Each scheduled and unscheduled maintenance function should be performed by appropriate personnel with tools designated and procedures prescribed in the maintenance package.

11. Human Factors Engineering.

a. The applicable procedures of TOP 10-3-505, Human Factors Evaluation, should be performed to determine if the test item meets human factors requirements stated in requirements documents, is suited for service in accordance with basic human factors principles, and to what degree the test garment meets with troop approval.

b. Throughout the course of the service test, data related to soldier acceptance, degradation of performance, and compatibility of the test item with soldier skills, aptitudes, and limitations will be noted, recorded, and evaluated.

12. Value Analysis.

a. Objective. To identify potential areas for a subsequent value engineering effort by the developer.

b. Method. During all subtests, note will be made of any unnecessary or costly test item features that might be eliminated or modified without compromising the effectiveness of the test garment.

c. Data Required. Comments, observations, and reports related to the identification of potential areas for an appropriate value engineering re-evaluation.

d. Analytical Plan. Data obtained should be analyzed and a recommendation for further developer improvement when applicable. Narrative should be supported with pictorial or graphic illustration when appropriate.

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APPENDIX REFERENCES

1. AR 70-10, Research and Development, Test and Evaluation During Development and Acquisition of Materiel.
2. AR 70-38, Research, Development, Test and Evaluation of Materiel for Extreme Climatic Conditions.
3. TECOM Reg 70-23, Equipment Performance Reports.
4. TECOM Reg 70-24, Documenting Test Plans and Reports.
5. TECOM Reg 70-34, Risk Analysis for Suitability Reports.
6. TECOM Reg 385-6, Verification of Safety of Materiel During Testing.
7. TECOM Reg 700-1, Value Engineering.
8. TECOM Reg 750-15, Maintenance Evaluation During Testing.
9. TOP 1-1-008, Tropic Environmental Considerations.
10. TOP 1-1-012, Classification of Deficiencies and Shortcomings.
11. TOP 1-1-045, General Supplies and Equipment Testing.
12. TOP 1-1-046, Field Combat Test Exercises.
13. TOP 3-1-002, Confidence Levels and Sample Size.
14. TM 10-228, Fitting of Footwear.
15. Military Standard 1472A, Human Engineering Design Criteria.

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