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TOP 8-2-555 establishes general procedures and guidance for determining the technical performance and safety aspects of chemical agent detector kits that are designed to detect the presence of chemical agents in the atmosphere, on the surfaces of various materials (metal, wood, glass, cloth, etc.), and in water. These procedures include: test preparations, test controls, receipt inspection, safety analysis, operator training, initial performance, accelerated packaged storage and sequential rough handling, adverse environments, operations with arctic and CB protective clothing, NBC contamination survivability, airdrop capability, battlefield interferents/contaminants, HFE analysis, logistic supportability evaluation, and sensitivity (chemical agent detection reliability). Data reduction and presentation are also described.

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U.S. ARMY TEST AND EVALUATION COMMAND
TEST OPERATIONS PROCEDURE

AMSTE-RP-702-103
*Test Operations Procedure 8-2-555 April 1989
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# CHEMICAL AGENT DETECTOR KITS


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1. SCOPE. This test operations procedure (TOP) establishes general procedures and guidance for determining the technical performance and safety aspects of chemical agent detector kits that are designed to detect the presence or absence of chemical agent in the atmosphere, on the surfaces of various materials (metal, wood, glass, cloth, etc.), and in water. The procedures in this TOP have been tailored for a kit intended for operation and storage in climatic design type (CDT) basic. For other requirements, environmental test procedures will require adjustments. The procedures include: test preparation, test controls, receipt inspection, safety analysis, operator training and familiarization, initial performance, accelerated packaged storage and sequential rough handling, adverse environments, operations with arctic and chemical/biological (CB) protective clothing, nuclear/biological/

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chemical (NBC) contamination survivability, airdrop capability, battlefield interferents/contaminants, human factors engineering (HFE) analysis, logistic supportability analysis, sensitivity (chemical agent detection reliability), and operational reliability. Procedures for data reduction and presentation of test results are also described.

## 2. FACILITIES AND INSTRUMENTATION.

### 2.1 Facilities.

| Item | Requirement |
|---|---|
| Chemical laboratory | Capable of performing chemical agent tests and chemical and simulated nuclear fallout material contamination survivability tests. Shall meet all safety, security, and surety requirements for performing chemical agent and nuclear simulant material testing and analysis. |
| Biological laboratory | Capable of performing biological agent simulant contamination survivability tests. Shall meet all safety and security requirements for performing biological agent simulant testing and assaying. |
| Storage chambers | Control temperature and induce relative humidity, as required by Army Regulation (AR) 70-38[1] and Military Standard (MIL-STD)-810.[2] |
| Rough handling test facility | Capable of performing shock and vibration tests specified in MIL-STD-810.[2] |
| Environmental chambers: | |
| a. Low pressure (Altitude) | As specified in MIL-STD-810, Method 500.2.[2] |
| b. High temperature | As specified in MIL-STD-810, Method 501.2.[2] |
| c. Low temperature | As specified in MIL-STD-810, Method 502.2.[2] |

[1] Reference numbers/letters correspond to those in Appendix D, References.

| | |
|---|---|
| d. Temperature shock | As specified in MIL-STD-810, Method 503.2. |
| e. Solar radiation (Sunshine) | As specified in MIL-STD-810, Method 505.2. |
| f. Rain | As specified in MIL-STD-810, Method 506.2. |
| g. Humidity | As specified in MIL-STD-810, Method 507.2. |
| h. Fungus | As specified in MIL-STD-810, Method 508.3. |
| i. Salt fog | As specified in MIL-STD-810, Method 509.2. |
| j. Sand and dust | As specified in MIL-STD-810, Method 510.2. |
| k. Leakage (immersion) | As specified in MIL-STD-810, Method 512.2. |
| Airdrop test area | Area approved for airdrop testing. See TOP 7-2-509. |
| Rigging building | Capable of rigging airdrop material and performing maintenance and packing of parachutes. |
| Support aircraft and operations facilities | Shall have required aircraft, operations facilities, rigging building, and adequate firefighting and safety equipment. |

2.2 Instrumentation.

| Device for Measuring | Permissible Error of Measurement |
|---|---|
| Weighing scales | ±1 g |
| Measuring tape | ±1 mm |
| Digital timer | ±0.1 s |
| Chemical agent vapor sampler (solid sorbent tube or bubbler sampler) | ±2% |

| | |
|---|---|
| Chemical agent contamination density sampler [printflex card, trinitrobenzene (TNB)-impregnated card, filter paper, or equivalent] | ±10% |
| Spectrophotometer, gas-liquid chromatographic analyzer, or equivalent apparatus | ±5% |
| Automatic spot counting and sizing (ASCAS) instrument, Hamamatsu™ image analyzer system, or equivalent apparatus | ±10% |
| Contact hazard sampler (dimethyl silicone sheet, contact applicator, or equivalent) | Capable of sampling surfaces of metal, wood, rubber, cloth, etc. for the presence of liquid chemical agent |
| Chemical agent application equipment | Capable of contaminating material with neat and thickened chemical agents at the required contamination densities |
| Chemical agent vapor generator | Capable of producing chemical agent vapors at the required concentration levels |
| Chemical agent alarms and monitors [M8 alarm, miniature infrared gas analyzer (MIRAN™), real-time monitor system (RTM), hydrogen flame emission detector (HYFED), automatic chemical agent monitoring system (ACAMS), or equivalent apparatus] | Capable of real-time monitoring of toxic test chambers and work areas in the chemical laboratory |
| Airtight chemical agent overpack | Capable of containing chemical agent during periods of transport without any release to the environment |
| Still color camera, Video camera, and recorder | Photograph test items and document test events and procedures |
| Thermometer | ±2°C |
| Psychrometer | ±5% |

| | |
|---|---|
| Rough handling test and environmental chamber instruments | As specified in MIL-STD-810[2] |
| Microsyringe | ±0.5 μL |
| Equipment required for sizing, dispensing, measuring density of, and decontaminating zinc sulfide fluorescent particles (FP) | As specified in TOP 8-2-111[4] |
| Airdrop delivery test instruments | As specified in TOP 7-2-509[3] |

3. PREPARATION FOR TEST.

3.1 Project Officer.

The project officer will be responsible for all phases of test planning, coordinating, conducting, and reporting.

3.2 Documentation.

The project officer will ensure that the following are available at the work site:

a. Independent assessment plan (IAP).

b. Approved detailed test plan (DTP).

c. Approved operations plan (OPLAN).

d. Safety assessment report (SAR).

e. Office of the Surgeon General health hazards assessment report (HHAR).

f. Funding document.

g. Basic issue item list (BIIL).

h. System support package (SSP) list.

i. Environmental impact assessment for life cycle (EIALC).

j. Record of environmental consideration (REC), or environmental assessment (EA) with a finding of no significant impact (FNSI), or environmental impact statement (EIS) (as necessary).

k. Standing operating procedures (SOPs).

3.3 Project Logbook, Project File, and Checklist.

The project officer will establish and maintain a project logbook, project file, and checklist as described in U.S. Army Test and Evaluation Command (TECOM) Pamphlet 70-3.[5]

3.4 Familiarization.

The project officer will ensure that test participants are thoroughly familiar with items to be tested, test procedures, support and test equipment, test measurement and diagnostic equipment (TMDE), repair parts and special tools (RPST), precautions to be observed, technical manuals (TMs), and other pertinent government and manufacturer publications. The project officer will ensure that new equipment training (NET) is provided by the developer, as necessary.

3.5 Safety.

3.5.1 Safety Assessment Report (SAR).

Before a test is started, the project officer will ensure that a SAR has been received from the developer and is understood. The SAR must include information about operational limitations and hazards peculiar to the test item. The SAR should include the Office of the Surgeon General's HHAR. If the SAR is not received or is inadequate, testing will be deferred until the matter is resolved.

3.5.2 Safety.

The project officer will ensure that test operations will be conducted in such a manner that test participants and nearby persons, property, and equipment will not be exposed to safety or health hazards beyond normal duty limits. All safety regulations, safety directives, safety requirements, and SOPs pertaining to the test item will be followed. Basic information on industrial, range, and chemical agent safety is included in AR 385-10[6], U.S. Army Materiel Command (AMC) Regulations 385-100[7] and 385-131[8], U.S. Army Dugway Proving Ground (DPG) Regulation 385-1[9] and TOP 8-2-553[10].

A safety officer will be responsible for the safety aspects of the test. The safety officer will be familiar with test item construction and operation and critical components. Before the start of testing, a safety inspection will be conducted by the safety officer and test personnel to identify potential safety and health hazards. The safety officer will also review test procedures for analyzing safety and health hazards and recommending control measures.

Each test participant will be informed of potential safety and health hazards involved, and the precautions required to prevent accidents and agent exposures.

3.5.3 System Safety Verification.

A system safety verification program, conducted in accordance with (IAW) TOP 1-1-060[11], is required to ensure that adequate testing is conducted to provide safety and health analysis of the system. This verification is the process by which systems that are to be fielded are tested and analyzed to ensure that they can be safely operated and maintained by field troops without compromising mission requirements. AR 385-16[12] describes the safety verification program and lists the requirements that must be met.

3.5.4 Safety Equipment.

The project officer will determine the type of safety equipment and level of protective clothing needed for each test procedure. The project officer will also ensure that the required quantities of each type of materiel are available and that materiel handling devices meet the standards of the Occupational Safety and Health Act (OSHA)[13].

3.5.5 Disposal Instructions.

The project officer will ensure the availability of approved procedures and equipment for disposal of damaged, corrosive, or toxic materials. Basic guidance for disposal of chemical agent-exposed materiel is in AMC Regulation 385-131[8].

3.6 Instrumentation.

The project officer will ensure that all instruments used for data acquisition are calibrated or certified for use IAW AR 750-25[14].

3.7 Environmental Assessment.

In compliance with the National Environmental Policy Act (NEPA), the Department of the Army (DA) requires that an EIALC be prepared and that potential environmental impacts be assessed at the earliest practical stage in the planning process of any new system. Test execution at TECOM agencies must also be assessed for environmental impact. To prepare the necessary environmental documentation, refer to AMC Supplement 1 and TECOM Supplement 1 to AR 200-2[15]. First, evaluate the proposed test and materials against the criteria for categorical exclusion from assessment documentation. If categorical exclusion is possible, work with the installation environmental coordinator to prepare and file the REC. If the test activities are not categorically excluded, work with the installation environmental coordinator in preparing an EA. The outcome of the EA will indicate whether the test activity will result in significant or insignificant impact. If insignificant impact would result, prepare an appropriate FNSI for local publication and filing before testing. If significant impact would result, a full EIS must be prepared. Preparation of an EIS is complex and time consuming. Consult the installation environmental coordinator because state agencies, the U.S. Environmental Protection Agency, and interested/affected public groups will become involved during comment periods built into the EIS approval cycle.

3.8 Security.

If classified information or materiel is involved in the test program, the project officer will ensure that all test participants have current security clearances, test and storage areas have adequate physical protection, and document containers meet required standards (see publications in the AR 380 and AR 539 series).

3.9 Surety.

The project officer will ensure that all test participants are currently enrolled in the Chemical Personnel Reliability Program (CPRP), that medical requirements are met, and that the DTP and OPLAN address all surety aspects IAW regulatory requirements (see publications in the AR 50 series).

3.10 Logistics.

The project officer will review the DTP to establish support requirements and ensure that test supplies and equipment are available in sufficient quantities to support the test. The project officer will carry out timely scheduling to ensure that facilities and instruments are available for each test.

4. TEST CONTROLS.

4.1 General.

Tests will be conducted in optimum sequence to make the most cost-effective and timely use of facilities, equipment, instruments, and people. The sequence of tests will be based upon a continual risk analysis and an estimate of those conditions under which it is suspected that the test item may not perform satisfactorily. High risk tests will be performed at the earliest practical stage.

4.2 Safety.

4.2.1 Documentation.

SOPs and OPLANs for all hazardous operations will be approved by the installation commander or his designated representative IAW AMC Regulation 385-100'.

4.2.2 Operational Readiness Inspection (ORI).

An ORI will be performed before conduct of any test involving lethal or incapacitating chemical agents or other hazardous operations. The ORI will consist of a complete trial, using all procedures as if agent were present or hazardous operations were being undertaken. The installation commander will be briefed on the results of the ORI.

4.2.3 Equipment Operation and Support Hazard Analyses.

Operation and support hazard analyses will be performed during testing to identify hazards associated with the test item, support equipment, and procedures. The results of hazard analyses, accident investigations, inspections, interviews, and test incidence reports (TIRs) of unsafe conditions will be used as methods for accumulating data. The project officer and test safety officer will analyze the data by using the risk analysis procedures in MIL-STD-882A[16].

4.2.4 Decontamination.

Facilities, test items, and equipment contaminated with chemical agent during testing will be decontaminated IAW the procedures in AMC Regulation 385-131[8]. Procedures (for decontaminating facilities, test items, and equipment contaminated with chemical agent) not covered in AMC Regulation 385-131[8] will be performed IAW proposals made by the Chemical Laboratory Division and approved by the Safety Office.

4.3 Test Chamber Operating Conditions.

The DTP and OPLAN will specify the operational limitations for storage and environmental chambers, including range and accuracy requirements for temperature, relative humidity, wind velocity, solar radiation, and other parameters specified in AR 70-38[1], MIL-STD-810[2], and applicable TOPs. For laboratory tests performed to determine detector kit agent sensitivity capabilities. the DTP, OPLAN, and SOPs will specify the range and accuracy requirements for laboratory hood temperature and relative humidity and the accuracy requirements for the various physical and chemical properties of specified chemical agents.

4.4 Human Factors Engineering (HFE) Tests.

HFE tests will include the use of soldier/operator, maintainer, tester, and evaluator (SOMTE) personnel to provide data and information for the HFE test and analysis. Selection of SOMTE personnel for test participation will be based on primary military occupational specialty (PMOS) qualifications, experience, and skill levels. Specific criteria for selecting SOMTE personnel will be stated in the DTP and OPLAN.

4.5 Test Item History and Maintenance Data.

A logbook will be prepared for recording test item histories, including storage time and conditions, and all appropriate information concerning the environmental and test conditions within which the test item is used. In addition, a maintenance log will be prepared to record all maintenance and service actions performed during the test. The maintenance log will be prepared and used IAW the requirements of TECOM Supplement 1 to AMC Regulation 700-15[17].

5. PERFORMANCE TESTS.

5.1 Receipt Inspection.

5.1.1 Method.

Receipt inspection will be performed IAW the applicable instructions in TOP 8-2-500[18]. All shipping containers will be inspected for damage, loose closures, correct and legible markings, and the presence of unpacking and storage instructions. Defects will be documented by TIRs and photographed (with metric scale), when applicable. All shipping containers, except those designated for use in the accelerated packaged storage and sequential rough handling test (Paragraph 5.5) and the airdrop delivery test (Faragraph 5.9), will be opened. The type and condition of the blocking, bracing, and cushioning material will be recorded.

Individual detector kits will be inspected for the following conditions:

a. Correct and legible identification markings.

b. An expiration date that corresponds with the shortest shelf life of any kit component.

c. Legible instructions.

d. All components present and individually identified.

e. Required vapor barrier bags for kit components present and sealed.

f. Defects, such as missing components, incorrect or missing identification markings, broken ampoules, spillage, shortages, and damaged vapor barrier bags (holes, cuts, tears, and punctures).

Defects will be documented by TIRs and photographed (with metric scale), when applicable. Detector kits that are judged to be so damaged that troops in the field would not use them will be removed from further testing. The remaining kits will be serial-numbered and the test identification and manufacturer serial numbers recorded. A minimum of 15 detector kits will be randomly selected and measured for conformance to the size and weight specifications. Consult statistician for guidance on valid random selection of detector kits.

5.1.2 Data Required.

The following data are required:

a. Shipping container:

(1) Type of material (wood, fiberboard, etc.).

(2) Means of closure (tape, metal bands, etc.).

(3) Markings (present or absent).

(4) Marking legibility.

(5) Unpacking instructions (present or absent).

(6) Storage instructions (present or absent).

(7) Evidence of damage. Photographs, with metric scale, will be taken when necessary to clarify descriptions.

(8) Type and condition of blocking, bracing, and cushioning material.

(9) Number of intermediate packages.

b. Detector kit:

(1) Correct identification markings (present or absent).

(2) Marking legibility.

(3) Expiration date on components.

(4) Correct expiration date on kit (present or absent).

(5) Operating instructions (present or absent).

(6) Legible operating instructions.

(7) Results of inventory.

(8) Markings on kit components (present or absent).

(9) Legibility of markings on kit components.

(10) Required vapor barrier bags (present or absent; sealed or unsealed).

(11) Evidence of defects. Photographs, with metric scale, will be taken when necessary to clarify descriptions.

(12) Weights and dimensions of measured kits.

(13) A list of test identification serial numbers with corresponding manufacturer serial numbers.

5.2 Safety Analysis.

5.2.1 Method.

5.2.1.1 Safety Analysis. The detector kit and components will be inspected to ensure compliance with the provisions outlined in the developer's SAR and

that all hazards identified in the SAR have been eliminated or controlled/ mitigated to an acceptable level. The requirements of the Office of the Surgeon General HHAR will be assessed IAW AR 40-10[19].

5.2.1.2 Test Item Inspection. The detector kit and components will be examined for any defect, omission, or condition that could be detrimental to user safety. Warnings, cautions, and procedures in the TM, on the operation instruction cards, and on test items will be examined, to ensure that they are conspicuous and adequate to minimize operational and maintenance hazards.

5.2.1.3 Safety Release Information. A recommendation for a safety release will be prepared and submitted to TECOM Headquarters, Aberdeen Proving Ground, Maryland, IAW TECOM Supplement 1 to AR 385-16[12] at the completion of the operator training and familiarization test (Paragraph 5.3).

5.2.2 Data Required.

a. Developer's SAR.

b. Office of the Surgeon General's HHAR, if not included in the SAR.

c. A detailed description of each safety and health hazard identified during any test will be presented with the appropriate hazard severity and probability of occurrence category IAW MIL-STD-882A[18]. Photographs, with metric scale, will accompany the hazard description as necessary to clarify the nature of the hazard.

d. Findings related to the adequacy of existing safety and warning devices, or the need for additional or improved safety or warning devices.

e. Findings related to the adequacy of safety instructions, with recommendations for changes or additions.

5.3 Operator Training and Familiarization.

5.3.1 Method.

5.3.1.1 New Equipment Training (NET). NET will be given to SOMTE personnel who have been certified by a medical authority to be physically fit and to have normal vision and normal color perception. NET will be performed IAW the applicable instructions of TOP 10-2-501[20] and the following guidance:

a. NET will be provided by the developer. Training will include safety instructions, operating instructions for the detector kit and the Simulator, Detector Tickets, Chemical Agent: Training M256 (TRAINS) during daylight and night conditions, operations with CB protective and arctic clothing, care (maintenance and decontamination), and storage.

b. Copies of the draft TM and written safety and operating instructions will be given to each test participant.

c. Initial training will be conducted with TRAINS, using chemical agent simulants. The project officer will verify that each test participant can perform all required operations with TRAINS before proceeding to operations with the detector kit.

5.3.1.2 Operations with the Detector Kit.

a. Each test participant will perform all of the detector kit positive and negative agent sensitivity tests. Blanks (samplers with no chemical agent or with a blank level of chemical agent present) will be used in the negative response tests. (NOTE: Blank levels are defined in Paragraph 5.4.1.1.) Each test participant will perform every test during daylight and night conditions at standard ambient temperature (25±10°C), as defined by MIL-STD-810[2], and at the extreme temperature (-31°C) for the basic cold CDT of AR 70-38[1]. While performing tests at standard ambient temperature, test participants will wear a standard CB protective mask, hood, gloves, and overgarment. While performing tests at the extreme basic cold temperature, test participants will wear arctic clothing with the standard CB protective mask, hood, impermeable glove liners, and overgarment.

b. The project officer will verify that each test participant understands the instructions, can perform the required kit operations, and can correctly interpret the test results.

5.3.1.3 Maintenance and Decontamination. Test participants will be trained in the methods of maintenance (if applicable) and decontamination in the draft TM. During the NBC contamination survivability test (Paragraph 5.8) and the logistic supportability test (Paragraph 5.11), these test participants will perform maintenance tasks and decontamination using the methods provided during training. Observations and measurements obtained during these tests will be used to evaluate the adequacy of the methods and training.

5.3.1.4 Questionnaire and Interview. At the end of this test, test participants will be asked a series of questions designed to provide information on the adequacy of the NET and the TM, the readability of the instructions by person wearing a CB protective mask, compatibility with CB protective and arctic clothing, and the ease of handling kit components, performing tests, and interpreting test results. The questionnaire and interviews will be prepared and administered IAW TECOM Pamphlet 602-1[11].

5.3.2 Data Required.

a. Comments on each of the following aspects of operator training and familiarization:

(1) Adequacy of NET.

(2) Suitability of the draft TM for training.

(3) Accuracy, completeness, and clarity of the draft TM and the detector kit and TRAINS operating instructions.

(4) Readability of detector kit and TRAINS operating instruction cards, while operator is wearing a CB protective mask.

(5) Compatibility of detector kit and TRAINS with CB protective and arctic clothing.

(6) Ease of handling kit samplers, performing tests, and interpreting results.

(7) Use of detector kit and TRAINS at night.

(8) Use of detector kit and TRAINS at basic cold temperature.

(9) Adequacy of maintenance and decontamination instructions and procedures.

b. Identification of procedural errors, if applicable.

c. Identification of incipient operator errors, if applicable.

d. Suggested improvements.

e. Time required to perform each sensitivity test during daylight and night conditions at standard ambient and basic cold temperatures.

5.4 Initial Performance.

5.4.1 Method.

5.4.1.1 Test Conditions. Initial performance (control) tests of untreated detector kits will be performed to determine if the detector kit samplers will respond correctly to the specified chemical agents at the required minimum concentration/density level within the required maximum time (see Appendix B for failure definitions). Every test for which the kit provides a detection capability will be performed with each assigned detector kit during day and night conditions and at each of the CDT test conditions in Table 1. A blank level of chemical agent will be established. The blank level is the level of agent that may be present but will not cause the kit sampler to indicate a positive determination. If the requirements document or IAP does not specify a blank level, the following will be used:

a. For water tests, the blank level equals 0.8 times the maximum permissible level specified in Technical Bulletin - Medical (TB MED) 577[a] for the long-term water quality standard.

b. For tests intended to provide an unmask indicator, the blank level equals 0.9 times the U.S. Army Nuclear-Chemical Agency (USANCA), Springfield, Virginia, negligible risk level in $mg \cdot min/m^3$ divided by 720[b].

c. For all other tests, the blank level equals 0.5 times the minimum detectable level specified in the requirements document.

Table 1. Climatic Design Types and Test Conditions for Initial Performance Test of Chemical Agent Detector Kits.

| Climatic Design Type | Operation Test Conditions |
|---|---|
| Standard ambient temperature[a] | 25±10°C |
| Basic cold[b] | As described in MIL-STD-810, Method 502.2, Procedure II, -31°C.[c] |
| Basic hot[b] | As described in MIL-STD 810, Method 501.2, Procedure II, Table 501.2-1 Induced.[c] |
| Variable high humidity[b] | As described in MIL-STD-810, Method 507.2, Procedure II, Table 507.2-1, Cycle 3.[c] |

[a] As defined in MIL-STD-810.[2]
[b] Reference 1.
[c] Reference 2.

NOTE: At least 50 percent of the blank tests will be done at the blank level. The remainder will be done with no agent present.

The number of replicate trials to be performed for positive (agent) and negative (blank) response tests for each agent/sample type/CDT test condition combination (e.g., nerve agent vapor tested at basic cold conditions) will be determined from the specified reliability and confidence level requirements.

An operator and an observer will be used. The operator, who may be a civilian employee, will operate the kit and laboratory equipment used in the test. The operator will know the true response of the test (positive or negative). SOMTE personnel will serve as observers. The observer will make test determinations under conditions that represent expected field conditions to the extent this is practicable in the laboratory. The observer will not know the true response of the test. The duty of the observer will be rotated among a representative group of soldiers.

5.4.1.2 Test Hoods. Agent challenge tests will be conducted inside charcoal-filtered laboratory hoods with transparent facings. The hoods are constructed to contain chemical agent during testing and to pass contaminated air through a certified filter system before release to the atmosphere. A separate hood will be used for each type of agent; however, if the kit is structured so that more than one agent is detectable with each sampler, then all agent and blank tests will be performed in one hood. The temperature and relative humidity of

the atmosphere within the chamber will be controlled. Agent vapor concentration, agent concentration in water, and contamination density will be controlled within the specified limits for the minimum detection concentration/density levels. Laboratory control samples will be taken and analyzed with appropriate laboratory instruments (Paragraph 2.2) to ensure that the agent concentration/density is within the specified limits.

5.4.1.3 Pretest Inspection. The samplers will be removed from the detector kit, unpackaged (if required), and inspected. A trained observer will perform the inspection. Samplers will be examined for physical and mechanical defects that would render the samplers incapable of making valid tests for the presence or absence of chemical agent. Examples of defects that would render the samplers unusable are missing components, broken ampoules, and obstructed reagent passageways. The time required to perform the inspection and the number and type of samplers inspected will be recorded.

5.4.1.4 Sampler Response Test. The samplers will be prepared for agent exposure IAW the kit operating instructions. The vapor samplers will be inserted in the appropriate chamber and exposed to agent for the required time. Surface contact samplers and samplers used to detect chemical agent in water will be operated in the test chamber IAW the kit instructions. Blanks (samplers with no agent or with the blank level of agent present) will be processed under the same temperature and humidity conditions as samplers with agent present. Total processing time will be recorded for each positive (agent) and negative (blank) response test.

NOTE: For vapor, water, and material samples contaminated with chemical agent and exposed to basic cold test conditions, additional time may be required to heat the water, materials, and samplers before performing the agent sensitivity tests.

5.4.1.5 Response Analysis. The response of each sampler will be independently read and recorded by the operator and an observer. Both persons will have been trained IAW the procedures in Paragraph 5.3. Using the kit instructions, the operator and observer will classify the responses as positive, negative, or uncertain. Background light conditions in the laboratory will be measured and recorded periodically during operations under day and night conditions. The time required to analyze each response will be recorded for operator and observer.

NOTE: Kit instructions may specify the use of a light source for response analysis under night conditions. In that event, light conditions will be determined within 1 m of the sampler.

5.4.2 Data Required.

a. Detector kit and sampler identification numbers.

b. Test conditions: (1) CDT test conditions; (2) agent; (3) agent concentration in vapor or water, or agent contamination density on material surface; and (4) type of material (wood, soil, concrete, glass, etc.), if applicable.

c. Sampler inspection times.

d. Descriptions of all observed sampler defects. Photographs, with metric scale, will be provided if necessary to clarify descriptions.

e. Light conditions (daylight or night) and luminance (light source) data.

f. Sampler exposure times.

g. Operator and observer response analyses (positive, negative, or uncertain).

h. Operator and observer response analysis times.

i. True analyses (positive or negative).

j. Category of operator and observer response analyses (correct, chemical failure, physical failure, or operational failure).

k. Color photographs, with metric scale, of typical sampler responses.

l. Laboratory control data.

5.5 Accelerated Packaged Storage and Sequential Rough Handling.

5.5.1 Method.

a. This test will determine the capability of the packaged test item to withstand the combined effects of accelerated packaged storage and sequential rough handling in CDT basic. The accelerated storage test will expose the packaged detector kit to higher and lower temperatures than it is expected to experience in actual packaged storage. Coordination should be made with the developer to ensure that the detector kit will endure these temperatures and to determine if a different shelf-life test is more appropriate.

b. Analysis will be on an indicative basis only. Success or failure in the accelerated packaged storage test does not conclusively indicate that the packaged detector kit has or does not have the specified storage life.

c. The sequential rough handling tests simulate transportation to a unit after depot storage.

5.5.1.1 Accelerated Packaged Storage Test. Three level-A shipping containers of packaged test items will be used in this test. One shipping container will be subjected to 12 weeks of accelerated basic cold storage conditions, one shipping container to 12 weeks of accelerated basic hot storage conditions, and one shipping container to 12 weeks of accelerated variable high humidity storage conditions. The storage conditions are described in MIL-STD-810[2] as follows:

a. Basic cold: Method 502.2, Procedure I, -31°C.

b. Basic hot: Method 501.2, Procedure I.

c. Variable high humidity: Method 507.2, Procedure II, Table 507.2-I, Cycle 3.

After completion of the packaged storage test, the detector kits in each shipping container will be inspected for damage. A random sample (approximately one-fourth) of the undamaged kits in each container will be removed and replaced with dummy packages. Damaged detector kits will also be replaced with dummy packages. The undamaged detector kits removed from the containers will be tested for chemical agent sensitivity IAW Paragraph 5.4.1 and Table A.1.

5.5.1.2 Sequential Rough Handling Tests. The three shipping containers will be subjected to the following sequential rough handling tests, performed IAW the indicated methods:

a. Low pressure (altitude): MIL-STD-810, Method 500.2, Procedure I[2].

b. Vibration: MIL-STD-810, Method 514.3, Category 3 (loose cargo transport)[2].

c. Shock: MIL-STD-810, Method 516.3, Procedure IV[2].

For test items subjected to basic cold, basic hot, and variable high humidity storage conditions, the vibration and shock tests will be conducted under the conditions shown in Table 2.

After completion of the low pressure test, the detector kits in each shipping container will be inspected for damage. A random sample (approximately one-fourth) of the undamaged detector kits in each shipping container will be removed and replaced with dummy packages. Damaged detector kits will also be replaced with dummy packages. The undamaged detector kits removed from the container will be tested for chemical agent sensitivity IAW Paragraph 5.4.1 and Table A.1. After the vibration test, all detector kits will be inspected for damage. A random sample (approximately one-fourth) of the undamaged detector kits from each shipping container will be tested for chemical agent sensitivity IAW Paragraph 5.4.1 and Table A.1.

The remaining detector kits will be subjected to the shock test in the unpackaged configuration. The drop height will be 1.5 m, unless otherwise specified in the DTP. After the shock test, all detector kits will be inspected for damage. Undamaged detector kits will be tested for chemical agent sensitivity IAW Paragraph 5.4.1 and Table A.1.

5.5.2 Data Required.

a. Test item identification numbers and record of treatment(s) for each detector kit.

Table 2. Test Conditions for Vibration and Shock Tests.

| Test Item Storage Conditions | Vibration and Shock Test Conditions |
|---|---|
| Basic cold -31°C.[a] | MIL-STD-810, Method 502.2, Procedure I, |
| Basic hot | MIL-STD-810, Method 502.2, Procedure I.[a] |
| Variable high humidity Table 507.2-I, Cycle 3.[a] | MIL-STD-810, Method 507.2, Procedure II, |

[a] Reference 2.

b. Temperature versus time data for basic cold, basic hot, and variable high humidity tests.

c. Relative humidity versus time data for basic cold, basic hot, and variable high humidity tests, if applicable.

d. Low pressure test chamber data:

(1) Pressure versus time data.

(2) Temperature versus time data.

e. Vibration test data:

(1) Descriptions of test apparatus and test fixture.

(2) Vibration spectrum and intensity.

(3) Duration of exposure.

(4) Axes of exposure.

(5) Location of accelerometers.

(6) Temperature/relative humidity versus time data.

f. Shock test data:

(1) Description of drop tester.

(2) Height of the drops.

(3) Number of drops per detector kit.

(4) Drop surface (face, edge, or corner) for each drop.

g. Results of package inspection.

h. Descriptions of damage. Photographs, with metric scale, will be provided if necessary to clarify descriptions.

i. Detector kit sampler inspection times.

j. Descriptions of all observed sampler defects. Photographs, with metric scale, will be provided if necessary to clarify descriptions.

k. Chemical agent sensitivity test conditions: (1) CDT test conditions; (2) agent type; (3) agent concentration in vapor or water, or agent contamination density on material surface; and (4) type of material (wood, soil, concrete, glass, etc.), if applicable.

l. Sampler exposure times.

m. Operator and observer response analyses (positive, negative, or uncertain).

n. Operator and observer response analysis times.

o. True analyses (positive or negative).

p. Category of operator and observer response analysis (correct, chemical failure, physical failure, or operational failure).

q. Laboratory control data.

5.6 Adverse Environments.

5.6.1 Method.

Determine the capability of the detector kit to withstand the effects of adverse environments by performing the tests listed in Table 3.

After each test, perform detector kit sampler inspection and chemical agent sensitivity tests IAW Paragraph 5.4.1 and Table A.1.

5.6.2 Data Required.

5.6.2.1 Low Pressure (Altitude Test).

a. Detector kit identification numbers.

b. Chamber pressure versus time data.

c. Chamber temperature versus time data.

Table 3. Test Methods, Number of Detector Kits, and Package Configurations for Adverse Environment Test of Chemical Agent Detector Kits.

| Adverse Environment | Test Method (Procedures and Methods from MIL-STD-810)[a] | Number of Items to be Tested | Package Configuration |
|---|---|---|---|
| High Temperature[b] | Method 501.2, Procedure I, Table 501.2-II Induced | 5 | Packaged |
| High Temperature | Method 501.2, Procedure I, Table 501.2-II Ambient | 5 | Unpackaged |
| Low Temperature[b] | Method 502.2, Procedure I, -31°C | 5 | Packaged |
| Low Temperature | Method 502.2, Procedure I, -31°C | 5 | Unpackaged |
| Temperature Shock | Method 503.2, Procedure I | 5 | Unpackaged |
| Solar Radiation | Method 505.2, Procedure II | 5 | Unpackaged |
| Rain | Method 506.2, Procedure I | 5 | Unpackaged |
| Humidity[b] | Method 507.2, Procedure I, Table 507.2-I, Cycle 3 | 5 | Unpackaged |
| Fungus | Method 508.3, Procedure I | 5 | Unpackaged |
| Salt Fog | Method 509.2, Procedure I | 5 | Unpackaged |
| Sand and Dust | Method 510.2, Procedures I and II | 5 | Unpackaged |
| Leakage | Method 512.2, Procedure I | 5 | Unpackaged |

[a] Reference 2.
[b] These tests may be omitted if the basic hot, basic cold, and variable high humidity tests of Paragraph 5.5.1 were successfully completed.

d. Results of inspection of detector kits.

e. Detector kit sampler inspection times.

f. Descriptions of all observed sampler defects. Photographs, with metric scale, will be provided if necessary to clarify descriptions.

g. Chemical agent sensitivity test conditions: (1) CDT test conditions; (2) agent type; (3) agent concentration in vapor or water, or agent contamination density on material surface; and (4) type of material (wood, soil, concrete, glass, etc.), if applicable.

h. Sampler exposure times.

i. Operator and observer response analyses (positive, negative, or uncertain).

j. Operator and observer response analysis times.

k. True analyses (positive or negative).

l. Category of operator and observer response analyses (correct, chemical failure, physical failure, or operational failure).

m. Laboratory control data.

5.6.2.2 High Temperature Test.

a. Detector kit identification numbers.

b. Packaging (present or absent).

c. Chamber temperature versus time data.

d. Chamber relative humidity versus time data, if applicable.

e. Results of inspection of detector kits and packages.

f. Detector kit sampler inspection times.

g. Descriptions of all observed sampler defects. Photographs, with metric scale, will be provided if necessary to clarify descriptions.

h. Chemical agent sensitivity test conditions: (1) CDT test conditions; (2) agent type; (3) agent concentration in vapor or water, or agent contamination density on material surface; and (4) type of material (wood, soil, concrete, glass, etc.), if applicable.

i. Sampler exposure times.

j. Operator and observer response analyses (positive, negative, or uncertain).

k. Operator and observer response analysis times.

l. True analyses (positive or negative).

m. Category of operator and observer response analyses (correct, chemical failure, physical failure, or operational failure).

n. Laboratory control data.

5.6.2.3 Low Temperature Test. Same as Paragraph 5.6.2.2.

5.6.2.4 Temperature Shock Test.

a. Detector kit identification numbers.

b. High and low temperature chamber test data and test item response temperatures.

c. Duration of each test.

d. Transfer times.

e. Results of inspection of detector kits.

f. Detector kit sampler inspection times.

g. Descriptions of all observed sampler defects. Photographs, with metric scale, will be provided if necessary to clarify descriptions.

h. Chemical agent sensitivity test conditions: (1) CDT test conditions; (2) agent; (3) agent concentration in vapor or water, or agent contamination density on material surface; and (4) type of material (wood, soil, concrete, glass, etc.), if applicable.

i. Sampler exposure times.

j. Operator and observer response analyses (positive, negative, or uncertain).

k. Operator and observer response analysis times.

l. True analyses (positive or negative).

m. Category of operator and observer response analyses (correct, chemical failure, physical failure, or operational failure).

n. Laboratory control data.

5.6.2.5 Solar Radiation Test.

a. Detector kit identification numbers.

b. Location of temperature sensors on detector kits.

c. Temperature versus time data for each cycle.

d. Solar lamp bank identification data.

e. Results of inspection of detector kits.

f. Detector kit sampler inspection times.

g. Descriptions of all observed sampler defects. Photographs, with metric scale, will be provided if necessary to clarify descriptions.

h. Chemical agent sensitivity test conditions: (1) CDT test conditions; (2) agent; (3) agent concentration in vapor or water, or agent contamination density on material surface; and (4) type of material (wood, soil, concrete, glass, etc.), if applicable.

i. Sampler exposure times.

j. Operator and observer response analyses (positive, negative, or uncertain).

k. Operator and observer response analysis times.

l. True analyses (positive or negative).

m. Category of operator and observer response analyses (correct, chemical failure, physical failure, or operational failure).

n. Laboratory control data.

5.6.2.6 Rain Test.

a. Detector kit identification numbers.

b. Exposure durations of test item surfaces.

c. Rainfall rate.

d. Wind velocity.

e. Water and test item temperatures.

f. Surfaces of detector kits subjected to rainfall.

g. Results of inspection of detector kit inner surfaces and components for water penetration and corrosion.

h. Detector kit sampler inspection times.

i. Descriptions of all observed sampler defects. Photographs, with metric scale, will be provided if necessary to clarify descriptions.

j. Chemical agent sensitivity test conditions: (1) CDT test conditions; (2) agent; (3) agent concentration in vapor or water, or agent contamination density on material surface; and (4) type of material (wood, soil, concrete, glass, etc.), if applicable.

k. Sampler exposure times.

l. Operator and observer response analyses (positive, negative, or uncertain).

m. Operator and observer response analysis times.

n. True analyses (positive or negative).

o. Category of operator and observer response analyses (correct, chemical failure, physical failure, or operational failure).

p. Laboratory control data.

5.6.2.7 Humidity Test.

a. Detector kit identification numbers.

b. Relative humidity versus time data.

c. Temperature versus time data.

d. Results of inspection of detector kit inner surfaces and components for water penetration and corrosion.

e. Detector kit sampler inspection times.

f. Descriptions of all observed sampler defects. Photographs, with metric scale, will be provided if necessary to clarify descriptions.

g. Chemical agent sensitivity test conditions: (1) CDT test conditions; (2) agent; (3) agent concentration in vapor or water, or agent contamination density on material surface; and (4) type of material (wood, soil, concrete, glass, etc.), if applicable.

h. Sampler exposure times.

i. Operator and observer response analyses (positive, negative, or uncertain).

j. Operator and observer response analysis times.

k. True analyses (positive or negative).

l. Category of operator and observer response analyses (correct, chemical failure, physical failure, or operational failure).

m. Laboratory control data.

5.6.2.8 Fungus Test.

a. Detector kit identification numbers and orientations.

b. Types of fungi (genus, species, and any other appropriate identification).

c. Evidence of fungal growth at the end of 7 days of exposure and at the end of the test.

d. Location of fungi.

e. Description of growth, including colors, area covered, growth patterns, density of growth, and thickness of growth. Photographs, with metric scale, will be provided if necessary to clarify description.

f. Test duration.

g. Data and observations related to effects of fungal growth (refer to MIL-STD-810, Method 508.3[2]).

h. Chamber relative humidity versus time data.

i. Chamber temperature versus time data.

j. Chamber air velocity versus time data.

k. Results of inspection of detector kit inner surfaces and components for fungal growth, corrosion, and deterioration.

l. Detector kit sampler inspection times.

m. Descriptions of all observed sampler defects. Photographs, with metric scale, will be provided if necessary to clarify descriptions.

n. Chemical agent sensitivity test conditions: (1) CDT test conditions; (2) agent; (3) agent concentration in vapor or water, or agent contamination density on material surface; and (4) type of material (wood, soil, concrete, glass, etc.), if applicable.

o. Sampler exposure times.

p. Operator and observer response analyses (positive, negative, or uncertain).

q. Operator and observer response analysis times.

r. True analyses (positive or negative).

s. Category of operator and observer response analyses (correct, chemical failure, physical failure, or operational failure).

t. Laboratory control data.

5.6.2.9 Salt Fog Test.

a. Detector kit identification numbers and orientations.

b. Test duration or cycling schedule.

c. Chamber temperature versus time data.

d. Salt solution concentration.

e. Salt solution pH.

f. Salt solution specific gravity.

g. Salt solution fallout rate.

h. Type of water and resistance of initial water.

i. Results of inspection of detector kit inner surfaces and components for water penetration, corrosion, and deterioration.

j. Detector kit sampler inspection times.

k. Descriptions of all observed sampler defects. Photographs, with metric scale, will be provided if necessary to clarify descriptions.

l. Chemical agent sensitivity test conditions: (1) CDT test conditions; (2) agent; (3) agent concentration in vapor or water, or agent contamination density on material surface; and (4) type of material (wood, soil, concrete, glass, etc.), if applicable.

m. Sampler exposure times.

n. Operator and observer response analyses (positive, negative, or uncertain).

o. Operator and observer response analysis times.

p. True analyses (positive or negative).

q. Category of operator and observer response analyses (correct, chemical failure, physical failure, or operational failure).

r. Laboratory control data.

5.6.2.10 Sand and Dust Test.

a. Detector kit identification numbers and orientations.

b. Chamber relative humidity versus time data.

c. Chamber temperature versus time data.

d. Chamber air velocity versus time data.

e. Sand and dust compositions.

f. Sand and dust concentrations.

g. Results of inspection of detector kit inner surfaces and components for deterioration and sand and/or dust penetration.

h. Detector kit sampler inspection times.

i. Descriptions of all observed sampler defects. Photographs, with metric scale, will be provided if necessary to clarify descriptions.

j. Chemical agent sensitivity test conditions: (1) CDT test conditions; (2) agent; (3) agent concentration in vapor or water, or agent contamination density on material surface; and (4) type of material (wood, soil, concrete, glass, etc.), if applicable.

k. Sampler exposure times.

l. Operator and observer response analyses (positive, negative, or uncertain).

m. Operator and observer response analysis times.

n. True analyses (positive or negative).

o. Category of operator and observer response analyses (correct, chemical failure, physical failure, or operational failure).

p. Laboratory control data.

5.6.2.11 Leakage (Immersion) Test.

a. Detector kit identification numbers.

b. Detector kit initial temperature.

c. Water initial temperature.

d. Depth of immersion.

e. Duration of immersion.

f. Results of inspection of detector kit inner surfaces and components for water penetration, corrosion, and deterioration.

g. Detector kit sampler inspection times.

h. Descriptions of all observed sampler defects. Photographs, with metric scale, will be provided if necessary to clarify descriptions.

i. Chemical agent sensitivity test conditions: (1) CDT test conditions; (2) agent; (3) agent concentration in vapor or water, or agent contamination density on material surface; and (4) type of material (wood, soil, concrete, glass, etc.), if applicable.

j. Sampler exposure times.

k. Operator and observer response analyses (positive, negative, or uncertain).

l. Operator and observer response analysis times.

m. True analyses (positive or negative).

n. Category of operator and observer response analyses (correct, chemical failure, physical failure, or operational failure).

o. Laboratory control data.

5.7 Operation with Arctic and CB Protective Clothing.

5.7.1 Method.

SOMTE personnel wearing arctic clothing with CB protective masks, hoods, impermeable glove liners, and overgarments will perform all tests for which the kit has a detection capability. Each person will have been trained IAW the procedures in Paragraph 5.3. Positive and negative response tests will be performed during day and night conditions. The number of replicate trials to be performed for each sensitivity test will be determined from the specified reliability and confidence level requirements. The test chamber will be maintained at a constant temperature of -31°C. At the end of the test, the observers will be asked a series of questions designed to provide information on the readability of the kit instruction cards while wearing a CB protective mask; the compatibility of the detector kit with arctic and CB protective clothing; use of the detector kit during night conditions; and the ease of handling kit components, performing tests, and interpreting results. The questionnaire and interview will be prepared and administered IAW TECOM Pamphlet 602-1[21].

5.7.2 Data Required.

a. Detector kit and sampler identification numbers.

b. Test conditions: temperature, chemical agent, type of sample (vapor, water, or surface-contact), and type of material contacted (wood, soil, concrete, glass, etc.), if applicable.

c. Sample inspection times.

d. Description of all observed sampler defects. Photographs, with metric scale, will be provided if necessary to clarify descriptions.

e. Light conditions (daylight, flashlight, or night).

f. Sampler exposure times.

g. Operator and observer response analyses (positive, negative, or uncertain).

h. Operator and observer response analysis times.

i. True analyses (positive or negative).

j. Category of operator and observer response analyses (correct, chemical failure, physical failure, or operational failure).

k. Human factors interview and questionnaire data.

l. Laboratory control data.

5.8 NBC Contamination Survivability.

5.8.1 Method.

Test will be conducted IAW the procedures in TOP 8-2-111.[4] Characteristics of NBC contamination survivability to be determined are defined as follows:

a. Decontaminability. Capability of being rapidly decontaminated to reduce the hazard to a negligible level for unprotected persons who operate, maintain, and resupply the material (equipment).

b. Hardness. Capability of withstanding the material-damaging effects of NBC contamination and the procedures and material required to decontaminate the test item. The detector kit must be hardened to ensure that exposure to five contamination/decontamination cycles does not degrade the operational performance of the detector kit more than 20 percent in a 30-day period. The five-cycle requirement is defined as five exposures to one or more contaminants (nuclear, biological, or chemical) and the associated decontaminating procedures. Performance degradation will be determined and compared with the test criteria and required performance characteristics.

c. Compatibility. Capability of being operated, maintained, and resupplied by persons wearing the full NBC protective ensemble in all CDT categories for which the item is designed and for a period specified in the requirements document.

5.8.1.1 Chemical Agent Contamination Survivability. Twelve detector kits will be used in this test. Three detector kits will be tested at standard ambient temperature (25±10°C), three at basic cold conditions, three at basic hot conditions, and three at variable high humidity conditions (Table 1). The test items will be preconditioned in the test chamber a minimum of 12 h before contamination begins. The contamination/decontamination cycle and detector

kit testing will be performed three times. In two of the cycles, the detector kits will be contaminated with chemical agent distilled mustard (HD) and in one cycle with chemical agent thickened soman (TGD).

NOTE: In the NBC contamination survivability subtest, each detector kit will be subjected to five contamination/decontamination cycles (three chemicals, one biological, and one nuclear). Each detector kit will be tested at the same CDT test conditions (standard ambient temperature, basic cold, basic hot, or variable high humidity) in each of the five contamination/decontamination cycles.

Locations identified as likely problem areas for case penetration or decontamination will be tested. A calibrated microsyringe will be used to apply agent to matched pairs of 4.0-$cm^2$ areas on the exterior surfaces of the detector kits. For HD and TGD contamination, two 2-$\mu$L drops will be placed on each 4.0-$cm^2$ area (HD and TGD contamination density approximately equal to 10 g/$m^2$). Detector kits will be aged for 1 h before decontamination begins. During aging, the wind speed at the surfaces of the detector kits will be no greater than 1 m/s. Decontamination will be performed on all exterior surfaces of the detector kits IAW the procedures in the draft TM.

After decontamination, standard detector paper (M8 or equivalent) will be used to sample one of the matched-pair areas on the exterior surfaces of the detector kits for the presence of chemical agent contamination. Completeness of decontamination will also be measured by swab sampling each of the other matched-pair areas and assaying the swab samples IAW the appropriate laboratory SOP. Vapor hazard sampling will be performed with appropriate sampling equipment (chemical bubblers, HYFEDs, MIRANs™, etc.). Laboratory controls will be used to ensure the required sensitivity and reliability of agent detection.

Detector paper and swab samples will be used to sample the interior surfaces and contents of the detector kits for chemical agent. Matched pair areas, 4.0 $cm^2$ each, located near likely places of agent penetration, will be identified and numbered. Sampling and assaying will be performed as described for the exterior surfaces of the detector kits.

After each contamination/decontamination cycle, the detector kits will be inspected for deterioration and tested for agent sensitivity capability (as described in Paragraph 5.4.1). All tests, for which the kit provides a detection capability, will be performed. Tests will be performed by persons wearing the full CB protective ensemble. The CDT test conditions for the agent sensitivity tests for each kit will be the same as during contamination/decontamination. The number of trials for positive (agent) and negative (blank) response tests will be determined from the specified reliability and confidence level requirements.

5.8.1.2 Biological Agent Contamination Survivability. Twelve detector kits will be used in this test. Three detector kits will be tested at standard ambient temperature, three at basic cold conditions, three at basic hot conditions, and three at variable high humidity conditions (Table 1). Each

detector kit will be contaminated with biological agent simulant Bacillus subtilis var. niger [(Bacillus globigii) (BG)]. The test items to be challenged will be placed in the test chamber and preconditioned a minimum of 12 h before contamination begins.

The exterior of the detector kit will be examined to identify areas likely to allow BG penetration or to present decontamination problems. A series of areas, 4.0 $cm^2$ each, will be selected and numbered. Each 4.0-$cm^2$ area will be inoculated with 400 BG colony-forming units (CFUs) (a contamination density equal to $1 \times 10^6$ BG CFU/$m^2$). Inoculation of culture plates will also be performed to provide contamination density control data for the inoculation technique.

Detector kits will be aged for 1 h before decontamination begins. During aging, the wind speed at the surfaces of the detector kits will be no greater than 1 m/s. Decontamination will be performed on all exterior surfaces of the detector kits IAW the procedures in the draft TM.

After completion of the decontamination procedures, swab samples will be taken from the sampling areas on the exterior and interior surfaces of the detector kits. The swab samples will be identified and assayed IAW the appropriate laboratory SOP.

After each contamination/decontamination cycle, the detector kits will be inspected for deterioration and tested for agent sensitivity capability (as described in Paragraph 5.4.1). All tests, for which the kit provides a detection capability, will be performed. Tests will be performed by persons wearing the full CB protective ensemble. The CDT conditions for the agent sensitivity tests for each kit will be the same as during contamination/ decontamination. The number of trials for positive (agent) and negative (blank) response tests will be determined from the specified reliability and confidence level requirements.

5.8.1.3 Nuclear Fallout Material Contamination Survivability. Twelve detector kits will be used in this test. Three detector kits will be tested at standard ambient conditions, three at basic cold conditions, three at basic hot conditions, and three at variable high humidity conditions (Table 1). FP will be used as the nuclear fallout simulant in this test.

The exterior surfaces of the detector kits will be examined to identify areas likely to allow FP penetration or to present problems of decontamination. Each surface area will be sufficiently large so that it may contain a set of three 2-$cm^2$ FP sampling areas. One 2-$cm^2$ area in each set will be used as a sampling site for measuring FP background contamination, one for FP challenge contamination density, and one for measuring the effectiveness of the decontaminating procedures.

The detector kits to be challenged will be placed in a test chamber and maintained at the specified conditions for at least 12 h before contamination starts. During this time, one 2-$cm^2$ area in each set will be sampled with a 2-$cm^2$ patch of microtiter plate sealing tape. These patch samples will be used to measure the FP background contamination densities.

An FP disseminator will be calibrated to determine the dissemination rate and time required to contaminate the air inside the chamber to a level of approximately 1 x $10^6$ FP particles/L of air. After completion of FP aerosol generation, the chamber air will be sampled for 1 min with 6-L/min membrane filters oriented face-downward. Duplicate samples will be obtained at two sampling stations, one located at the front and one at the rear of the test chamber. The FP aerosol will be allowed to settle (fallout) for 1 h and, at the end of this time, the test chamber will be airwashed for 1 h. The 1-h airwash will also serve as the 1-h aging time. Airwash will be controlled to ensure that the wind speed across the surfaces of the detector kits does not exceed 1 m/s.

Before decontamination starts, a 2-$cm^2$ patch of microtiter tape will be used to sample the second section of each set of FP sampling areas. These patch samples will be used to measure the FP challenge contamination densities. The desired FP challenge contamination level is 2.5 x $10^4$ particles/$cm^2$.

Decontamination will be performed IAW the instructions in the draft TM. The entire surfaces of the detector kits will be decontaminated. FP sampling areas will receive no more or no less attention, time, or effort than other areas not selected for FP sampling. After completion of the decontaminating procedures, the exterior surfaces of the detector kits will be air-dried. When the surfaces are dry, a 2-$cm^2$ patch of microtiter tape will be used to sample the third section of each FP sampling area. These patch samples will be used to measure the effectiveness of the decontaminating procedures.

After the contamination/decontamination cycle, the detector kits will be inspected for evidence of deterioration and tested for agent sensitivity capability (as described in Paragraph 5.4.1). All tests, for which the kit provides a detection capability, will be performed. Tests will be performed by persons wearing the full nuclear protective ensemble. The CDT conditions for the agent sensitivity tests for each kit will be the same as during contamination/decontamination. The number of trials for positive (agent) and negative (blank) response tests will be determined from the reliability and confidence level requirements.

5.8.2 Data Required.

5.8.2.1 Chemical Agent Contamination Survivability.

a. Detector kit and sampler identification numbers.

b. Test conditions: (1) CDT test conditions; (2) agent; (3) agent contamination density; and (4) descriptions of locations of contaminated areas on detector kit. Photographs or diagrams, with metric scale, will be provided if necessary to clarify descriptions.

c. Description of decontaminant used and method of decontamination.

d. Aging time.

e. Vapor and contact hazard sampling results.

f. Detector kit sampler inspection times.

g. Descriptions of all observed detector kit sampler defects. Photographs, with metric scale, will be taken if necessary to clarify descriptions.

h. Detector kit agent sensitivity test results: sampler exposure time, response analyses (positive, negative, or uncertain), and operator and observer response analysis times.

i. True analyses (positive or negative).

j. Category of operator and observer response analyses (correct, chemical failure, physical failure, or operational failure).

k. Laboratory control data.

5.8.2.2 Biological Agent Contamination Survivability. Same as Paragraph 5.8.2.1.

5.8.2.3 Nuclear Fallout Material Contamination Survivability.

a. Detector kit and sampler identification numbers.

b. CDT test conditions (standard ambient temperature, basic cold, basic hot, or variable high humidity).

c. FP particle size distribution data.

d. Total quantity of FP dispensed and the contamination density on the detector kit.

e. Descriptions of sampling areas on each detector kit.

f. Aging time.

g. Description of decontaminant used and method of decontamination.

h. FP contamination densities after decontamination.

i. Detector kit sampler inspection times.

j. Descriptions of all detector kit sampler defects. Photographs, with metric scale, will be provided if necessary to clarify descriptions.

k. Detector kit agent sensitivity test results: sampler exposure time, operator and observer response analyses (positive, negative, or uncertain), and operator and observer response analysis times.

l. True analyses (positive or negative).

m. Category of operator and observer response analyses (correct, chemical failure, physical failure, or operational failure).

n. Laboratory control data.

5.9 Airdrop Delivery.

5.9.1 Method.

One level-A shipping container of packaged detector kits and nine additional packaged detector kits will be used in this test. Before the start of the airdrop tests, all detector kits will be inspected IAW the procedures in Paragraph 5.1.1. Damaged detector kits and samplers will be replaced with undamaged test items. The detector kits will be labeled for identification and the shipping container repackaged to level-A conditions. After repackaging, the shipping container will be rigged for airdrop and airdropped IAW the procedures described in TOP 7-2-509[3]. Two low-velocity (8.7 m/s) and two high-velocity (21.3 to 27.4 m/s) airdrop tests will be conducted. After each airdrop test, the shipping container and packages will be inspected for damage. Any damage to the shipping container and packages will be recorded and photographed, and items will be repaired. After each of the first three airdrop tests, three detector kits will be randomly selected from the undamaged detector kits, removed from the shipping container, and replaced with spare detector kits. The removed detector kits will be tested for chemical agent sensitivity at standard ambient temperature (25±10°C). After completion of the last airdrop test, three detector kits will be randomly selected from the undamaged detector kits and tested for chemical agent sensitivity at standard ambient temperature (25±10°C).

5.9.2 Data Required.

a. Results of pretest inspection of detector kits.

b. Detector kit identification numbers.

c. Rigging test:

(1) Type of container and parachute.

(2) Weight of container and load.

(3) Dimensions of load configuration.

(4) Number of shipping containers in load configuration. (NOTE: Load complement may include shipping containers filled with weight ballast.)

(5) Number of load spreaders required.

(6) Number of skid loads required.

(7) Amount of energy dissipater (honeycomb) required.

(8) Type of overpack and ballast.

(9) Materials-handling equipment.

(10) Type of aircraft used.

(11) Description(s) of damage, if any, sustained by the load during movement from the rigging area to the aircraft, loading aboard the aircraft, and during flight. Photographs, with metric scale, will be taken if necessary to clarify descriptions.

(12) Type of tie-down devices and other restraints.

d. Airdrop tests:

(1) Type of drop.

(2) Method of extraction for each load.

(3) Meteorological conditions at time of release.

(4) Location of each force-measuring and shock-recording instrument used for each airdrop.

(5) Extraction velocity (relative to delivery aircraft).

(6) Peak acceleration and impact velocity of each load.

(7) Photographic coverage of load from release to impact and immediately after impact.

(8) Description of terrain at impact site, including slope, vegetation, soil type, and soil firmness.

(9) Description(s) of damage to shipping container and detector kits. Photographs, with metric scale, will be taken if necessary to clarify description(s).

e. Chemical agent sensitivity test:

(1) Detector kit sampler inspection times.

(2) Descriptions of all observed sampler defects. Photographs, with metric scale, will be taken if necessary to clarify descriptions.

(3) Test conditions: CDT test conditions; agent; agent concentration in vapor or water, or agent contamination density on material surface; and type of material (wood, soil, concrete, glass), if applicable.

(4) Sampler exposure times.

(5) Operator and observer response analyses (positive, negative, or uncertain).

(6) Operator and observer response analysis times.

(7) True analyses (positive or negative).

(8) Category of operator and observer response analyses (correct, chemical failure, physical failure, or operational failure).

(9) Laboratory control data.

5.10 Battlefield Interferents/Contaminants.

5.10.1 Method.

An interferent is a substance that when present with a chemical agent at or above the minimum detectable level causes a false negative when otherwise a true positive would have resulted. A contaminant is a substance that when present in the absence of chemical agent or the presence of chemical agent at the blank level causes a false positive when otherwise a true negative would have resulted. It is conceivable that a single substance could be both an interferent and a contaminant. For this reason, all substances listed in Table 4 will be tested as both a potential interferent and a potential contaminant.

Interferents will be tested to the extent possible under laboratory conditions with chemical agents. All interferents will be tested under field conditions with all chemical agent simulants. All contaminants tested when a blank level of chemical agent is present will be tested to the extent possible under laboratory conditions. All contaminants will be test under field conditions. For those field tests requiring the presence of a blank level of chemical agent, an appropriate chemical agent simulant will be used.

The operators and observers performing this test will wear the CB protective clothing required for operation of the detector kit and for protection against exposure to the battlefield interferent/contaminants. The operators will work independently and interpret the responses independently. In addition, the responses will be analyzed and recorded independently by an observer. All tests, for which the kit has a detection capability, will be performed by each operator in the presence of the potential battlefield interferent/contaminant. Tests will be performed at standard ambient temperature (25±10°C). The number of replicate trials to be performed for positive and negative response tests will be based on the specified reliability and confidence level requirements.

Procedures for testing the detector kit in the presence of potential battlefield interferents/contaminants are described in Table 4. The field tests will not be conducted during precipitation, or with wind speeds greater than 4.4 m/s. Before each test begins, the samplers will be inspected for physical defects IAW the procedures in Paragraph 5.4.1.3.

5.10.2 Data Required.

a. Type of test (chemical agent, chemical agent simulant, or blank).

b. Potential battlefield interferent/contaminant.

Table 4. Procedures for Testing the Chemical Agent Detector Kit in the Presence of Potential Battlefield Interferents/Contaminants.

| Battlefield Interferent/Contaminant | Test Procedure[a,b] |
|---|---|
| Burning brush and rubbish | Test under inversion conditions in the path of the smoke. |
| Exhaust fumes:<br>a. Gasoline<br>b. Diesel fuel<br>c. Jet fuel | Test 5 m downwind from the exhaust of two parked vehicles with their engines running. If exhaust interferes, conduct test at 10 m downwind. Repeat until exhaust does not interfere. |
| Decontaminants:<br>a. Supertropical bleach (STB)<br>b. High-test hypochlorite (HTH)<br>c. Calcium hypochlorite<br>d. Sodium hydroxide<br>e. Decontaminating solution number 2 (DS2)<br>f. Soapy water<br>g. Diesel fuel<br>h. Formalin solution | (1) Test 5 m downwind from shallow pan containing a decontaminant. If decontaminant interferes, conduct test at 10 m downwind. Repeat until decontaminant does not interfere.<br>(2) Expose detector kit to decontaminant fumes for 1 h. Perform agent sensitivity tests. |
| Riot control agent (CS2) | Test under inversion conditions 25 m downwind from two burning grenades. |
| Fumes from explosives:<br>a. Trinitrotoluene (TNT)<br>b. Small arms powder<br>c. Artillery propellant<br>d. Solid rocket propellant | Test under inversion conditions 25 m downwind from 454 g of detonated explosive. |
| Fuel vapor:<br>a. Gasoline<br>b. Diesel fuel<br>c. Kerosene<br>d. Motor oil<br>e. Antifreeze<br>f. Jet fuel | Expose detector kit to fuel vapor for 1 h. Perform agent sensitivity tests. |
| Smoke:<br>a. Hexachloroethane (HC) mixture<br>b. White phosphorus (WP)<br>c. Fog oil<br>d. Red signaling smoke<br>e. Green signaling smoke<br>f. Yellow signaling smoke<br>g. Violet signaling smoke | Test under inversion conditions 25 m downwind from burning grenades or thermally generated fog oil smoke. |

Table 4. Procedures for Testing the Chemical Agent Detector Kit in the Presence of Potential Battlefield Interferents/Contaminants (Cont'd).

| Battlefield Interferent/Contaminant | Test Procedure[a,b] |
|---|---|
| Decomposing waste | Test within 1 m of dead animals and human waste. |
| Insecticide | Test in path of spray from aerosol can (within 0.5 m of aerosol can). |

[a] Contact samplers will be used on appropriate materials (wood, soil, metal, glass, etc.).
[b] Where safety prohibits simultaneous exposure of the sampler to the chemical agent simulant and the potential battlefield interferent/contaminant, the sampler will be placed on a stake positioned to ensure exposure to the potential battlefield interferent/contaminant. Immediately after exposure to the battlefield interferent/contaminant, the sampler will be tested with the appropriate chemical agent simulant.

c. Type of material contacted with sampler, if applicable.

d. Descriptions of all observed sampler defects. Photographs, with metric scale, will be taken if necessary to clarify descriptions.

e. Sampler exposure times.

f. Operator and observer sampler response analyses (positive, negative, or uncertain).

g. Operator and observer response analysis times.

h. True analyses (positive or negative).

i. Category of operator and observer response analyses (correct, chemical failure, physical failure, or operational failure).

j. Laboratory control data.

5.11 Logistic Supportability Analysis.

5.11.1 Method.

Basic guidance for conducting logistic supportability testing is in TECOM Supplement 1 to AMC Regulation 700-15[17]. It outlines the elements that would generally cover logistic supportability testing. This outline must be tail-

ored to fit the test being conducted and the test item being analyzed. The IAP or test planning directive prepared by TECOM Headquarters will indicate the scope of logistic supportability testing to be conducted.

NOTE: Detector kits are usually expendable items requiring no logistic supportability analysis other than analysis of the adequacy of the draft TM.

5.11.2 Data Required.

Appendix E, TECOM Supplement 1 to AMC Regulation 700-15[17] provides lists of required data for the elements of logistic supportability. These lists must be tailored to fit the test being conducted and the test item being analyzed.

5.12 Human Factors Engineering (HFE) Analysis.

5.12.1 Method.

Basic guidance for conducting HFE testing is in TECOM Supplement 1 to AR 602-1[22]. It outlines the following elements that would generally cover HFE testing and analysis. Primary emphasis is placed on testing and analyzing the effectiveness and degree of safety with which the test item can be operated, maintained, and transported by users in the designated environment. The primary methods of analysis include observations and measurements, questionnaires and interviews, and HFE analysis.

5.12.1.1 Human Factors Initial Inspection and Analysis. Start every HFE subtest with a preliminary inspection and analysis of the detector kit. The project officer or human factors engineer should attempt to perform the required tasks, using specially prepared checklists to analyze the aspects of the detector kit design and operation that may affect performance and safety. The checklists for this initial inspection should be developed from procedures and data in the draft TM and in TOP 1-2-610[23].

5.12.1.2 Observation and Measurement of Task Performance. The project officer, human factors engineer, and/or observer/recorder will observe SOMTE personnel in the pretest inspection, sampler preparation, and response testing of the detector kit during actual or simulated item use conditions. To standardize observations, a human factors checklist of required tasks will be used to provide an orderly means of collecting data. The purpose of these measurements is to acquire data on human performance reliability in terms of the types of errors, error rates, and performance times. The information obtained by the checklist will be summarized for incorporation in the final or test report. A separate error report (see sample format in Section II, TECOM Supplement 1 to AR 602-1[22]) will be prepared based on error-likelihood analysis. This form will be used to describe all test participant errors that occurred during preparation, operation, and maintenance (if applicable) of the detector kit. Descriptions of conditions under which errors occurred and the consequences of each type of error will be included in the error report. These data will be used to determine the severity of each type of error and will be assessed and classified in terms of the following:

a. Hazardous to people.

b. Degrades item performance.

c. Degrades component performance.

d. No effect on item performance.

5.12.1.3 Questionnaire and Interview of Test Participants. Subjective opinions of people who operate and maintain the detector kit will be collected by use of a structured interview, questionnaire, or both. TECOM Pamphlet 602-1[21] will be used as a guide for preparing and administering interviews and questionnaires.

5.12.1.4 Measurement and Recording. Preparation for obtaining quantitative data on such factors as lighting, temperature, humidity, visibility, workspace, and force/torque will include development of data collection forms for recording data. The forms will provide spaces for entries of all readings taken.

5.12.1.5 Environmental Considerations. Environmental effects will be measured and analyzed in terms of the following:

a. Compatibility of CB protective and environmental clothing and detector kit that may affect the mobility, reach, workspace, vision, and dexterity of test participants preparing, operating, and maintaining the detector kit.

b. Reduced human performance (conditions that impair the ability of the test participant to perform accurately and effectively).

c. Conditions that contribute to increased operating maintenance time, errors, or degradation in task performance.

d. Human or detector kit safety.

5.12.2 Data Required.

NOTE: The required data for HFE analysis will include completed checklists and questionnaires, results of interviews, narrative descriptions, photographs (with metric scale), charts, sketches, and other information as appropriate for the detector kit under consideration.

5.12.2.1 Human Factors Initial Inspection and Analysis. Record appropriate HFE data for the following:

a. Uncrating or unpacking.

b. Chemical hazards checklist.

c. Physiological hazards checklist.

d. Item preparation checklist.

e. Item operation checklist.

f. Item maintenance checklist.

g. Item malfunctions, failures, and accidents.

h. Special handling requirements.

i. Warning labels.

j. Instructional material and draft TM.

5.12.2.2 Observation and Measurement of Task Performance. Record appropriate HFE data for items a through j above and the following:

a. Anthropometric and demographic data for SOMTE participants.

b. Results of questionnaires and interviews.

c. Error reports.

5.12.2.3 Measurement and Recording. Record appropriate HFE data for the following:

a. Lighting.

b. Temperature and humidity.

c. Visibility.

d. Workspace.

e. Force/torque.

5.12.2.4 Environmental Considerations. Record appropriate HFE data for the following:

a. Climatic conditions.

b. Terrain conditions.

c. Compatibility of CB protective and environmental clothing and equipment with task performance.

d. Conditions that impair test participant's ability to perform accurately and effectively.

e. Conditions that contribute to increased operating and maintenance time, errors, or degradation in task performance.

6. PRESENTATION OF DATA.

6.1 Receipt Inspection.

a. Present a description of the level-A shipping container, including type of material, means of closure, dimensions, and weight. State whether identification markings and storage and unpacking instructions were present or absent. If present, state whether markings and instructions were adequate or inadequate. Describe inadequacies, if applicable. Use photographs (with metric scale) to document illegible markings, instructions, and warning labels. Describe type and condition of blocking, bracing, and/or cushioning material.

b. Prepare a table showing the number of shipping containers received, type of shipping container (level-A or nonlevel-A), and the number of detector kits per shipping container. Describe the condition of the shipping containers upon receipt. Use photographs, with metric scale, to document any damage or deterioration.

c. Take photographs, with metric scale, of a typical level-A shipping container.

d. Prepare a table showing detector kit identification [national stock number (NSN), nomenclature, lot number, manufacturer, and expiration date].

e. Describe condition of detector kits and their contents. Use photographs, with metric scale, to document any evidence of damage or deterioration. State whether identification markings and expiration dates on kit components were present or absent. State whether instruction card was present or absent. If present, state whether identification markings, expiration dates, and instructions were legible and accurate. Describe inaccuracies. Use photographs, with metric scale, to document inaccuracies and illegible markings, expiration dates, and instructions.

f. Provide a list of components given in the BIIL and SSP but not present upon receipt.

g. Provide a list of shortages.

h. Take photographs, with metric scale, of a typical detector kit and its components.

6.2 Safety Analysis.

a. Describe each safety and health hazard identified during any test. Describe the human error, environmental conditions, design inadequacies, procedural deficiencies, component malfunctions, and/or other factors that are directly or indirectly associated with each hazard.

b. Describe the effects of each hazard, if applicable, and all potential consequences.

c. Assign the proper hazard level to each hazard IAW the hazard-severity categories of MIL-STD-882A[16].

d. Prepare and submit a recommendation for safety releas to TECOM Headquarters IAW TECOM Supplement 1 to AR 385-16[12].

e. Provide suggested safety improvements and, if applicable, describe equipment, procedures, or other control measures that exist or can be implemented to prevent the actual or potential hazard(s).

6.3 Operator Training and Familiarization.

a. Present results of questionnaires and interviews of test participants. Analyze results and determine the following:

(1) Adequacy of the NET.

(2) Suitability of the draft TM for training.

(3) Accuracy, completeness, and clarity of the draft TM and the detector kit and TRAINS operating instruction cards.

(4) Readability of detector kit and TRAINS operating instruction cards while operator is wearing a CB protective mask.

(5) Compatibility of detector kit and TRAINS with CB protective and arctic clothing.

(6) Ease of handling kit samplers, performing tests, and interpreting results.

(7) Adequacy and ease of use of the detector kit and TRAINS at night and during basic cold temperature conditions.

(8) Adequacy of decontamination and maintenance instructions and procedures.

b. Provide tables summarizing times required to perform each sensitivity test during day and night conditions at standard ambient and basic cold temperatures.

c. Describe procedural and incipient operator errors, if applicable.

d. Provide suggested improvements, if applicable.

6.4 Initial Performance.

a. Prepare a table summarizing the times required to perform pretest inspection of each set of detector kit samplers.

b. Describe all observed sampler defects. Photographs, with metric scale, will be provided if necessary to clarify descriptions.

c. Prepare tables showing the results of the agent sensitivity tests. In each table, provide the following information:

(1) Detector kit and sampler identification numbers.

(2) Type of sampler.

(3) Type of chemical agent or chemical agent simulant.

(4) Type of response test (positive, negative, or blank).

(5) CDT test conditions (standard ambient temperature, basic cold, basic hot, or variable high humidity).

(6) Agent concentration or contamination density.

(7) Types of material contaminated, if applicable.

(8) Sampler exposure times.

(9) Operator and observer response analyses.

(10) Operator and observer response analysis times.

(11) True analyses.

(12) Category of operator and observer response analyses.

d. Provide color photographs, with metric scale, of typical sampler responses.

6.5 Accelerated Packaged Storage and Sequential Rough Handling.

a. Prepare a table showing detector kit identification numbers and histories, and a summary of posttest inspection.

b. Prepare tables and/or graphs summarizing the temperature versus time data obtained from monitoring the chambers during test item storage.

c. Prepare a table and/or graph summarizing the relative humidity versus time data obtained from monitoring the chambers during test item storage.

d. Prepare tables and/or graphs showing pressure versus time data, temperature versus time data, and relative humidity versus time data obtained from monitoring the chamber in the low pressure test.

e. Describe the vibration test apparatus, the axes of exposure of the shipping containers, and the locations of the accelerometers on the shipping containers. Use photographs, with metric scale, if necessary to clarify descriptions.

f. Prepare a table and/or graph showing the vibration spectrum and intensity and the duration of exposure of the shipping containers.

g. Prepare tables and/or graphs showing the temperature versus time and relative humidity versus time data obtained during the vibration tests.

h. Describe the drop test apparatus and list height of drops, drop surfaces, and number of drops per detector kit.

i. Present results of posttest inspection. Use photographs (with metric scale), narrative comments, and other suitable means to report evidence of damage and deterioration of shipping containers and detector kits resulting from accelerated packaged storage and sequential rough handling.

j. Prepare a table summarizing the detector kit sampler inspection times.

k. Describe all observed sampler defects. Use photographs, with metric scale, if necessary to clarify descriptions.

l. Prepare tables showing the results of the agent sensitivity tests. In each table, provide the following information:

(1) Detector kit and sampler identification numbers.

(2) Detector kit history.

(3) Type of sampler.

(4) Type of chemical agent.

(5) Type of response test (positive, negative, or blank).

(6) CDT test conditions (standard ambient temperature, basic cold, basic hot, or variable high humidity).

(7) Agent concentration or contamination density.

(8) Types of material contaminated, if applicable.

(9) Sampler exposure times.

(10) Operator and observer response analyses.

(11) Operator and observer response analysis times.

(12) True analyses.

(13) Category of operator and observer response analyses.

6.6 Adverse Environments.

For each adverse environment test, perform the following:

a. Prepare a table showing detector kit identification numbers and a summary of posttest inspection results.

b. Describe all observed damage and deterioration of shipping containers (if applicable) and detector kits. Use photographs, with metric scale, if necessary to clarify descriptions.

c. Prepare tables and/or graphs summarizing the required adverse environments data in Paragraph 5.6.2.

d. Prepare a table summarizing the detector kit sampler inspection times.

e. Describe all observed sampler defects. Use photographs, with metric scale, if necessary to clarify descriptions.

f. Prepare tables showing the results of the agent sensitivity tests. Provide the following information in each table.

(1) Detector kit and sampler identification numbers.

(2) Type of sampler.

(3) Type of chemical agent.

(4) Type of response test (positive, negative, or blank).

(5) CDT test conditions (standard ambient temperature, basic cold, basic hot, or variable high humidity).

(6) Agent concentration or contamination density.

(7) Types of material contaminated, if applicable.

(8) Sampler exposure times.

(9) Operator and observer response analyses.

(10) Operator and observer response analysis times.

(11) True analyses.

(12) Category of operator and observer response analyses.

6.7 Operation with Arctic and CB Protective Clothing.

a. Prepare tables showing the results of the agent sensitivity tests. Provide the following information in each table.

(1) Detector kit and sampler identification numbers.

(2) Type of sampler.

(3) Type of chemical agent.

(4) Type of response test (positive, negative, or blank).

(5) Light conditions (daylight, night, or flashlight).

(6) Chemical agent simulant concentration or contamination density.

(7) Types of material contaminated, if applicable.

(8) Sampler exposure times.

(9) Operator and observer response analyses.

(10) Operator and observer response analysis times.

(11) True analyses.

(12) Category of operator and observer response analyses.

b. Prepare a table summarizing the results of questionnaires and interviews concerning human factor aspects of operation with arctic and CB protective clothing.

6.8 NBC Contamination Survivability.

6.8.1 Chemical Agent Contamination Survivability.

a. Prepare tables containing the following information on chemical contamination:

(1) Identification numbers of detector kits contaminated with chemical agent.

(2) CDT test conditions (standard ambient temperature, basic cold, basic hot, or variable high humidity).

(3) Chemical agent used to contaminate the detector kits.

(4) Chemical agent contamination density.

b. Describe the locations of the contaminated sampling areas on the exterior surfaces of the detector kit and the sampling areas inside the detector kit (used to measure case penetration and permeability). Use photographs or diagrams, with metric scale, if necessary to clarify descriptions.

c. For each chemical agent type, describe the decontaminant used and the method of decontamination. Specify the time allowed for aging.

d. Prepare tables showing vapor and contact hazard sampling results.

e. Prepare a table showing detector kit sampler inspection times.

f. Describe all detector kit sampler defects. Use photographs, with metric scale, to document any evidence of damage or deterioration.

g. Prepare tables showing the results of the agent sensitivity tests. Provide the following information in each table.

(1) Detector kit and sampler identification number.

(2) Type of sampler.

(3) Type of chemical agent.

(4) Type of response test (positive, negative or blank).

(5) CDT test conditions (standard ambient temperature, basic cold, basic hot, or variable high humidity).

(6) Agent concentration or contamination density.

(7) Types of material contaminated, if applicable.

(8) Sampler exposure times.

(9) Operator and observer response analyses.

(10) Operator and observer response analysis times.

(11) True analyses.

(12) Category of operator and observer response analyses.

6.8.2 Biological Agent Contamination Survivability.

Same as Paragraph 6.8.1.

6.8.3 Nuclear Fallout Material Contamination Survivability.

a. Prepare tables containing the following information on nuclear fallout material contamination:

(1) Identification numbers of detector kits contaminated with nuclear fallout material.

(2) CDT test conditions (standard ambient temperature, basic cold, basic hot, or variable high humidity).

(3) FP particle size distribution data.

(4) Total quantity of FP dispensed.

(5) FP contamination density on detector kits.

b. Describe the decontaminant used and the method of decontamination. Specify the time allowed for aging.

c. Prepare tables showing the number of FP particles on the exterior surfaces of the detector kits after completion of the decontamination procedure.

d. Prepare a table showing the detector kit sampler inspection times.

e. Describe all detector kit sampler defects. Use photographs, with scale, to document any evidence of damage or deterioration.

f. Prepare tables showing the results of the agent sensitivity tests. Provide the following information in each table.

(1) Detector kit and sampler identification numbers.

(2) Type of sampler.

(3) Type of chemical agent.

(4) Type of response test (positive, negative or blank).

(5) CDT test conditions (standard ambient temperature, basic cold, basic hot, or variable high humidity).

(6) Agent concentration or contamination density.

(7) Type of material contaminated, if applicable.

(8) Sampler exposure times.

(9) Operator and observer response analyses.

(10) Operator and observer response analysis times.

(11) True analyses.

(12) Category of operator and observer response analyses.

6.9 Airdrop Delivery.

a. Prepare a table showing the detector kit identification numbers and the results of pretest inspection. Use photographs, with metric scale, to document any evidence of damage or deterioration.

b. Prepare a table showing all pertinent rigging test data for each airdrop test.

c. Provide photographs, with metric scale, of the rigged shipping container and load configuration.

d. Describe any damage sustained by the load during the rigging test. Use photographs, with metric scale, to document any evidence of damage.

e. Prepare a table showing the test conditions for each airdrop test (aircraft type, altitude, heading, and speed; meteorological conditions; type of rigging used; type and location of sensors on load; type and location of telemetry equipment; and a description of the terrain at the impact site).

f. Reduce, analyze, and summarize the telemetry data. Present results in tables and graphs.

g. Describe any damage sustained by the load during the airdrop test. Use photographs, with metric scale, to document any evidence of damage.

h. Describe all detector kit sampler defects. Use photographs, with metric scale, to document any evidence of damage or deterioration.

i. Prepare tables showing the results of the agent sensitivity tests. Provide the following information in each table:

(1) Detector kit and sampler identification numbers and history.

(2) Type of sampler.

(3) Type of chemical agent.

(4) Type of response test (positive, negative or blank).

(5) Agent concentration or contamination density.

(6) Type of material contaminated, if applicable.

(7) Sampler exposure times.

(8) Operator and observer response analyses.

(9) Operator and observer response analysis times.

(10) True analyses.

(11) Category of operator and observer response analyses.

6.10 Battlefield Interferents/Contaminants.

a. Prepare a table listing the potential battlefield interferents/contaminants used, test procedures (methods of sampler exposure), and pertinent test conditions (temperature, relative humidity, wind speed, meteorological stability category, etc.).

b. Prepare a table showing the results of pretest inspection. Describe all detector kit sampler defects. Use photographs, with metric scale, to document any evidence of damage or deterioration.

c. Prepare a table showing the results of the agent sensitivity tests. In each table, provide the following information:

(1) Detector kit and sampler identification numbers.

(2) Potential battlefield interferent/contaminant.

(3) Type of sampler.

(4) Type of chemical agent or chemical agent simulant.

(5) Type of response test (positive, negative, or blank).

(6) Chemical agent or chemical agent simulant concentration or contamination density.

(7) Type of material contaminated, if applicable.

(8) Sampler exposure times.

(9) Operator and observer response analyses.

(10) Operator and observer response analysis times.

(11) True analyses.

(12) Category of operator and observer response analyses.

6.11 Logistic Supportability Analysis.

Prepare tables, graphs, charts, and other suitable forms of data presentation for the applicable required data in Appendix E of TECOM Supplement 1 to AMC Regulation 700-15[17]. Determine the required maintenance parameters IAW the instructions and formulae of Appendix E of TECOM Supplement 1 to AMC Regulation 700-15[17]. Analyze, summarize, and discuss test results, comments, and questionnaire responses. Provide suggested improvements, if applicable. Inadequacies or suggested improvements to equipment publications will be reported on DA Form 2028 or instructional material adequacy guide and evaluation standards (IMAGES) forms, if IMAGES are used.

6.12 Human Factors Engineering Analysis.

6.12.1 Human Factors Initial Inspection and Analysis.

Present results of inspection and analysis for HFE checklists given in Paragraph 5.12.2.1. Identify HFE design characteristics, maintenance and operating procedures, and interface problems that may have an adverse effect on system performance and safety.

6.12.2 Observation and Measurement of Task Performance.

Present observations and measurements in tables, error reports, graphs, and other suitable forms of presentation. Summarize and discuss results regarding compatibility, safety, ease of task performance, and acceptability. Determine system (soldier-test item) performance in terms of operating and maintenance times, accuracy, and other appropriate measures of performance.

6.12.3 Questionnaire and Interview of Test Participants.

Present results of questionnaires and interviews of test participants. Analyze results and determine the adequacy of the NET, training aids, TMs, and operating and maintenance procedures. Provide a summary of comments and suggested improvements.

6.12.4 Measurements and Recording.

Provide tables, charts, graphs, photographs, and other suitable forms of presentation of measurements and information obtained during HFE testing. Reduce data, analyze, and determine whether factors (lighting, noise, etc.) constitute operational or health hazards.

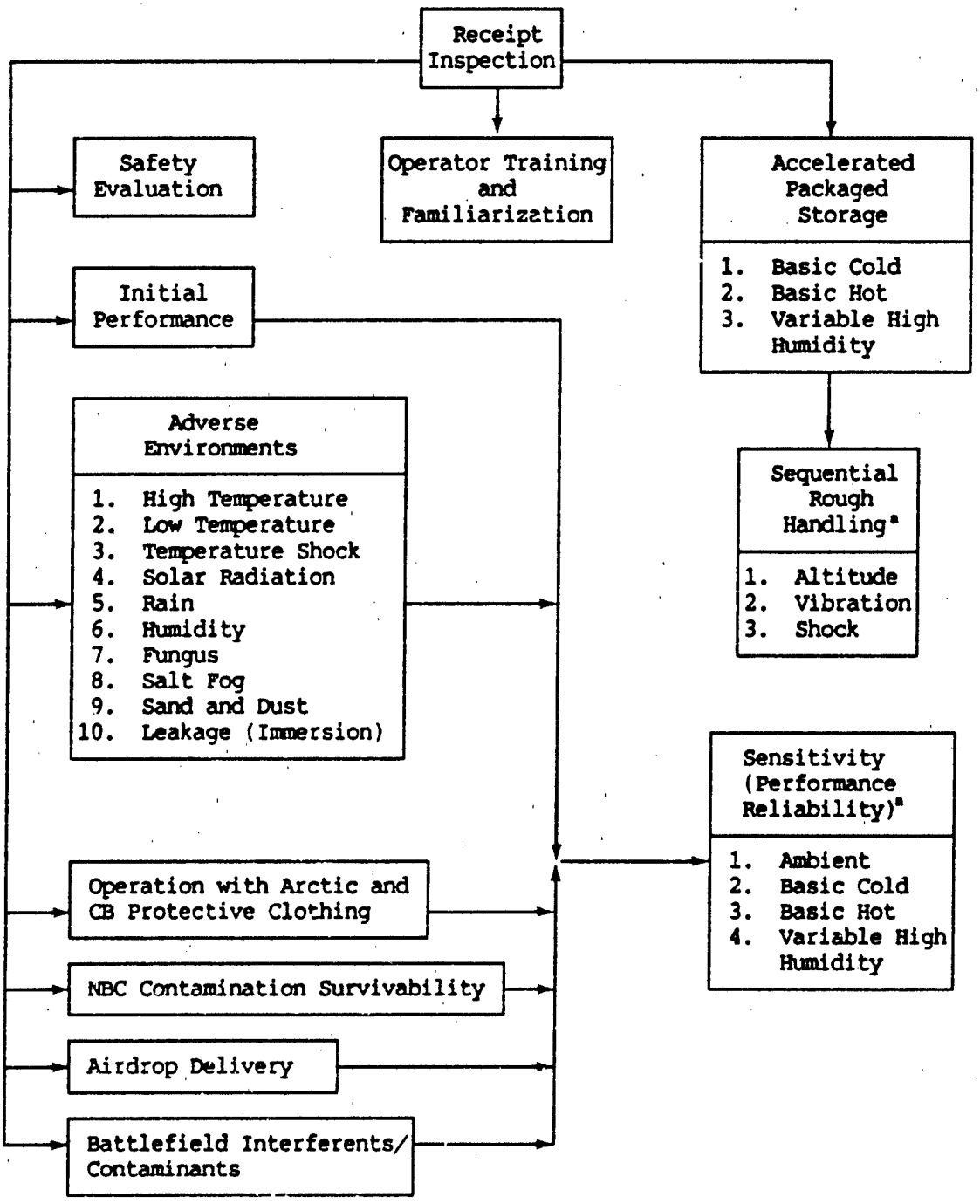
6.12.5 Environmental Considerations

Provide tables, graphs, charts, narrative descriptions, and photographs of climate and terrain conditions. Analyze data and determine whether environmental elements adversely affect performance by introducing physiological stresses. Determine whether CB and environmental protective clothing and equipment are compatible with task performance.

Forward comments, recommended changes, or any pertinent data that may be of use in improving this publication to Commander, U.S. Army Test and Evaluation Command, ATTN: AMSTE-TC-M, Aberdeen Proving Ground, MD 21005-5055. Technical information may be obtained from the preparing activity: Commander, U.S. Army Dugway Proving Ground, ATTN: STEDP-MT-TM-CB, Dugway, UT 84002-5000. Additional copies are available from the Defense Technical Information Center, Cameron Station, Alexandria, VA 2304-6145. This document is identified by the accession number (AD No.) printed on the first page.

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# APPENDIX A. TEST FLOW




[a]See Table A.1.

Figure A.1. Test Flow Diagram for Chemical Agent Detector Kits.

Table A.1. Test Conditions and/or Climatic Category for Chemical Agent Detector Kit Treatment and Sensitivity Tests.

| Performance Test | Treatment | Test Conditions and/or Climatic Category[a] | |
|---|---|---|---|
| | | During Treatment | During Agent Sensitivity Test |
| Initial Performance | None | Not Applicable | Standard Ambient Temperature[b] |
| | | | Basic Cold |
| | | | Basic Hot |
| | | | Variable High Humidity |
| Adverse Environments | High Temperature | MIL-STD-810,[c] Method 501.2, Procedure I, Table 501.2-II Induced | Basic Hot |
| | Low Temperature | MIL-STD 810, Method 502.2, Procedure I, -31°C | Basic Cold |
| | Temperature Shock | MIL-STD-810, Method 503.2, Procedure I | Basic Hot |
| | Solar Radiation (Sunshine) | MIL-STD-810, Method 505.2, Procedure I | Basic Hot |
| | Rain | MIL-STD-810, Method 506.2, Procedure I | Variable High Humidity |
| | Fungus | MIL-STD-810, Method 508.3 | Variable High Humidity |

Table A.1. Test Conditions and/or Climatic Category for Chemical Agent Detector Kit Treatment and Sensitivity Tests (Cont'd).

| Performance Test | Treatment | Test Conditions and/or Climatic Category[a] | |
|---|---|---|---|
| | | During Treatment | During Agent Sensitivity Test |
| | Salt Fog | MIL-STD-810, Method 509.2 | Variable High Humidity |
| | Sand and Dust | MIL-STD-810, Method 510.2, Procedure I, and II | Basic Hot |
| | Leakage | MIL-STD-810, Method 512.2, Procedure I | Variable High Humidity |
| Operations with Arctic and CB Protective Clothing | Operations with Arctic and CB Protective Clothing | Basic Cold | Basic Cold |
| NBC Contamination Survivability | NBC Contamination/ Decontamination | Standard Ambient Temperature, Basic Cold, Basic Hot, and Variable High Humidity | Standard Ambient Temperature, Basic Cold, Basic Hot, and Variable High Humidity |
| Airdrop Capability | Packaged Airdrop | See TOP 7-2-509[d] | Standard Ambient Temperature |
| Battlefield Interferents/ Contamination | Interference/ Contamination | Standard Ambient Temperature | Standard Ambient Temperature |

Table A.1. Test Conditions and/or Climatic Category for Chemical Agent Detector Kit Treatment and Sensitivity Tests (Cont'd).

| Performance Test | Treatment | Test Conditions and/or Climatic Category[a] | |
|---|---|---|---|
| | | During Treatment | During Agent Sensitivity Test |
| Accelerated Packaged Storage and Sequential Rough Handling | Basic Cold Storage and Sequential Rough Handling | MIL-STD-810, Method 502.2, Procedure I, -31°C | Basic Cold |
| | Basic Hot Storage and Sequential Rough Handling | MIL-STD-810, Method 501.2, Procedure I, Table 501.2-II Induced | Basic Hot |
| | Variable High Humidity and Sequential Rough Handling | MIL-STD-810, Method 507.2, Procedure I, Table 507.2-I, Cycle 3 | Variable High Humidity |

[a] Categories for climatic design types are defined in AR 70-38[1].
[b] Standard ambient temperature, as defined by MIL-STD-810[2], is 25±10°C.
[c] Reference 2.
[d] Reference 3.

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## APPENDIX B. DEFINITIONS OF FAILURE

Relevant chemical failures will provide the basis for determining performance. The sum of relevant chemical, physical, and operational failures will determine the overall operational reliability of the chemical agent detector kit, where chemical, physical, and operational failures are defined as follows:

a. Chemical Failure: A chemical failure is defined as the incorrect determination (as defined by the kit instructions) by a noncolorblind, properly trained observer (representative of the user population) viewing the sampler at the time of sampler functioning when the sampler is operated properly, and there are no physical or operational failures of the sampler as discerned by the operator exposing the sampler. A chemical failure can be either an incorrect determination that agent is present when the sampler has not been exposed to agent or has been exposed to agent at the blank level (false positive), or an incorrect determination that agent is not present when the sampler has been properly exposed for the required time at concentrations of agent equal to or above the specified minimum detection level (false negative).

b. Physical Failure: A physical failure is defined as any physical defect or physical damage caused by a treatment that can be visually discerned by a trained operator and will render a sampler incapable of making a valid test for the presence (or absence) of agent.

c. Operational Failure: An operational failure is defined as an incorrect determination made by a noncolorblind, properly trained observer that results from an error made by the operator or observer (improper operation or viewing) or from environmental conditions which the observer does not or cannot control. If the operator or observer realizes that an error was made and the observer makes a correct determination on a retest, then the failure will be reported as an operational failure-corrected. However, if the error cannot be corrected by a retest, as for example, because it is due to environmental conditions beyond operator and observer control, or the agent would have dissipated before the retest could be done, then the failure would be reported as an operational failure-uncorrectable. If the retest is done and also results in an incorrect determination, the failure will be reported as an operational failure-uncorrected.

d. Nonrelevant Failures: Any chemical, physical, or operational failure shall be considered as nonrelevant if the sampler is:

(1) Operated improperly by an untrained or colorblind operator.

(2) Stored or operated in an environment that exceeds the specified design requirements.

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## APPENDIX C. ABBREVIATIONS

ACAMS - automatic chemical agent monitoring system

AMC - U.S. Army Materiel Command

AR - Army Regulation

ASCAS - automatic spot counting and sizing

BG - Bacillus subtilis var. niger (Bacillus globigii)

BIIL - basic issue item list

CB - chemical/biological

CDT - climatic design type

CFU - colony-forming unit

CPRP - chemical personnel reliability program

CS2 - riot control agent

DA - Department of the Army

DPG - U.S. Army Dugway Proving Ground

DS2 - decontaminating solution number 2

DTP - detailed test plan

EA - environmental assessment

EIALC - environmental impact assessment for life cycle

EIS - environmental impact statement

FNSI - finding of no significant impact

FP - zinc sulfide fluorescent particles

HC - hexachloroethane

HD - distilled mustard

HFE - human factors engineering

HHAR - health hazards assessment report

HTH - high-test hypochlorite

HYFED - hydrogen flame emission detector

IAP - independent assessment plan

IAW - in accordance with

IMAGES - instructional material adequacy guide and evaluation standards

MIL-STD - military standard

MIRAN™ - miniature infrared gas analyzer

MTP - materiel test procedure

NBC - nuclear/biological/chemical

NEPA - National Environmental Policy Act

NET - new equipment training

NSN - national stock number

OPLAN - operations plan

OSHA - Occupational Safety and Health Act

ORI - operational readiness inspection

PMOS - primary military occupational specialty

REC - record of environmental consideration

RPST - repair parts and special tools

RTM - real-time monitor

SAR - safety assessment report

SOMTE - soldier/operator, maintainer, tester, and evaluator

SOP - standing operating procedure

STB - supertropical bleach decontaminant

SSP - system support package

TB MED - technical bulletin - medical

TECOM - U.S. Army Test and Evaluation Command

TGD - thickened soman

TIR - test incidence report

TM - technical manual

TMDE - test measurement and diagnostic equipment

TNB - trinitrobenzene

TNT - trinitrotoluene

TOP - test operations procedure

TRAINS - Simulator, Detector Tickets, Chemical Agent: Training M256

USANCA - U.S. Army Nuclear-Chemical Agency

WP - white phosphorus

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## APPENDIX D. REFERENCES

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