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ALARMS, CHEMICAL/BIOLOGICAL

Paul W. Lavendar

Army Test and Evaluation Command
Aberdeen Proving Ground, Maryland

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

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*Test Operations Procedure 8-3-066

ALARMS, CHEMICAL/BIOLOGICAL

SECTION I
GENERAL

1. Purpose and Scope.

a. This procedure applies to systems designed to detect the presence of chemical or biological agents and, upon detection, to provide a warning to friendly troops in sufficient time to allow them to take protective measures. It describes methods and techniques for use in the conduct of a service test to determine whether the test item meets the criteria established in appropriate needs documents and is suitable for use by the US Army.

b. These procedures address a preoperational inspection to determine the physical characteristics and serviceability of the test item, a series of appropriate tests designed to examine the functional performance of the test item, and an examination of the safety, human factors, and value engineering aspects of the test item.

c. This document provides for tests to be conducted in a realistic tactical environment to include simulated combat conditions when appropriate. Testing will be conducted using soldiers representative of those who will operate and maintain the test item in the field and under climatic and environmental conditions representative of those areas where the equipment will be used. Observations of the climatic conditions prevailing during the service test should be made to provide a record for future evaluations.

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Paul W. Lavendar

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13. ABSTRACT

Describes a method for evaluation alarm system operational and functional performance characteristics. Identifies supporting tests, equipment, and facilities required. Provides procedures for functional suitability tests. Applicable to chemical and biological alarms

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Biological Agent Detection Device						
Biological Materiel						
Chemical Agent Detectors						
Chemical Alarms						
Chemical Materiel						
Detectors						

d. During all phases of testing, the test soldiers will be equipped with field uniforms, weapons, and equipment appropriate for the prevailing weather and the activities in which they are engaged. Test soldiers will be informed of the overall test objectives and the specific objectives of each test phase in which they will participate.

e. In consideration of the potential hazards which may result from the use of chemical agents, these procedures apply to testing conducted without using toxic chemical agents. Technical information relative to the ability of the test item to detect and warn against specific chemical or biological agents may be obtained from the results of the engineering or laboratory tests.

2. Background.

a. With the possibility that chemical or biological agents may be used as weapons in future warfare, alarm systems which will provide sufficient sensitivity and advance warning to allow personnel to take adequate protective measures in time to avoid casualty effects are needed. Unit commanders must be able to collect and report through the chain of command information of a chemical or biological attack. In addition, each commander is responsible for warning subordinate units of hazards resulting from such attacks.

b. Measures to detect chemical or biological agents are implemented by unit commanders based on the degree or intensity of the enemy CB threat. CB alarms will provide field-type units with a capability of detecting and monitoring CB agents on a continuing basis.

c. The M8 automatic chemical agent alarm is the present organic means of alerting a unit of chemical attack. Biological agent detectors comparable to the chemical agent detectors are presently not available. Normally, warning of a biological attack will be broadcast on the division's communications channels. Units may also detect a biological attack by local indications (refer to FM 21-40, para 5-5).

d. It is anticipated that research and development will continue, and alarm systems with improved capabilities will be developed. As these new alarms are developed, service tests will be required to determine the suitability of the test item for use by the US Army.

3. Equipment and Facilities.

a. Equipment.

(1) Test items.

(2) Control items, if provided.

(3) Safety and first aid equipment.

(4) Photographic equipment, still and motion.

(5) Linear and weight measurement tools.

(6) Meteorological equipment, for determining temperature, relative humidity, atmospheric pressure, wind speed and direction, and precipitation.

(7) Communications equipment.

(8) Transport vehicles (trucks and aircraft).

(9) Stopwatches.

(10) Parachutes and related equipment.

(11) Chemical agent simulants (if available).

(12) Signal smoke devices.

(13) Smoke generator.

(14) Sound level meter.

(15) Individual CB protective clothing and equipment.

(16) Individual load carrying equipment, including parachutists' equipment.

(17) Ammunition for TOE weapons.

b. Facilities.

(1) Field training areas.

(2) Firing ranges.

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

SECTION II
TEST PROCEDURES

4. Supporting Tests.

a. The procedures outlined in this document provide general guidance to the test officer for a service test of chemical or biological agent alarms. Detailed specific test procedures will depend upon the characteristics of the item being tested and the

stated requirements in the applicable requirements documents.

b. During all test phases, sufficient data must be collected to support valid conclusions. This goal may be constrained by limitations on the number of test items, time available for testing, manpower and funds available, or support and control equipment available. During preparation of his test plan, the test officer should consult with statisticians, human factors personnel, and experienced test engineers or test officers for assistance in developing an experimental pattern. The proper pattern for the experiment will aid in control of bias, simplify the requisite calculations of the analysis, and permit clear estimation of the effects of the factors. The suggested consultants can advise and assist the test officer in determining appropriate techniques for random sampling, the sample size required to estimate the true performance, in estimating average performance (or variability of performance) from a sample, in comparing materials or products with respect to average performance (or variability of performance), the 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. All applicable TOP's, the tests defined in Section III, and other published documents to be considered in formulating an expanded service test plan are iisted below. Additional reference materiel is in the appendix.

	TEST SUBJECT TITLE	PUBLICATION NO.
(1)	Preoperational Inspection and Physical Characteristics	8-3-500
(2)	Safety	8-3-506
(3)	Personnel Training	10-3-501
(4)	Functional Suitability (refer to para 5)	
(5)	Desert Environmental Test of General Supplies and Equipment	10-4-001
(6)	Tropic Environmental Test of General Supplies and Equipment	10-4-003
(7)	Durability and Reliability	8-3-503
(8)	Maintainability	8-3-507 and TECR 750-15

TEST SUBJECT TITLE	PUBLICATION NO.
(9) Man-Portability	10-3-506
(10) Transportability	6-3-510
(11) Airdrop Operations	7-3-511 and 7-3-512
(12) Adverse Conditions	3-3-524
(13) Security From Detection	1-3-515
(14) Human Factors Engineering	8-3-509
(15) Value Analysis	TECR 700-1

SECTION III
SUPPLEMENTARY INSTRUCTIONS

5. Functional Suitability.

a. Objectives:

(1) To determine whether the test item can be readily operated by the test soldiers.

(2) To determine whether the test item is compatible with standard items of clothing and equipment, particularly CB protective equipment.

(3) To evaluate the susceptibility of the test item to produce false alarms.

b. Method.

NOTE: The sensitivity of the test item to specified chemical and biological agents, and the test item's capability to provide the required alarm response within the prescribed time limits will normally be determined from the results of engineering and laboratory tests. (See TOP 8-2-066, Biological Alarms, and TOP 8-2-191, Chemical Alarms). Toxic chemical or biological agents are not normally used during service testing, and the procedures herein apply to testing conducted without the use of toxic agents.

(1) Test soldiers equipped with fighting and existence loads, and wearing CB protective equipment as appropriate, will employ the

test item in tactical exercises conducted under simulated combat conditions. The tactical exercises will be designed to ensure all of the test item's operational characteristics described in requirements documents or test directives are fully demonstrated. During the performance of the test exercises, the functional operation of the test item will be observed and evaluated in comparison with the control item being operated at the same time and under the same conditions. The exercises will resemble as closely as possible those situations which the intended users of the test item can reasonably expect to encounter in the performance of their combat missions. Field Manual 21-48, Chemical, Biological and Radiological (CBR) and Nuclear Defense Training Exercises should be used as a guide in planning and conducting the test exercises.

(2) The test exercises will be conducted during both daylight and darkness, and during inclement weather that occurs during the test period.

(3) The test time will be emplaced at a suitable test site with the detector units separated from the alarm unit at distances and in radial directions commensurate with specifications in the requirements documents. The test site should have sufficient area to ensure the effects of simulant agents used in testing do not interfere with unrelated activities outside the test area.

(4) The test item will be operated continuously for a period of time sufficient to allow a valid determination of whether the test item meets the prescribed requirements for durability and reliability. All operations will be performed in accordance with applicable instructions accompanying the test item.

(5) All available power sources appropriate and authorized for the test item should be used in its operation. This will include, as applicable, the integral batteries of the test item, vehicular power sources, electrical generators, common external batteries, and any other power sources normally available to the type troop unit expected to employ the test item. If rechargeable batteries are involved, the recharging equipment normally available to the type troop unit will be used to maintain the batteries in adequate operating condition.

(6) While being operated continuously, the test item (detection elements) will be exposed to atmospheric pollutants, e.g., vehicle exhaust fumes, dust, smoke, propellant fumes from weapon firings, and other substances normally found in the test item's intended operational areas. Test personnel should not intentionally create unrealistic conditions of pollution. The atmospheric pollutants introduced for

test purposes should be of the types and amounts that could reasonably be expected in actual operations. Any indications that the pollutants cause a false alarm response by the test item will be noted. All false alarms will be recorded. If the specific causative pollutant is identified, a description of the incident will be recorded, to include date and time of incident, length of time the test item was exposed to the contaminant, and a judgmental assessment of the pollutant density. False alarms that occur for unknown causes will be so indicated in the record.

(7) Meteorological data (temperature, humidity, barometric pressure, precipitation, wind speed and direction), and light conditions (daylight or darkness) should be recorded during this subtest.

(8) During the conduct of the field exercises, the soldiers using the test item will be closely observed to determine any indications of incompatibility between the test item and the protective clothing and equipment, and note will be made of any difficulties encountered in the operation of the test item. A determination will be made as a result of observations, questionnaires, or interrogations of test soldiers as to whether the soldiers can properly use the test item for its intended function.

(9) The test item will be employed and operated concurrently with, and in the normal proximity of, those vehicles, weapons, electronic equipment, and camouflage materials normally present in the type troop units expected to employ the test item. Any indications of incompatibility or interference between the test item and other equipment will be noted.

(10) The alarm portion of the test item will be evaluated by determining whether the visual or audible warning signal can be seen or heard under the conditions prescribed in requirements documents. Test soldiers will be placed in a random pattern at various distances from the alarm unit. With the test item in the operating mode, the visible and audible alarms should be activated. How well the test soldiers can see or hear the warning signal, and at what distances, may be determined by moving the test soldiers away from the alarm unit and measuring the distance at which the alarm could last be seen or heard. If the test item is equipped with a device to regulate the loudness or brightness of the warning signal, the device should be manipulated to determine its ease and efficiency of operation.

c. Data Required.

(1) A description of the tactical exercise conducted to include date and time, location, and dimension of test area.

(2) Meteorological data (temperature, barometric pressure, humidity, precipitation, wind speed and direction) and light conditions (daylight or darkness).

(3) The number of hours the test item was in continuous operation during each exercise, the number of failures, malfunctions, or false alarms, and the cause of each. These data will be used in determining test item reliability in accordance with TOP 8-3-503, Durability and Reliability (CB Equipment).

(4) A description of the various sources of power used and any incompatibility or difficulty encountered with any power source.

(5) A description of battery recharging, the operational time elapsed before recharging was necessary, and any difficulties encountered.

(6) Any difficulties encountered in switching from one power source to another.

(7) A description of the kind and amount of atmospheric pollutants to which the test item was exposed, how it was disseminated, the period of time exposed, and any failures or false alarms resulting from the exposure.

(8) A description of any incompatibility between the test item and the protective clothing and equipment worn by the test soldiers and any difficulties noted in the operation of the test item by the test soldiers.

(9) A description of any difficulties resulting when the test item was operated concurrently with, and in the normal proximity of, the vehicles, weapons, electronic equipment, and camouflage materials of the test unit.

(10) The distances at which the warning signals could be seen or heard and a description of the ambient noise and light conditions at the time.

(11) A description of any difficulties in adjusting the loudness or brightness of the warning signals.

d. Analytical Plan.

(1) The test data should be analyzed subjectively to determine whether the test item can be readily operated by the test soldiers and is compatible with standard items of clothing and equipment. Any problem areas should be clearly identified and described in narrative format.

(2) The data pertaining to false alarms caused by atmospheric pollutants should be analyzed subjectively to determine if the pollutants cause undue restrictions or limitations on tactical use of the test item. Problem areas should be clearly identified and described in detail. The number of false alarms that occur for no apparent reason should be used in conjunction with other reliability computations in accordance with TOP 8-3-503.

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APPENDIX
REFERENCES

1. AR 70-10, 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. FM 21-40, Chemical, Biological, Radiological and Nuclear Defense.
4. FM 21-41, Soldiers' Handbook for Defense Against Chemical and Biological Operations and Nuclear Warfare.
5. FM 21-48, Chemical, Biological, Radiological (CBR) and Nuclear Defense Training Exercises.
6. TM 10-277, Protective Clothing, Chemical Operations.
7. National Bureau of Standards Handbook 91, Experimental Statistics.
8. TECR 70-23, Equipment Performance Reports.
9. TECR 70-24, Documenting Test Plans and Reports.
10. TECR 385-6, Verification of Safety of Materiel During Testing.
11. TECR 700-1, Quality Assurance; Value Engineering.
12. TECR 750-15, Maintenance Evaluation During Testing.
13. TOP 1-1-012, Classification of Deficiencies and Shortcomings.
14. TOP 1-1-045, General Supplies and Equipment Training.
15. TOP 1-1-046, Field Combat Test Exercises.
16. TOP 3-1-002, Confidence Intervals and Sample Size.
17. TOP 8-2-066, Alarms, Biological.
18. TOP 8-2-191, Alarms, Chemical.