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ENTRENCHING TOOLS

Army Test and Evaluation Command  
Aberdeen Proving Ground, Maryland

17 November 1972

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13. ABSTRACT

Describes a method for evaluation of entrenching tool operational and functional performance characteristics. Identifies supporting tests, facilities, and equipment required. Provides procedures for confidence intervals, sample size, preoperational inspection, physical characteristics, safety, functional suitability, combat effectiveness, and value analysis.

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ENTRENCHING TOOLS

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SECTION I  
GENERAL

1. Purpose and Scope. This document provides procedures for evaluation of entrenching tool operational and functional performance characteristics. It establishes the test methods and techniques used to determine if the test item meets the criteria described by the applicable requirements document and its suitability for use by the U. S. Army.

2. Background. A requirement for a lightweight collapsible entrenching tool was established under a Department of the Army Qualitative Materiel Requirement (QMR) for a System of Lightweight Individual Combat Clothing and Equipment (LINCLOE). Entrenching tools developed in response to this requirement have been tested and type classified. Additional tests will be required, however, as current items are improved or new ones developed.

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3. Equipment and Facilities. In addition to the equipment and facilities defined in the documents listed in Section II, the following are required.

- a. Control items, if applicable.
- b. Safety and first aid kits.
- c. Tactical vehicles.
- d. Stopwatches.
- e. Administrative materials (data forms, rating questionnaires, pencils, marking pens, etc.).
- f. Safety release.
- g. Ammunition.
- h. Test troop unit, with TOE weapons and equipment.
- i. Soil sampling equipment.
- j. Firing ranges.
- k. Field training areas.
- l. Classroom, storage area, and office space.
- m. Instrumented test facilities, if available.

SECTION II  
TEST PROCEDURES

4. Supporting Tests. Common Service TOP's, the tests defined in Section III, and other published documents to be considered in formulating an EST plan are as follows:

<u>TEST SUBJECT TITLE</u>	<u>PUBLICATION NO.</u>
a. Confidence Intervals and Sample Size (refer to para 5)	3-1-002
b. Preoperational Inspection and Physical Characteristics (refer to para 6)	10-3-500

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- c. Safety (refer to para 7) 10-3-507
- d. Operator Training and Familiarization 10-3-501
- e. Functional Suitability (refer to para 8)
- f. Airdrop Operations 7-3-511
- g. Combat Effectiveness Test (refer to para 9) 10-2-509
- h. Durability and Reliability 10-3-502
- i. Portability and Transportability 10-3-506
- j. Maintenance 10-3-504
- k. Human Factors Engineering 10-3-505
- l. Value Analysis (refer to para 10) TECOM Reg 700-1,  
USAMC SUPPL 1  
to AR 11-26

SECTION III  
SUPPLEMENTARY INSTRUCTIONS

5. Confidence Intervals and Sample Size. It is advantageous for the test officer to consult with the statistical analyst, prior to preparing the test plan or conducting the test, to develop the experimental pattern. The proper pattern for the experiment will aid in control of bias and in measurement of precision, will simplify the requisite calculations of the analysis, and will permit 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.

6. Preoperational Inspection and Physical Characteristics.

a. Conduct evaluations as defined in TOP 10-3-500 limiting the procedures to those applicable to the entrenching tool.

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b. 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. Occasionally the cause of a test failure is attributable to something which happened prior to receipt of the item and should be reported as such. Data of this nature must, in order to insure valid reporting, be discovered and recorded during the preoperational inspection phase of the test.

c. The physical characteristics of the tested entrenching tool, as prescribed in the requirements documents, are verified during the preoperational inspection. Some examples of characteristics that might be applicable are:

(1) Dimensions, such as length of handle and blade, width of blade or diameter of handle.

(2) Weight. Not only total weight of test item, but the weight of separate components, and the general distribution of weight, or the balance of the test item.

(3) Type of material. Generic description, such as wood, metal, synthetics, rubber, fabric, etc. Also more definitive description, such as steel, tin, brass, polyethylene, cotton, etc.

(4) Color, to include variations such as mottled and camouflage pattern.

(5) Texture and reflection characteristics, such as smooth, rough, bright, shiny, etc.

(6) Design features, such as folding handle, square blade, one (or more) cutting edges, D-type handle, serrated blade, etc.

d. The preoperational inspection should include inspection for shipping damage, rust, and pretest functioning of each item (e.g., functioning of folding handle, locking devices, etc).

## 7. Safety.

a. Accomplish the applicable procedures of TOP 10-3-507, Safety. Normally only those pertaining to mechanical hazards, individual items, and miscellaneous hazards will apply to entrenching tools. In addition, perform safety confirmation in accordance with TECOM Regulation 385-6, Verification of Safety of Materiel During Testing.

8. Functional Suitability.

a. Objective. To determine the operational and functional characteristics of the test item.

b. Method.

(1) The test item will be evaluated during the conduct of controlled field exercises, using test soldiers representative of user populations. Realistic combat tasks will be accomplished in a tactical environment. For example, the test soldiers will clear fields of fire, prepare and camouflage positions, put in barriers, etc. Test soldiers equipped with fighting and existence loads, as appropriate, will use the test item for all its intended purposes, such as digging foxholes (individual and crew size), chopping small trees for overhead cover, cutting vegetation to clear fields of fire, digging slit trenches, and any other uses considered appropriate for entrenching tools. When using the test item to cut trees, caution must be exercised to insure that the tree diameters do not exceed the designed cutting capability.

(2) The field exercises should be conducted in areas containing variations in types of topography, vegetation, and soil to the maximum extent practicable, in order to obtain test data for all conditions that would normally be encountered during actual combat. For example, test conditions should include varying degrees of flat and hilly terrain; open and heavily wooded areas; varying soil textures (sandy, loam, clay, rocky, etc.); shallow and deep soils; and wet and dry conditions.

(3) When control items are provided, the test design should allow the collection of comparative data during functional tests.

c. Data Required.

(1) Narrative description of each tactical field exercise conducted, to include data, time, place, light conditions (daylight or darkness), temperature, and description (in general terms) of topography, vegetation, and soil conditions.

(2) Description of clothing and equipment worn or carried by test soldiers.

(3) Description of the test item function that was performed (digging foxhole, clearing fields of fire, etc.). Include, as applicable, the type of material, physical dimensions, volume, weight, and time involved.

(4) Description of any discomfort, difficulty, or injury attributed to the test item.



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(5) Any additional data having a bearing on the functional suitability of the test item.

(6) Supplement narrative data with photographs whenever appropriate.

d. Analytical Plan.

(1) Summarize all data obtained during the conduct of the test, making use of photographs and charts as appropriate. Properly identify and label all photographs and charts.

(2) When a specific test has been completed, examine the test data for completeness and assurance that the results are reasonable. When illogical results are noted, take immediate action to account for or correct them. Explain any special condition or circumstance that may have contributed to any test results.

(3) Compare the test item's observed functional characteristics (capability for digging, cutting, chopping, etc.) with those of the control item, or those prescribed in applicable requirements documents. Show whether or not the test item offers a significant improvement over the control item, or only a minimal and perhaps costly improvement. Identify test item deficiencies and shortcomings when established criteria are not met.

(4) Conclude with a statement of the adequacy of the test item's functional suitability and any recommendations for improvement.

9. Combat Effectiveness Test.

a. Accomplish the procedures defined in TOP 10-2-509 to determine the effects of the test item on the individual soldier's combat effectiveness while transporting the tool and while employing it for cutting and digging functions.

b. The procedures specified are practical and realistic exercises to determine how the test item affects the individual soldier's ability to perform normal combat tasks, such as loading, firing, and reloading a weapon; observing, detecting, locating, and identifying hostile targets; maneuvering; marching; throwing hand grenades; digging hasty fighting positions; preparing and using cover, camouflage and concealment; and using communications equipment.

c. Test soldiers are equipped with fighting and existence loads, as appropriate, when performing combat tasks under simulated combat conditions, with and without the test item, to obtain comparative data. When control items are provided, comparative data for the control item and test item are obtained.

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10. 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, examine the test item from a value standpoint, and record comments concerning any features which can be eliminated without degrading the test item in performance, durability, or safety.

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

d. Analytical Plan. Summarize all data collected during the test and present the results in narrative form supplemented with charts and photographs as appropriate. Where opinions of test soldiers or judgments of test supervisory personnel are presented, identify these as such, and separate from factual data. Accumulated data will be subjectively analyzed to determine if appropriate criteria are met. Conclude with a recommendation of specific changes to be made to the test item.

Recommended changes to this publication should be forwarded to Commanding General, U. S. Army Test and Evaluation Command, ATTN: AMSTE-ME, Aberdeen Proving Ground, Maryland 21005. Technical information related to this publication may be obtained from U. S. Army Infantry Board, ATTN: STEBC-MO-M, Fort Benning, Georgia 31905. Additional copies of this document are available from the Defense Documentation Center, Cameron Station, Alexandria, Virginia 22314. This document is identified by the accession number (AD No) stamped on the first page.

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APPENDIX  
REFERENCES

1. AR 70-10, Test and Evaluation During Development and Acquisition of Materiel.
2. QMR (DA approved) for a System of Lightweight Individual Combat Clothing and Equipment (LINCLOE), 1 Sep 65.
3. AMCTC Meeting 8-66, Jan 66. (Agenda Item 4750) Read for Record, Technical Characteristic for Lightweight Entrenching Tool.
4. TECR 70-23, Equipment Performance Reports.
5. TECR 70-24, Documenting Test Plans and Reports.
6. TECR 310-3, TECOM Test Operations Procedures Style Manual.
7. TECR 385-6, Verification of Safety of Materiel During Testing.
8. TECR 700-1, Value Engineering.
9. TECR 750-15, Maintenance Evaluation During Testing.
10. National Bureau of Standards Handbook 91, Experimental Statistics.