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SECURITY FROM DETECTION

Army Test and Evaluation Command
Aberdeen Proving Ground, Maryland

9 October 1972

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13. ABSTRACT

Describes a method for evaluation of infantry equipment physical and operational characteristics relative to position disclosing effects. Discusses preliminary activities, facilities, and equipment required. Provides procedures for audio and visual position disclosing effects, silhouette, radiation, tactical vulnerability, and safety. Applicable to infantry weapons, munitions, equipment, and accouterments.

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EXPANDED SERVICE TEST - COMMON TEST OPERATIONS PROCEDURES

AMSTE-RP-702-100

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SECURITY FROM DETECTION

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SECTION I
GENERAL

1. Purpose and Scope

a. The procedures outlined herein have been designed to determine the extent to which the operational and physical characteristics of weapons, ammunition, munitions, and items of individual and organizational combat clothing and equipment compromise the location of friendly positions during daylight, darkness, and periods of limited visibility. These procedures do not apply to vehicles, tactical missile systems, or to artillery ammunition, since those particular items are addressed in separate TOPs. Specific equipment performance is covered in the individual equipment engineering or service test operations procedure.

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b. Specifically, these procedures do enable test supervisory personnel to evaluate those position disclosing effects -- noise, flash, blast, smoke, reflection, silhouette, radiation -- and any other detectable characteristics of the test item which might tend to compromise the security of a friendly position when the item is used in a tactical environment. Accordingly, the items undergoing tests in accordance with these procedures will be operated or will be used in a normal tactical environment.

c. The use of these procedures will also provide the test supervisory personnel with sufficient data from which they will be able to make both objective and subjective analyses of the test item's characteristics and methods of functioning. From these, too, test supervisory personnel can determine whether a test item satisfies the position disclosing criteria stated in the appropriate requirements documents.

d. The conduct of specific supporting tests will usually depend on three factors: the characteristics of the test item; the type of troops available to assist in the testing program; and the stated requirements in the materiel needs documents. Current standard items (if any) in the Army's inventory should be used for comparison and control purposes, and should be employed alternately under the same weather and visibility conditions.

e. The environmental criteria for conducting an expanded service test (EST) using these procedures are applicable to all climatic categories. As used herein, the night environment is defined as: full moon, 1×10^{-2} to 4×10^{-2} foot candles; half-moon, 1×10^{-3} to 4×10^{-3} foot candles; starlight, 1×10^{-4} to 4×10^{-4} foot candles; overcast, 1×10^{-5} to 4×10^{-5} foot candles; dawn and dusk, 1 to 10 foot candles; and twilight, 1×10^{-1} to 10 foot candles.

2. Background.

a. Successful combat operations require that weapons and equipment worn or used by a combat soldier should not possess characteristics that might aid an enemy in locating the equipment by sight, sound, or instrumentation. Therefore, a combat soldier's equipment should be so designed that it will produce a minimum of position disclosing effects and have as low a silhouette as possible. Those particular characteristics must be observed and evaluated in service testing to provide a basis for recommendations on the suitability of the equipment for Army use.

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b. Although it is next to impossible to achieve complete security from detection, new equipment, in particular, should be designed to produce as few position disclosing effects as possible, and it should not increase the possibility of detection over and above that caused by standard items of equipment. An evaluation of those effects is best accomplished during expanded service testing, at which time soldiers representative of user personnel can identify areas where improvements can be affected.

3. Equipment and Facilities. Due to the variety of items to which this TOP might apply, it is not feasible to list all required equipment and facilities. Those detailed requirements will be governed by the item tested. The list appearing below should be used as a guide only:

a. Suitable test areas with the following features:

(1) Varying types of terrain and vegetation.

(2) Test areas free of background noises and lights which would prevent discrimination of the noise and light-producing position disclosing effects of the item under test.

(3) Ranges with easily identifiable positions for the test soldiers, the test items, and the test supervisory personnel.

(4) Materials for cover and concealment readily available.

b. Photographic equipment.

c. Communications equipment.

d. Binoculars.

e. Lensatic compasses.

f. Night observation devices.

g. Meteorological instrumentation (thermometer/anemometer).

h. Measuring tape.

i. Clip boards and recorder sheets for observers.

j. Sound measuring equipment.

k. Flash measuring equipment.

l. Infrared detectors.

- m. Radiation measuring devices.
- n. Thermal viewers.
- o. Stopwatches.
- p. Aircraft.
- q. Photometric equipment.

SECTION II
TEST PROCEDURES

4. Audio and Visual Position Disclosing Effects.

a. Objective. To determine the range and direction at which the sound, smoke, flash, blast, and reflection resulting from the employment of a test item might serve to identify its position.

b. Standard. None applicable.

c. Method.

(1) Observer personnel should be positioned at various distances from the location where the test item is to be employed or used. Their duties will include, but should not be limited to the following:

(a) To record during a series of timed exercises, the observed signature effects of sound, smoke, flash, blast, and reflection. These observations should be made concurrently, when possible, to reduce total test time.

(b) To use an interval rating scale to record the relative ease with which they are able to detect, recognize, and identify the test item. (For purposes of this test operations procedure, detection is defined as an indication of the presence of a target of potential military interest in a reasonable length of time, but without recognition of the object. Recognition is the discrimination between targets (objects) as to the class, e.g., tank, truck; gun, howitzer; radio, radar set; man. Identification is defined as the discrimination between targets (objects) within a class, e.g., M60 tank, T54 tank; M14 Rifle, M16 Rifle; 81-mm mortar, 4.2-inch mortar. Depending on the degree of preciseness desired by the test officer, the interval rating scales should range from a six-point general scale to a nine-point specific scale. It is recommended that a human factors specialist construct an equal interval rating scale to ensure the overall acceptability of the rating.

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(c) To locate the test item's position by referencing terrain features or by recording the magnetic azimuth to the suspected location.

(d) To augment their observations, as required, with photography, i.e., still, fast frame.

(2) Observers should be stationed in observation aircraft (if applicable) to perform the same tasks specified in paragraph 4c(1), above.

(3) The test item should be employed or used in one or more positions as appropriate. The test item should be operated in all of its design modes and should perform all functions for which it was designed.

(4) Noise and flash measuring equipment should be used when a more accurate determination of noise and flash level and location is desired.

d. Data Required:

(1) Weather, to include wind velocity, humidity, temperature, and visibility.

(2) Personnel data: name, rank, and unit of personnel.

(3) Photography to support test findings.

(4) Number of successes and failures (including false or incorrect localization), by range and direction, in detecting the position of the test item, and the particular signature effect(s) causing their disclosure.

(5) Results of rating scales used by observers to record the relative ease with which they were able to see or hear the position disclosing effects.

(6) Distance at which the test item was not detected.

(7) Time of day or night and photometer readings which may aid in subsequent analysis of data.

(8) Type terrain, vegetation, and width of area observed.

(9) Pertinent remarks of observer personnel.

e. Analytical Plan:

(1) Noise, smoke, flash, blast, and reflection resulting from the test item will be analyzed by range, mode of fire, light, or any other applicable conditions. Detection rate should be defined as the ratio of the number of successful detections (i.e., sounds heard, flash or smoke seen, and positions correctly identified) to the number of observations. Confidence intervals for sound, flash, and position detection rates, based on a binomial distribution, should be calculated and reported. In addition, the relative ease with which the position disclosing effects were seen or heard should be reported as a percentage of the number of observations, by range light conditions, and any other factors which are applicable.

(2) Noise, sound, flash, and other position detection rates should be normalized using an appropriate transformation and submitted to an analysis of variance to determine if significant differences exist between test and control items and ranges. Confidence levels based on established criteria or those specified in requirements documents will be stated, and a detailed method of statistical analysis of each different set of data will be defined. The results of all statistical analyses, as well as observer comments, photographs, and motion pictures should be subjectively evaluated to determine whether or not the stated criteria have been met.

5. Silhouette.

a. Objective. To determine detection through size, shape, and silhouette characteristics of the test item during daylight and darkness.

b. Standards. None Applicable.

c. Method.

(1) This objective should be accomplished in accordance with applicable portions of paragraph 5c, above.

(2) Test soldiers wearing or using the test item should be observed and photographed while in a variety of tactical situations. Observations should be made against a background of trees, brush, and tall grass to determine the distance at which the test items are discernible. Observations should also be made from within the desired vegetation.

(3) Observations and pictures should be made so that front, side, rear, overhead, and angular views are obtained.

(4) Observations should also be made of the test soldier equipped with or using the test item while moving cross-country.

d. Data Required:

(1) A visual and photographic record of the silhouette produced by soldiers while operating or using the test item and the test item alone.

(2) The maximum distance at which the silhouette of the test item is discernible.

(3) Observer comments on the silhouette symmetry, size, color, movement, and illumination which tends to reveal the test item's position and identity.

(4) Observers' opinions as to the degree to which the silhouette contributes to the disclosure of the test item's position.

e. Analytical Plan:

(1) Photographs, observer comments, and accumulated data should be subjectively evaluated to determine whether the silhouette of the test item significantly influences the detection of its position.

(2) Comparison data between the test and control items should be evaluated to determine significant differences.

6. Radiation.

a. Objective. To determine the range and direction at which radiation (infrared, thermal, electromagnetic, or optic) generated by the test item can be detected.

b. Standard. None applicable.

c. Method.

(1) This subtest may be conducted in accordance with applicable sections of TOP 6-2-135, Infrared Equipment.

(2) Observers equipped with selected detecting devices should be placed at suitable distances from the location of the test item. Air observers should also be employed, when applicable.

(3) Using the detecting devices, observers should determine the background radiation.

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(4) At the time of operation, observers should record any increase in radiation (detector readings, scope images, or photography).

(5) Observers will record the length of time required for instruments to return to their normal background reading.

d. Data Required.

(1) Nomenclature of equipment used to determine increase in radiation.

(2) The date on which detection equipment was calibrated.

(3) Time, duration, and amount of increase in radiation noted, by range.

e. Analytical Plan.

(1) Data should be tabulated and analyzed to determine the extent to which radiation is a factor in disclosing the location of the test item.

(2) Data on the test and control items should be compared and evaluated to determine significant differences.

7. Tactical Vulnerability.

a. Objective. To identify the position disclosing effect(s) considered most significant in compromising the security and location of the test item, thus making it vulnerable in a tactical environment. This supporting test should be used specifically to identify those test item designs which contribute to disclosure of position.

NOTE: This supporting test applies primarily to those categories of materiel and equipment normally employed in communicating, in combat surveillance, and in security operations, including all types of sensors.

b. Standard. None applicable.

c. Method.

(1) The test item, operated by test soldiers, should be employed in an appropriate tactical environment.

(2) The test soldiers should be instructed to operate all noise and light-emitting components normally employed during the particular combat operation being simulated.

(3) Observer personnel should attempt to locate the position of the test item by approaching it from different directions.

(4) The exercise should be repeated a specified number of times (as determined by consultation with statistical personnel) under varying light conditions, in both active and passive modes, and the observers should be required to use first their unaided eyes, then binoculars, metasopes, and starlight scopes, and, finally, other vision and detection equipment available to the test personnel.

d. Data Required.

(1) The cause of detection.

(2) The average detectable distance/angle at which the test item was distinguishable.

(3) Observers' comments as to any particular test item characteristic which permitted them to more easily detect the item.

e. Analytical Plan. From the data collected, the test officer should subjectively determine the relative significance of the position disclosing effect(s) which compromise the location of the test item. The size, relative shape, silhouette, contrasting colors, distinctive odor, audible hum, light glow, luminous dials, and the noise made by the adjustment of knobs, dials, or switches are test item characteristics which should be considered in making this determination. The effects of utility lighting, external power sources, radiation, and background light should also be considered.

SECTION III
SUPPLEMENTARY INSTRUCTIONS

8. Preliminary Activities.

a. Since he must collect sufficient data during each supporting test to arrive at valid conclusions, the test officer will find it advantageous to consult with a statistical analyst to develop an experimental design. The statistician can contribute in a number of ways, by recommending the number of test soldiers required, for example, and by advising on the number of repetitions or replications required to obtain the maximum results from the specific tests.

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b. If possible, the test officer should also consult with human factors personnel for assistance in the preparation of pertinent portions of his test plan and test reports, and for the development of interview and questionnaire items.

c. Additional statistical guidance can be found in TOP 3-1-002, Confidence Intervals and Sample Size, and in National Bureau of Standards Handbook 91, Experimental Statistics.

9. Visual and Hearing Examination. As an adjunct to training in preparation for the conduct of the test program, all test soldiers and observers should undergo a visual and hearing examination conducted by medical personnel to insure that they are representative of the user population. Those individuals with defective sight or hearing as defined in AR 40-501 should not be used in the test program.

10. Selection of Terrain. Terrain selected should be appropriate for the item being tested. Firing positions, observer locations, routes, trails, cross-country tracks, and other control measures, as appropriate, should be prepared before the commencement of the test program. Preparations such as these will enable the test officer to control the sequence of events, locate observer personnel most effectively, and determine accurately the distance at which a particular position disclosing effect was detected. Firing exercises which require the use of service ammunition, if any, should be rehearsed to insure proper control and to verify that test supervisory personnel are thoroughly familiar with the ranges used, the range regulations, and the appropriate safety procedures.

11. Safety. All safety precautions specified in the safety release and in other applicable sources should be followed. During the conduct of the test, all potential safety hazards should be observed and recorded. If the test item should contain radioactive material, specific controls and radiation monitoring procedures must be followed. If the necessary safety procedures are not specified in the safety release, guidance should be requested from the headquarters which is directing the test.

12. Ammunition. When testing ammunition, or in evaluating a weapon or weapon system, every effort must be made to insure that the ammunition furnished for the conduct of the expanded service test is identical in every respect to that which will be standard should the test ammunition or test weapon be accepted for entry into the Army's inventory.

13. Meteorological Data. Meteorological data -- temperature, atmospheric pressure, relative humidity, precipitation, wind speed, direction and light level readings should be collected in those test situations where such data will have a bearing on the test results.

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APPENDIX
REFERENCES

1. AR 70-10, Test and Evaluation During Research and Development.
2. FM 21-75, Combat Training of the Individual Soldier and Patrolling.
3. National Bureau of Standards Handbook 91, Experimental Statistics.
4. TECR 70-23, Equipment Performance Reports.
5. TECR 70-24, Documenting Test Plans and Reports.
6. TECR 385-6, Verification of Safety of Materiel During Testing.
7. TECR 700-1, Quality Assurance; Value Engineering
8. TECR 750-15, Maintenance Evaluation During Testing.
9. TOP 1-1-012, Classification of Deficiencies and Shortcomings.
10. TOP 2-2-615, Security from Detection (Vehicles).
11. TOP 2-3-511, Security (Susceptibility to Detection).
12. TOP 3-1-002, Confidence Intervals and Sample Size.
13. TOP 3-2-811, Noise and Blast Measurement.
14. TOP 4-3-505, Security.
15. TOP 5-3-534, Vulnerability to Detection and Identification.
16. TOP 6-2-135, Infrared Equipment.