REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

The public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Department of Defense, Washington Headquarters Services, Directorate for information on Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.
PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.

1. REPORT DATE (DD-MM-YYYY)	**2. REPORT TYPE**	**3. DATES COVERED** *(From - To)*
23-06-2020	Final	

4. TITLE AND SUBTITLE
Test Operations Procedure (TOP)
08-2-138 Glove and Boot Testing

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
US Army Dugway Proving Ground
West Desert Test Center
(TEDT-DPW)
Dugway, UT 84022-5000

8. PERFORMING ORGANIZATION REPORT NUMBER
TOP 08-2-138

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Policy and Standardization Division (CSTE-CI-P)
U.S. Army Test and Evaluation Command
6617 Aberdeen Boulevard
Aberdeen Proving Ground, MD 21005-5001

10. SPONSOR/MONITOR'S ACRONYM(S)

11. SPONSOR/MONITOR'S REPORT NUMBER(S)
Same as item 8

12. DISTRIBUTION/AVAILABILITY STATEMENT

Distribution Statement A: Approved for public release; distribution unlimited.

13. SUPPLEMENTARY NOTES

Defense Technical Information Center (DTIC), AD No.:

14. ABSTRACT

This TOP provides the standardized procedures for preparation, planning, conduct, and reporting of glove and boot testing. This TOP addresses the conduct of two distinct tests: quantification test for vapor permeation or penetration of vapor chemical warfare agent (CWA) challenge through protective gloves or boots [vapor challenge/vapor penetration (V/V)] and quantification test for vapor permeation or penetration of liquid CWA challenge through protective SUTs [liquid challenge/vapor penetration (L/V)].

15. SUBJECT TERMS
Glove; boot; individual protection; decontamination; contamination avoidance; chemical; testing; vapor permeation; vapor penetration; liquid challenge; vapor challenge

16. SECURITY CLASSIFICATION OF:			**17. LIMITATION OF ABSTRACT**	**18. NUMBER OF PAGES**	**19a. NAME OF RESPONSIBLE PERSON**
a. REPORT	**b. ABSTRACT**	**c. THIS PAGE**	SAR	41	**19b. TELEPHONE NUMBER (**include area code)
Unclassified	Unclassified	Unclassified			

(This page is intentionally blank.)

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

*Test Operations Procedure 08-2-138 23 June 2020
DTIC AD No.

GLOVE AND BOOT TESTING

* Approved for public release; distribution unlimited.

1. SCOPE.

1.1 Purpose.

a. This Test Operations Procedure (TOP) provides information and guidance for test plan development. The TOP describes current standards for conducting testing and quantifying permeation or penetration of liquid and vapor challenge chemical agents through protective gloves or boots as defined in a System Evaluation Plan (SEP) or equivalent document. This TOP addresses the conduct of two distinct tests:

(1) Quantification test for vapor permeation or penetration of vapor chemical warfare agent (CWA) challenge through protective gloves or boots (vapor challenge/vapor penetration (V/V)). The term system under test (SUT) will be used in place of gloves or boots throughout this document.

(2) Quantification test for vapor permeation or penetration of liquid CWA challenge through protective SUTs [liquid challenge/vapor penetration (L/V)].

b. This TOP also details test processes for determining SUT resistance to CWA permeation when the internal pressure of the SUT is neutral, negative, or positive relative to the air pressure outside the SUT.

(1) A negative pressure condition exists when the pressure on the inside of the SUT is less than the pressure on the outside.

(2) A positive pressure condition exists when the pressure on the inside of the SUT is greater than the pressure on the outside.

(3) A neutral pressure condition exists when pressures inside and outside the SUT are equal.

c. Permeable, semipermeable, or impermeable; single or multi-layered composites; or inert, sorptive, or reactive SUT materials may be tested using these procedures. A variety of SUT configurations, conditions, and CWAs may be used during the tests. Most tests will involve all layers of the SUT as it was designed to be worn in the field. SUT testing may be performed on new material, stored material, material treated with various contaminants, systems combined with other items such as liners, or systems subjected to periods of wear under varying field use conditions. Application of the procedures in this TOP can provide relative ranking or screening information about the ability of a SUT to resist CWA permeation or penetration.

d. Testing SUTs using the procedures in this TOP can provide data to evaluate the effects of different conditions on the permeation or penetration resistance of the SUT.

e. This TOP provides the procedures for characterizing SUT system performance as a baseline for later quality assurance (QA), lot acceptance testing, and production verification testing.

1.2 Background.

a. The L/V procedures are used to test the ability of a system to resist convective penetration and/or diffusive permeation of chemical vapor when liquid or thickened CWA droplets are placed on the surface of the SUT and a flow of air is applied to the SUT. Various CWAs may be used for this test. The SUT used in this test may be new or worn and may be conditioned with a variety of substances such as simulated seawater, diesel fuel, insect repellant, etc.

b. The V/V test procedures are used to test any SUT for the ability to resist convective penetration and/or diffusive permeation of chemical vapor when a CWA vapor-contaminated airflow is applied to the SUT. During V/V testing, a known concentration of CWA vapor-contaminated air is applied to the SUT under controlled conditions [temperature, relative humidity (RH), differential pressure, and airflow rate].

1.3 Application.

The test procedures described in this document must be referenced and may be incorporated into a Detailed Test Plan (DTP) or similar document for testing. These procedures may be modified in the DTP to accommodate specific testing requirements or objectives (as outlined in system requirement documents) after coordination with the test sponsor and the test and evaluation integrated process team. Modifications, however, must be made only after a full consideration of how the changes may affect the reliability and validity of the resulting data. Any modification, along with a description of the desired effect and consequent changes in the assessment process must be fully described in the DTP.

1.4 Limitations.

a. The procedures in this TOP alone are not sufficient to assess the ability of protective systems to protect the wearer. The testing is designed to be used as part of an overall assessment program evaluating the material performance, manufacturing, and system integration with other pieces of the protective ensemble. Results from this process are usually compared with materials tested previously to statistically assess the ability of the SUT to protect the wearer. It is not recommended that results obtained by these procedures be used to correlate to specific medical or toxicological values. However, because the item is a subset of the entire ensemble, the results cannot express an absolute protection value. In addition, data obtained solely by these procedures cannot be correlated to operational effectiveness.

b. The procedures in this TOP do not cover testing of interfaces between the SUT and the suit.

c. The procedures in this TOP reflect the current test capability for gloves and boots. As test capabilities for more operationally realistic testing are developed, this TOP will be updated to include the new methods.

2. FACILITIES AND INSTRUMENTATION.

2.1 Facilities.

Item	Requirement
Chemical surety laboratory and chemical agent storage facility	The laboratory provides general support needed for work with toxic CWAs, including secure storage of agents, general and specialized chemical analysis support, and emergency response provisions, as well as hazardous waste storage and disposal.
Chemical fume hood(s)	Hood(s) must meet all of the chemical surety and safety requirements for working with toxic chemical agents as well as all local Standing Operating Procedures (SOPs).
Test fixture	Must provide an environmentally controlled environment for mounting hand or foot forms with the SUTs. Glove ports provide access for the application of liquid agent and working within the fixture.

2.2 Equipment.

Item	Requirement
Agent vapor generator	Must provide a controlled concentration of vapor into the test fixture.
Hand form	The hand form supports the glove when it is installed in the test fixture. A hand form constructed to simulate a human hand is required. The form must support the glove when a vacuum is imposed on the internal space of the glove. Details of the hand form are in Appendix A.
Foot form	The foot form supports the boot when it is installed in the test fixture. A foot form constructed to simulate a human foot is required. The form must support the boot when a vacuum is imposed on the internal space of the boot. Details of the foot form are in Appendix A.
Seals	The seals for use with either style of form must be validated with each type of test item to demonstrate that the SUT seals to the form.
Liquid CWA dispensing device	This device is used to provide an accurate, rapid means of applying neat, thickened agents, and/or CWA simulants. The device must provide agent droplets with a uniform volume onto the surface of the SUT for L/V tests.

Item	Requirement
Test fixture	The test fixture must allow control of the RH, temperature, and pressure environment surrounding the SUT.
Tubing	All tubing used to conduct air that could contain chemical vapor must have a low tendency to absorb the chemical. Fluorinated polymers are acceptable. Heating the tubing further reduces the tendency of chemicals to be absorbed by the tubing. Only the minimum length of tubing necessary should be used. All sample tubing for each test item must be the same length.
Samplers	Samplers used to analyze the analyte from the inside of the SUT are MINICAMS® or equivalent systems for near-real time (NRT) sampling. Samplers that are used to collect the analyte from the inside of the SUT include: solid sorbent tubes (SSTs), or bubblers. If cumulative data are required, aspirated samplers such as SSTs may be used. More information on samplers is in Appendix A.
Flow controllers	A mass flow controller or meter is required for each flow that needs to be controlled. Critical orifices may be used if a means of monitoring and controlling airflow is not available.
Vacuum pump	A vacuum pump will be used to draw air through the SUT cavity and into the sampler. Size the pump to accommodate all sampler flows. The air flow to the samplers must be constant to ensure that no perturbations occur in the interior of the glove differential pressure (between the glove and the fixture).
Chemical analysis instruments	Gas chromatographs (GCs) with flame photometric or flame ionization detection may be used to quantify agent trapped in the bubblers or the sorbent tubes. Other devices may be used that provide appropriate precision and accuracy.
Data acquisition system (DAS)	This system allows the test operators to monitor and record the environmental conditions in the test fixture during a trial. The DAS will display fixture temperature, RH, and both the SUT-to-test fixture and fixture-to-fume hood differential pressures. The system must independently control the differential pressure and flow within each hand or foot form and control the temperature and RH in the test fixture.

Item	Requirement
Manifolds	Manifolds may be used to simplify the setup of test fixtures and samplers. An appropriate number of manifolds may be used for the V/V and L/V test fixtures (assemblies). Manifolds may be used to supply clean, conditioned air to the test fixture, the internal volume of the forms, and conditioned agent vapor. Manifolds may also be used to provide the vacuum to draw effluent air through the forms and samplers.

2.3 Instrumentation.

Instruments must be able to accurately measure the respective test parameters as described to meet the test program requirements.

Parameter	Measuring Device	Permissible Measurement Uncertainty
Agent drops	Agent dispenser.	The device must be capable of applying 1-microliter (μL) droplet of neat agent with ±10 percent precision and 5-μL droplets of thickened agent with ±25 percent precision.
Analyte concentration (dissemination and detection)	MINICAMS®, GC, high-performance liquid chromatography (HPLC), liquid chromatography (LC), spectrophotometer, or equivalent.	±15 percent; ±25 percent at the bottom of the range being measured.
Analyte concentration (quality spike control)	MINICAMS®, GC, HPLC, LC, spectrophotometer, or equivalent.	±15 percent.
Temperature [-32 to 50 °Celsius (°C)].	Thermocouple with digital recording capability or equivalent.	±0.5 °C.
RH	Hygrometer or similar measuring instrument with digital recording capability.	±3 percent.

2.4 Test Controls.

Parameters	Tolerances
Air temperature in the test fixture and supply air	±1.0 °C
RH in test fixture and supply air	±5 percent

Parameters	Tolerances
Volume of neat liquid agent droplet	±10 percent
Volume of thickened liquid agent droplet	±25 percent
Agent vapor concentration	±20 percent
Sampler collection efficiency	±15 percent
Mass flow of test fixture challenge air	±1 percent
Mass flow of supply and sampling air	±1 percent
Differential pressure	±0.1 inches water gauge (iwg)

NOTE: The tolerances listed above reflect the required accuracy around the measured parameters.

3. REQUIRED TEST CONDITIONS.

3.1 Documentation.

3.1.1 Familiarization.

a. Potential problem areas must be identified by reviewing records and results of similar tests, if available.

b. Development of a DTP requires familiarization with the applicable test planning and requirements documents such as:

(1) Safety release and approval from the authorizing agency (e.g., U.S. Army Test and Evaluation Command (ATEC)) to begin testing, if required.

(2) Government and manufacturer's publications, including the current safety data sheets (SDSs) for all materials used in the test.

(3) Program-specific requirements documents: capability development document, system performance specification, SEP, safety assessment report (SAR), test directive, event design plan, system support package (SSP), and SSP list.

c. Test personnel must familiarize themselves with the relevant SOPs and other procedures for applicability, completeness, and adequacy. These documents will be updated as required.

d. All applicable/available safety documents such as the SAR and health hazard assessments should be reviewed to determine if any safety or health issues require special test protocols.

e. Test item characteristics, such as permeability and physical properties, should be analyzed to determine any unique considerations in mounting the SUT in the test fixture.

3.1.2 Environmental Compliance.

Test personnel and participants must receive and understand environmental documentation before the test begins.

3.2 Test Planning.

a. This TOP is to be used as a guide in preparing the DTP. The test plan will incorporate input from test and evaluation subject matter experts. Test plan format can be test-site specific with customer agreement but the content will address all elements required for test conduct. The following elements must be considered.

(1) The test plan must describe collection of required data, data reduction, analytical procedures, and reporting procedures.

(2) The test plan must include safety procedures addressing hazard analysis, operations, and decontamination.

(3) The test plan must define the required challenge level of the agent(s) being disseminated, the trial conditions, analytical limitations, and safety considerations.

b. The procedures described in this TOP may require tailoring to address the particular purpose and requirements for a specific SUT. Any modifications of these procedures and the specific parameters used must be described in the DTP, along with the rationale.

c. The DTP shall describe the specific test processes to be used, based on factors including the concept of operations requirements and threats for the SUT being tested. These factors should give consideration to the operational conditions which the SUT would be subjected to in the field.

d. The location(s) for agent application to the SUT must be coordinated with the test sponsor and system evaluators.

3.3 Simulant Selection.

If simulants are required, selection should be conducted in accordance with (IAW) TOP 08-2-196[1**]. An agent simulant relationship may be established using TOP 08-2-140[2].

** Superscript numbers correspond to those in Appendix C.

3.4 Experimental Planning and Design.

a. When performed correctly, Designs of Experiment (DoE) are the most efficient way to test. Multiple factors are varied simultaneously in a specific systematic manner that is mathematically sound. This means that DoE techniques minimize the number of trials needed to obtain statistical validity.

b. It is recommended that proper use of DoE be applied for all testing. When creating a DoE the following should be considered:

(1) The test objective(s).

(2) The response variable(s).

(3) The factors that affect the response variable(s).

(4) The levels (or ranges) of the factors.

(5) Any mathematical model assumptions.

(6) Statistical measures such as confidence, power, variability, and error structures, etc.

(7) The final analysis method.

(8) Any limitations of funding, SUT availability, and/or schedule.

3.5 Safety.

3.5.1 General.

a. All test operators must read, understand, and have available the SDS associated with each chemical used in the test. The operator is expected to be familiar with the operation of the test fixture and to have read and understood the test plan. The test plan will be available to the operators in the laboratory.

b. The required SDSs, testing protocols, and safety procedures will be available at the test site.

c. When appropriate, the test personnel will wear required personal protective equipment (PPE).

d. Daily safety checks will be conducted to ensure that all identified safety hazards have been addressed before testing proceeds.

e. All established safety air monitoring and other hazardous operations SOPs must be followed.

3.5.2 Chemical Toxicity.

a. All handling of toxic chemicals must be performed within well-ventilated hoods or test fixtures. The operator must wear PPE IAW applicable SOPs. Surety regulations must be followed.

b. The evaluation of chemical toxicity issues must include consideration of the effects of leaks or spills on both the test operator and nearby laboratories. Storage and handling SOPs must be followed.

3.5.3 Training.

Test personnel must be trained regarding the test items, test scenarios, and test conditions to include the identification of appropriate test personnel and processes to report any safety, surety, security, or health-related issues.

3.6 Quality Control (QC) and Quality Assurance (QA).

3.6.1 General.

a. Before testing, the data decision rules will be established for the test in question. These rules will determine the test requirements for data elements, limits of data collected, and allowable errors for data elements. The ability to meet the decision rules will be demonstrated during a pilot trial.

b. Chain of Custody (CoC) procedures for SUT, sampler, and analytical data control and accountability must be established and specified in the DTP. Each test item must have a CoC document that shall be implemented immediately upon receipt of test items. The CoC document will be updated at the time the SUTs are removed from storage or when custody of a sample passes from one individual to another. CoC documentation will contain the following columns as a minimum:

(1) Date and time of each transaction.

(2) Signature spaces for the persons relinquishing and receiving custody.

(3) Operation description.

(4) The current location of the SUT or sample.

(5) SUT inspection.

c. Test item identification number (TIIN).

(1) A unique TIIN must be assigned to each SUT.

(2) A unique sample identification control number (SICN) will be assigned to each agent sampler, sampler data file, and CoC control established. The SUT TIIN will be correlated

with the SICN such that the samples can be correlated with a SUT, the CWA used for the trial, and the sample time period (if applicable).

d. All equipment, controls, and instruments shall be calibrated IAW SOPs and manufacturer's procedures. The DAS shall be checked to ensure all data are stored IAW the DTP.

e. Preliminary demonstrations of readiness, such as an operational readiness review and pilot trial(s) should be conducted to ensure proper test processes and procedures are in place and the test program is properly coordinated. The pilot trial(s) should also demonstrate that current methods and procedures, as contained in the DTP and SOPs, are followed by the test team, and that these methods and procedures are adequate to conduct the test in a safe manner.

f. Chemical analysis shall be conducted IAW procedures in local SOPs or manufacturer's recommended practices. The appropriate number of standards, blanks, and analytical controls must be used. Acceptable control limits of the results and how deviations from those control limits are treated must be addressed in the DTP or SOPs.

g. The sampler selected for use must be well characterized. For example, if MINICAMS® are used, ensure that precision and accuracy studies are performed after the multipoint calibration. Ensure that airflow in the fixture is adequate, does not affect data, and that there is no carryover contamination. If SSTs are used, take steps to ensure the capacity of the sorbent is not exceeded and that carry-over does not occur. When solvents are used for extraction, document the extraction efficiency.

h. An agent QC spike control will be used to validate the actual contamination density applied to the SUTs.

i. Several storage controls will be stored with the test samples if the samples must be stored for longer than one day before being analyzed. These storage control samples shall then be analyzed with the test samples to show any sample degradation or pick-up of interfering chemicals during storage. The storage control samples will consist of blanks and analytical standards with the CWA concentration levels near the CWA contamination level expected in the test samples. Acceptable control limits for the results and how deviations from these results will be treated must be addressed in the DTP.

j. All aspects of testing shall be conducted with emphasis on acquiring valid, credible, and verifiable results.

4. TEST PROCEDURES.

4.1 Pretest Procedures.

4.1.1 Receipt Inspection.

a The SUTs will be received, prepared, and labeled IAW TOP 08-2-500A[3].

b. The test item will be labeled appropriately with a TIIN, photographed (with a metric scale), and the information will be recorded on a data sheet and/or in a program laboratory log book. The TIIN should relate to the sample identification control number assigned to samples generated from testing the SUT.

c. All SUTs must be carefully handled so as not to induce any uncontrolled environmental effects or damage that could potentially affect test results. One-time preparation activities, such as wearing and washing of the SUT, should be described in the DTP under test item preparation/pretreatment.

d. SUTs should be kept in sealed containers until needed for preconditioning (if applicable) or testing.

4.1.2 Chemical Agent.

Before testing, a purity analysis will be performed to verify that the neat agent is at least 95 percent pure.

4.1.3 Test Setup.

a. The following preparations are required for test setup:

(1) Safety air monitoring will be set up as required by test site SOPs.

(2) Glove and boot testing will be conducted in a test fixture. The fixture will be installed in a chemical fume hood. The test assemblies (forms and manifolds) will be set up in the fixture. The fixture will be set for the temperature and RH specified in the DTP.

(3) NRT chemical analyzers used to analyze the sampled air stream, such as MINICAMS® or equivalent instruments, will be calibrated. SSTs must be cleaned by heating and purging.

(4) All data acquisition components will be calibrated. A preliminary check will ensure that all hardware and software are functioning properly.

(5) Figure 1 is a diagram illustrating the basic setup for test equipment. This setup may be used to test SUTs in positive, negative, and neutral pressure environments.

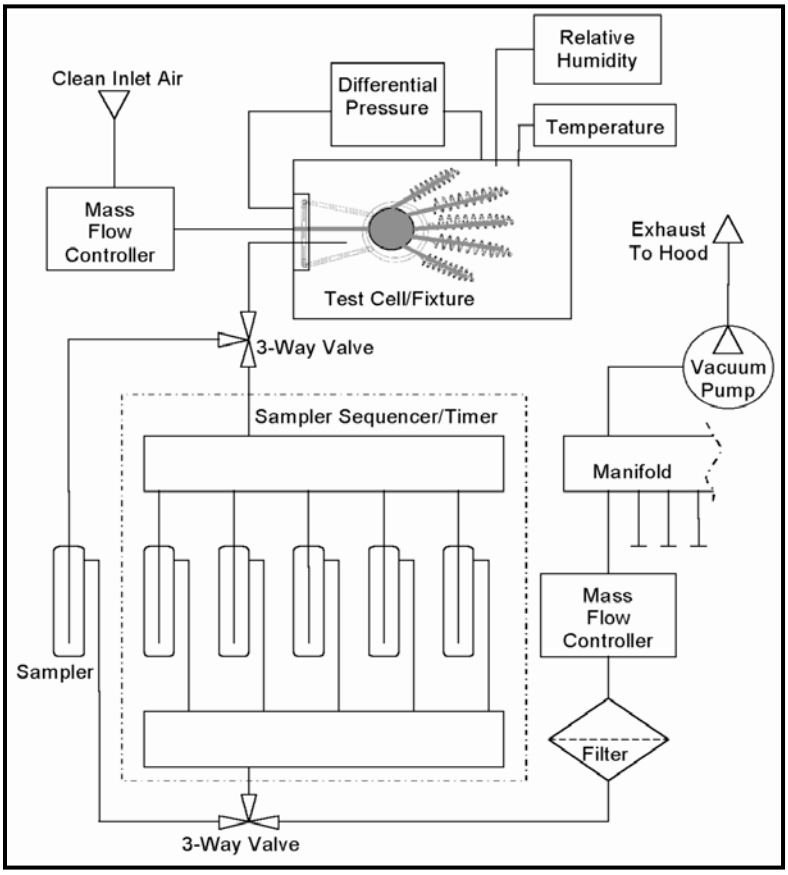


Figure 1. Basic setup for test equipment; chemical agent resistance testing of glove or boot systems.

NOTE: The sampler locations in this figure are representative of a SST setup. This block can be replaced by a NRT system.

(6) The SUT required for testing, SSTs, sampler labels, and any other equipment and materials necessary for the test will be staged in the laboratory.

(7) The SUT will be removed from the sealed container, will be sealed onto the appropriate form and test fixture.

4.1.4 Leak Testing.

a. Perform leak testing once the SUT is mounted and sealed onto the form.

b. Both a helium line and exhaust line will be connected to the bottom of the form. The third port will then be sealed with tape. The exhaust line will be checked to make sure that it extends far enough into the hood so that it does not interfere with the helium detector.

c. The valve for the helium will be carefully opened so that it slightly inflates the SUT but not stress the SUT by over inflation.

d. The helium leak detector probe will slowly be passed over the sealed area of the SUT while the detector is observed for signs of leakage (Figure 2).

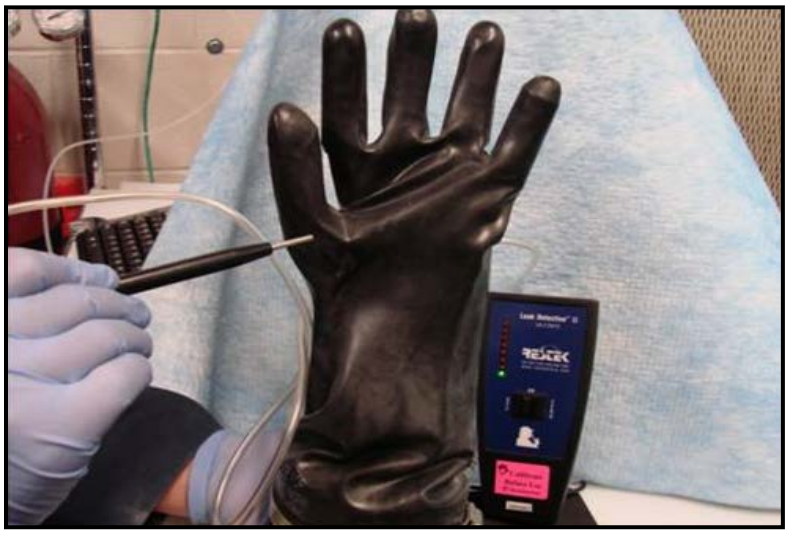


Figure 2. Helium leak check of glove before mounting on glove fixture carousel.

(1) If no leak is found on the seal of the SUT, the leakage check will be continued on the rest of the SUT. Once the leak check is completed, the tape will be removed from the third port.

(2) If the SUT fails the helium seal check, it will be remounted onto the form and re-checked. If it fails a second time, without any obvious reason for the failure, it will be removed from the test and replaced with another SUT.

e. After securing the SUT form to the carousel, a helium leak check will be performed at the SUT form/carousel interface (Figure 3) as well as the fitting connections of the sampling line, pressure line, and intake line. If a leak is found, then appropriate measures to correct the problem, such as resealing or replacing the test item, tightening fittings, or remounting the item, will be performed.

Figure 3. Helium leak check of glove, fittings, lines, and interfaces after securing base to glove fixture carousel.

(1) If no leaks are found, the leak check will continue with the next SUT until all items pass the leak check.

(2) Each position must pass the leak check before testing proceeds.

4.1.5 Background Checks.

a. Before each permeation or penetration trial is conducted, a background check will be conducted on the system to determine if interfering chemicals are in the system and to obtain a contaminating agent baseline value.

b. A SUT, representative of the SUT type being tested, will be mounted in the fixture and checked for two MINICAMS® cycles to determine if there are any off-gassing interferents detected.

c. Background checks should also be made on representative samples of the SUT that have been worn or have battlefield contaminants (BFCs) applied.

d. If any off-gassing interferents are detected, the off-gassing quantified will become the baseline value, which will be subtracted from the level of agent detected during the trials.

4.1.6 SUT Treatment Conditioning.

a. Depending upon the particular test program, BFCs may be used to treat the SUT before chemical agent resistance testing. The treated SUT will then be tested for agent resistance IAW the procedures in this TOP.

b. Description of Treatments. Treatments or combinations of treatments may be used to address program specific requirements. The compatibility of each treatment with the analytical systems and application methods must be demonstrated as part of test preparation. Commonly used treatments include:

(1) Petroleum, oils, and lubricants (POLs). POLs include diesel fuel, jet propulsion fuel number 8 (JP8), Break Free® gun lubricant, and hydraulic fluid.

NOTE: Diesel fuel and JP8 are not distinct chemical species. Their chemical composition can vary depending on the source of the crude oil from which they have been distilled and the manufacturing process. This can potentially affect agent resistance results.

(2) Water and bodily fluids, such as salt water, fresh water, sweat, blood, urine, and feces.

(3) M258A1 Individual Decontamination Kit.

(4) Reactive Skin Decontamination Lotion (RSDL).

(5) M295 Individual Equipment Decontamination Kit.

(6) 10 percent high-test hypochlorite solution.

(7) 5 percent Sodium Carbonate solution.

(8) Hot soapy water [1 pound of Detergent, General Purpose, Liquid, NSN 7930-00-282-9699, in 5 gallons of water at 38 °C (100 °Fahrenheit (°F)].

(9) Super tropical bleach.

(10) Aqueous film-forming foam.

(11) Insect repellant, N,N-diethyl-meta-toluamide.

c. SUT Treatment Contamination Procedure.

(1) The SUTs will be held in a manner such to permit application of the treatment and to prevent the treatment from running off the specified area of application.

(2) The amount of treatment, location of application, and weathering should be determined based on the guidance from program specific requirements and must be appropriately documented in the DTP.

(3) Amount of treatment. The SUTs will be treated with 20 milligram (mg) (dry) or milliliter (mL) (liquid) of the BFC unless otherwise dictated by the program specific mission exposure. This is based on thoroughly covering the 202 cm^2 surface area of the boots, gloves will require smaller amounts. Some treatments may also require immersion and/or total saturation.

(4) Treatment Location. The treatment type and locations are described in Table 1.

TABLE 1. BATTLEFIELD CONTAMINANT TYPE AND TREATMENT LOCATION

BATTLEFIELD CONTAMINANT TYPE	TREATMENT LOCATION
Petroleum, oil, and lubricants, water, and aqueous film forming foam	Exterior application
N,N-diethyl-meta-toluamide	Interior and/or exterior application
Bodily fluids (sweat, blood, etc.)	Interior application
M258A1 Individual Decontamination Kit	Exterior application
Reactive Skin Decontamination Lotion	Interior and/or exterior application
M295 Individual Equipment Decontamination Kit	Exterior application
10 percent high-test hypochlorite solution	Exterior application
5 percent Sodium Carbonate solution	Exterior application
Hot soapy water [1 pound of Detergent, General Purpose, Liquid, national switch network 7930-00-282-9699, in 5 gallons of water at 38 °C (100 °F)]	Exterior application
Super tropical bleach	Exterior application

(5) Treatment Weathering. Any of the treatments may be tested either wet, dry (wet application and then dried), or both (2 treatment conditions with one applied wet and one dry), depending on the program specific requirements.

(6) Wet treatments will remain on the SUT at ambient temperature for one hour; then any excess liquid will be drained off and blotted. If the wet treatment on the SUT is to be tested in a dry state, then the treated SUT will be exposed to air at 21 °C (70 °F) and held for 24 hours. If the treatment on the SUT is to be tested in a wet state, then the SUT will be tested immediately following blotting.

(7) Dry (not applied as a liquid) will be tested immediately.

(8) If the program-specific requirements include simulating the entire decontamination process, the decontaminant may need to be rinsed with running water after the appropriate decontaminant application time to ensure no residue remains. If the requirement of

the program is to determine the effect of the decontamination compound itself, then the rinsing procedure will be omitted.

4.2 Liquid Challenge/Vapor Penetration (L/V) and Vapor Challenge/Vapor Penetration (V/V) Testing.

4.2.1 General.

a. SUTs of any configuration may be tested using the methods detailed. All SUT types must be listed in the DTP.

b. CWA permeation or penetration is measured when the internal pressure is neutral, negative, or positive relative to the air pressure outside the SUT.

c. Any number of CWAs may be applied to the SUT for permeation/penetration tests. The CWAs commonly used include distilled mustard (HD), sarin (GB), soman (GD), and a persistent nerve agent.

(1) The amount of liquid CWA applied is a function of the contamination density required, in g/m^2. The nuclear, biological, and chemical survivability criteria[4] currently lists the contamination density as 10 g/m^2, but the program requirements should be the overriding consideration.

(2) The agent applicator will be verified before testing to confirm that it produces droplets within the required specifications (Paragraph 2.4). The ability of the liquid CWA application device to apply an appropriate volume of CWA will be demonstrated by contaminating a dose confirmation coupon before and at the end of the application procedure. The coupon is extracted with a known volume of reagent-grade solvent. The solvent will be analyzed for CWA content by using the procedures detailed in the testing organization's SOPs and specified in the DTP. The results of these analyses will be will be recorded and matched to the SUT being tested.

(3) The liquid CWA application time will be measured. The time to apply will be executed within an acceptable window defined in the DTP.

(4) Table 2 lists the agent density (g/mL) for various agents.

TABLE 2. AGENT DENSITY (g/mL) FOR CALCULATING THE AMOUNT OF AGENT REQUIRED

AGENT	AGENT DENSITY (g/mL)[a]
Distilled mustard	1.27
Sarin	1.09
Soman	1.02
Persistent nerve agent	1.01

[a]At 25 °C, from safety data sheet information.

(5) Vapor challenge is expressed as mg/m^3 and must be specified in the DTP.

(6) The following equation provides a means of determining the number of droplets that must be applied to obtain the desired contamination density.

$$N = \frac{D \cdot A}{10 \cdot \rho \cdot V \cdot C} \qquad \textit{(Equation 1)}$$

Where:

N = number of droplets (rounded to the nearest whole number)
D = contamination density (g/m^2)
A = area to be contaminated (cm^2)
ρ = agent density (g/mL)
V = volume of agent per droplet (µL/drop)
C = purity correction factor (CWA purity in decimal fraction).

d. Table 3 lists the suggested test parameters that may be used to establish baseline performance of the SUTs.

TABLE 3. SUGGESTED TEST PARAMETERS USED TO ESTABLISH BASELINE PERFORMANCE OF THE SUTS

PARAMETER	LIQUID CHALLENGE/VAPOR PENETRATION	VAPOR CHALLENGE/VAPOR PENETRATION
Challenge	5-10 g/m^2	20 mg/m^3 (threat) 120 mg/m^3 (capacity)
Droplet volume	1 µL (neat) 5 µL (thickened)	Not applicable
Temperature	32.2±1.7 °C (90.0±3.0 °F) (fixture air) Ambient (SUT supply air)	21.1 °C (70 °F) (fixture supply air) Ambient (SUT supply air)
Relative humidity	80 percent (fixture air) Ambient (SUT supply air)	50 percent (fixture supply air) Ambient (SUT supply air)
Minimum detection	0.1 ng (sampler dependent)	0.1 ng (sampler dependent)

4.2.2 SUT Mounting, Sealing and Leak Check.

The SUT will be mounted, sealed, and leak checked per the test sites applicable SOP. However, if a site SOP or instruction is not available, the following procedures may be followed. Any changes or deviations from the procedures will be described and justified in the DTP.

a. The proper size SUT mounting base, O-rings, and metal left or right hand or foot form will be selected to match the SUT under test.

b. O-rings will be placed in the grooves on the mounting base, and the metal form installed into the holes in the top of the mounting base.

c. The SUT will be eased over the metal form and mounting base, and then pulled over the O-rings (Figure 4). The O-rings will be checked to verify that they are still in the grooves of the mounting base.

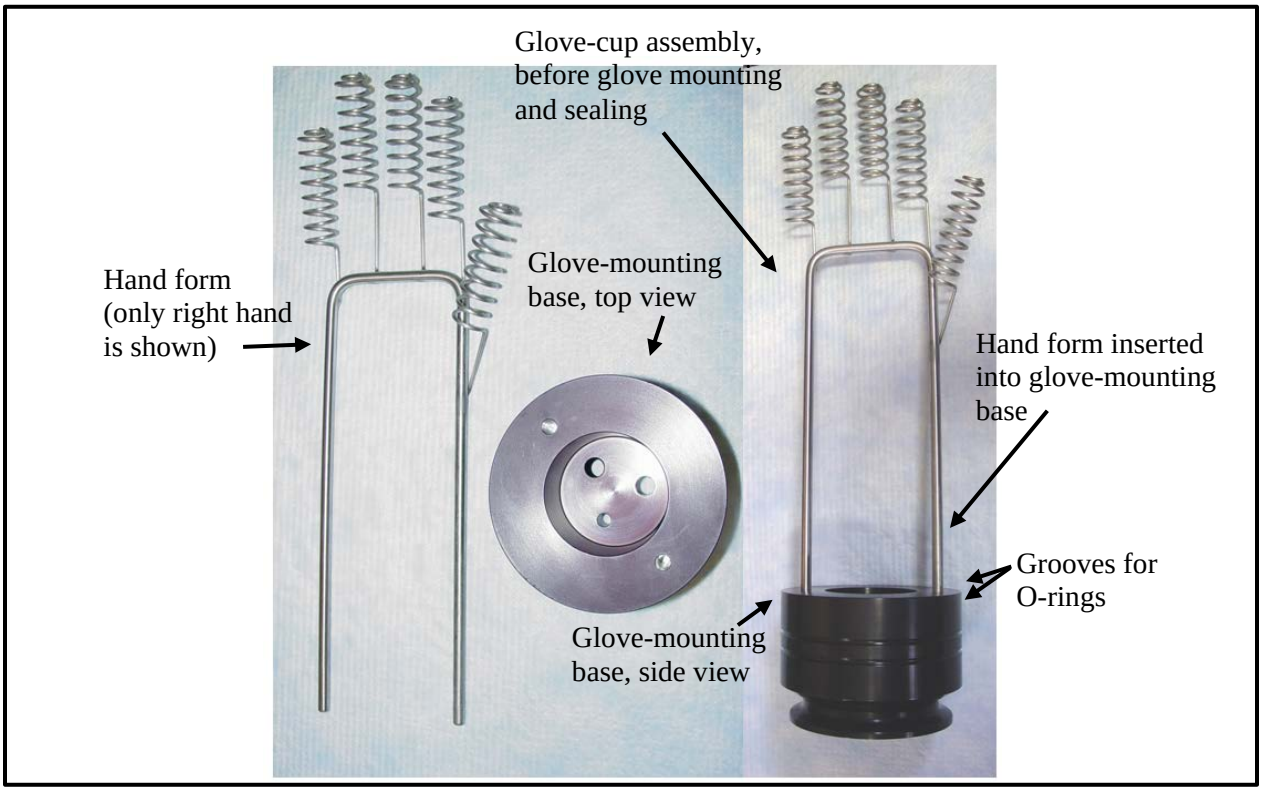


Figure 4. Hand form, glove-mounting base, and glove assembly.

d. A layer of silicon tape will be placed on the surface of the glove cuff immediately over the O-rings on the mounting cuff. Next, a metal hose clamp will be placed over the SUT and centered over the O-rings and silicon tape. The hose clamp will be tightened until it starts to compress the SUT to the O-rings, which will secure and seal the SUT to the mounting cuff.

4.2.3 Background Sampling and Near-Real Time (NRT) Sample Analysis.

a. After the SUT is mounted to the carousel, background monitoring of the SUT and sampling system will be performed.

b. Background monitoring and NRT sample analysis will be conducted with a previously calibrated NRT sampler, such as MINICAMS®, per site SOP. The NRT samplers will monitor each glove for a minimum of two sample cycles. Each sample cycle will be 5 minutes. The sampling line of the NRT sampler will be attached to the distal end of the sampling manifold with respect to the SUT sampling line connection of the sampling manifold.

c. Background monitoring results for each trial will be recorded.

4.2.4 Environmental Conditioning.

a. The trial temperature and RH will be set to those specified in the DTP trial matrix.

b. After the SUT has completed the background check, the test fixture will be sealed and test personnel will perform the following equipment/instrumentation procedures:

(1) The control system and the DAS will be initiated.

(2) The house airflow rate (the airflow rate to establish the required safety differential pressure between the fixture and the laboratory; this is not a required data element) and recirculating fan (fans inside the test fixture to circulate the air in the fixture) will be set to the level required to operate the fixture.

(3) The heater system will be adjusted to achieve the targeted fixture temperature.

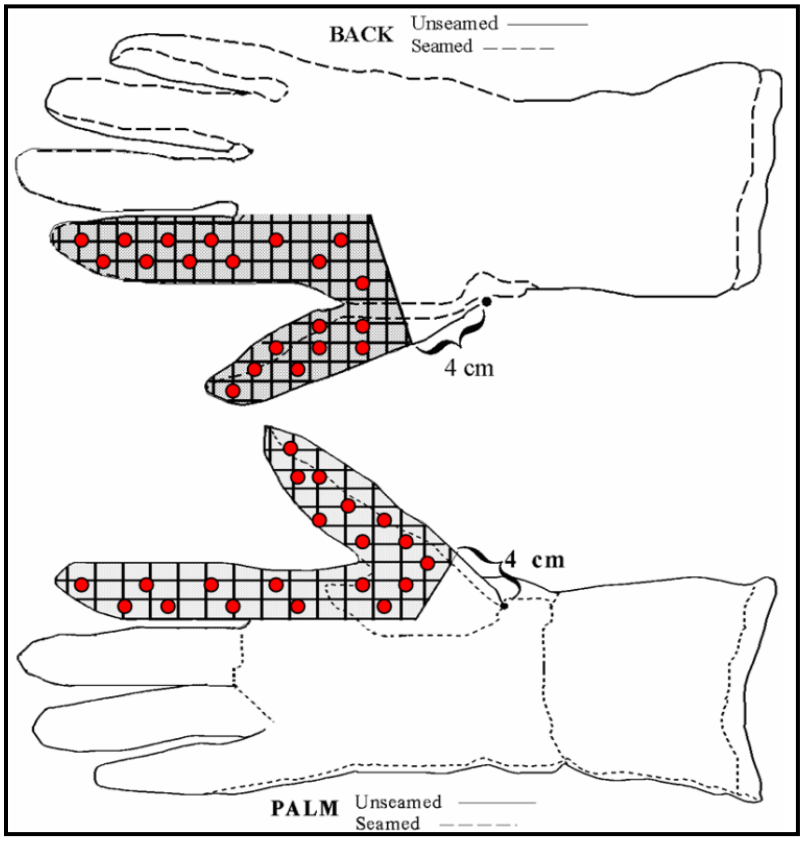
(4) The humidification system will be adjusted to achieve the targeted fixture RH.

(5) The fixture environmental conditions will be allowed to stabilize. The environmental conditions for temperature, RH, and pressure will be recorded for each trial.

4.2.5 Agent Application.

a. The SSTs will be attached to the sampling manifold and readied for sampling before agent application begins. The NRT samplers will be operational, online, and sampling the airflow. The stream selector will be set up, operational, and ready to sample. The dispenser will be primed, and the dispenser tubing will be inserted into the test fixture. Test personnel will use the glove ports into the fixture to insert the tubing and apply agent drops on each SUT being tested.

b. The required number of agent drops will be applied to designated locations of the SUT (Figure 5). The number of drops will be determined based upon a target contamination density and the SUT surface area, which will be specified and detailed in the DTP.



NOTE: Gloves are not drawn to scale.

Figure 5. Example of glove agent application locations.

c. An auto-dispenser may be used to allow reproducible and safe application of the chemical agent onto the SUT. The SUT will be contaminated using individual drops. This method allows for precise control of the area and amount of contamination.

d. The start and end time for contamination of the SUT will be recorded. The carousel will be moved so that the first SUT contaminated will be in its initial contamination position to maintain trial-to-trial and position-to-position uniformity with respect to fixture effect on each test item.

e. The vacuum pumps and the sampling manifold control system will be turned on after SUT contamination is completed to initiate the start of the trial. Record the trial start time. During the trial, all flow rates, temperature, RH, and pressure data will be recorded by the DAS. Record sampling times in the test log.

f. A QC spike control will be completed just before SUT contamination and just after. This control confirms the quantity of agent applied. The QC spike control and analysis will be completed per site SOP. The results of the QC spike controls will be recorded.

4.2.6 Sampling, Extraction, and Analysis.

a. The airflow through the SUT sampling lines will be directed through labeled SSTs. An automated sample sequencer (changes from one sampler to the next) will be used to switch the airflow from the SUT to the appropriate sampler at the required intervals. The samplers will be changed at predetermine intervals, as specified in the DTP.

b. The samplers will be removed and liquid extracted IAW site SOPs. A 1.5-mL aliquot of solvent will be removed from each extracted sample and pipetted into labeled vials for analysis. The vial identification, SICN, and extraction volume will be recorded. The vial identification codes will be checked against the CoC document.

c. The proper sample custody procedures, as specified in the site SOPs, will be followed for accepting and analyzing the extracted samples.

d. NRT sample analysis will be conducted for each SUT and the data will be placed on a test network.

4.2.7 Trial Completion.

a. At the completion of the trial, residual agent will be removed from the test fixture by increasing the temperature to ~50 °C, increasing airflow, and setting the circulation or recirculation fans to their maximum speed.

b. After at least 12 hours of heating and increased airflow, the mounted SUT will be removed from the carousel and the fixture IAW the appropriate SOPs and placed in a vacant hood for further processing. The SUT will be removed from the form and placed in the appropriate decontamination solution IAW the site SOP. The test fixture will be air washed to lower the agent concentration within the fixture. Residual agent will be removed from the form assembly by heating or with an acetone rinse, as necessary. The sample lines will be cleaned with acetone and sampled by MINICAMS to determine if the lines are clean. If the lines are not clean, they will be replaced in order to remove any agent contamination.

5. DATA REQUIRED.

a. Environmental monitoring records from sample preparation and storage.

b. Duration of each sampling interval (minutes).

c. The differential pressure (iwg) between each SUT and the fixture during preconditioning and trial execution.

d. Volumetric flow rates (standard liter per minute (slpm)) of air for each SUT and the fixture during preconditioning and trial execution.

e. Temperature and RH for all supply air manifolds and environmental control fixtures during pre-conditioning and trial execution.

f. Results of negative and positive control samples.

g. Results of QC spike control samples.

h. Results from CWA purity analysis.

i. Mass of CWA (nanogram (ng)) quantified during each sampling interval from the SSTs (as appropriate).

j. Calibration and QC sample results from all chemical analyses.

k. Sampler collection efficiencies.

l. Operator-annotated comments on any observed anomalies during execution of the preconditioning and test phase of each trial.

m. Operator inspection observations for each SUT by TIIN.

n. Concentration of agent (mg/m^3) quantified during each sampling interval from the MINICAMS® (as appropriate).

o. For L/V testing, the number, location, and volume of drops (µL) applied to the surface of each SUT.

p. For V/V testing using the Simulant Agent Resistance Test Manikin (SMARTMAN) fixture, the test fixture concentration profile during the trial (mg/m^3).

q. For V/V testing, the total dosage ($mg \cdot min/m^3$).

r. Test item receipt inspection data.

s. QC and QA audit results.

t. Area of each SUT exposed to CWA.

u. Location of the SUT in the fixture.

v. CWA application method and QC validation data.

w. Data Review. The test officer and project scientist will review all data for consistency and acceptability. Specifically, the following will be reviewed:

(1) The mass of CWA found during each sampling period to determine if the results obtained are reasonable and consistent.

(2) The precision obtained on the analytical controls.

(3) The duration of each sampling period.

(4) The pressures, air temperatures, and RH to ensure test parameters were maintained during the test period.

(5) The background check results to determine if false positive values were obtained, and if so, whether the analytical procedure was changed to a method that will discriminate between CWA and interferent.

(6) Any notable observations made by test operators.

(7) Mass penetration/permeation data.

(8) Measurement uncertainty calculated for analytical instruments.

6. PRESENTATION OF DATA.

a. Test parameter data such as temperature, RH, differential pressures will be presented as graphs with trial time on the x-axis. Control limits will be presented on the graphs to visually demonstrate that trial parameters are within required tolerances.

b. Results of the statistical analysis will be presented as specified in the DTP.

c. All other data will be presented in tabular format grouped by agent, SUT type, and environmental conditions.

(This page is intentionally blank.)

APPENDIX A. INSTRUMENTATION.

A.1. INTRODUCTION.

Special test equipment has been developed at Battelle's Hazardous Materials Research Center, Columbus, Ohio, and West Desert Test Center, U.S. Army Dugway Proving Ground, Utah, to meet requirements for this TOP. This equipment is described below to assist laboratories in developing their own specialized equipment to meet TOP requirements. The equipment described in this Appendix includes forms and fixtures. Paragraphs A.2 and A.3 describes the hand and foot form respectively, and Paragraph A.4 describes fixtures used. The equipment may be used for the negative, neutral, and the positive pressure process. Samplers that may be used in SUT testing are described in Paragraph A.5.

A.2. HAND FORM.

Historically, a hand form has not been used for the positive pressure process; the glove was held in position by the pressure applied inside the SUT. However, nothing prevents the use of a hand form for the positive pressure process. The neutral or negative pressure method requires a hand form to support the glove and hold it in an expanded position for sampling and operational applicability requirements. The hand form currently being used for glove testing is described in the following paragraphs and shown in Figure A-1

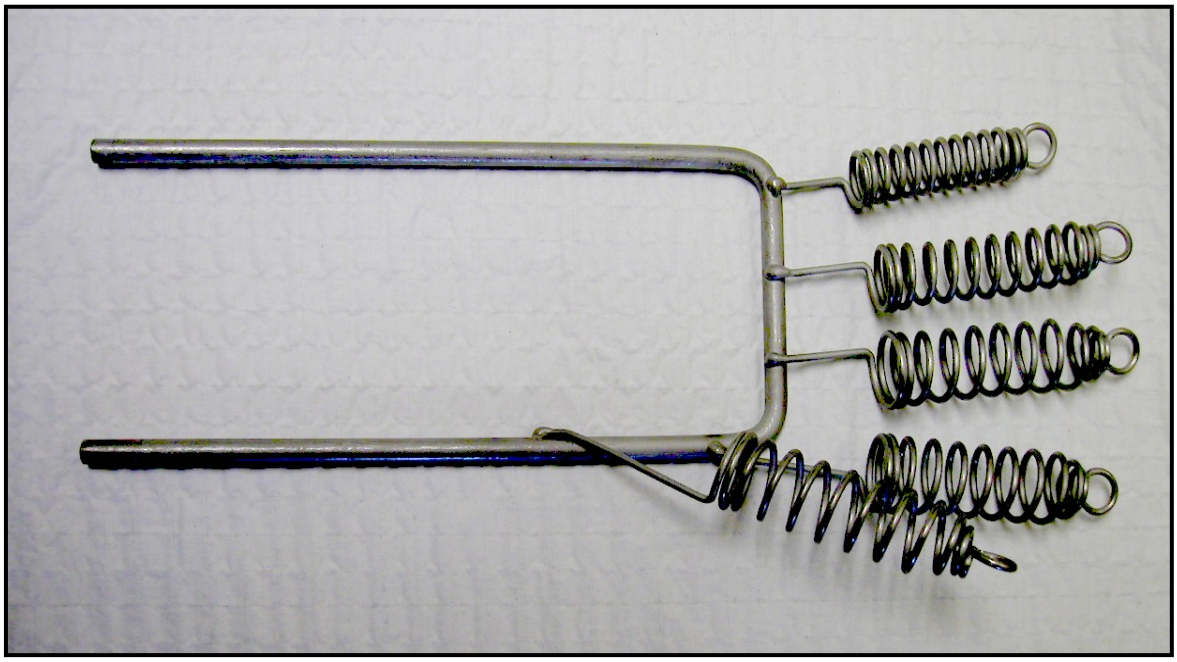


Figure A-1. Currently used hand form for chemical agent resistance testing of glove systems.

APPENDIX A. INSTRUMENTATION.

a. A hand form with spring-like coils to form the digits is configured to maximize airflow and CWA penetration to the inside of the glove. The digits are sufficiently flexible to accommodate donning and doffing the SUT.

b. A tube will be placed inside the hand form, which will extend at least into the area of the base of the fingers of the form. This will be the tube through which the makeup air enters. The tube that draws the sample air will extend only to the base of the form. The purpose of this setup is to ensure that the supply air has time to mix with the potentially contaminated air inside the SUT before it is drawn into the sample tube.

c. The SUT and hand form assembly are mounted and sealed at the sleeve/cuff-to-fixture interface (part of the fixture described below).

A.3. FOOT FORM.

a. A foot form is configured to maximize airflow and potential CWA penetration to the inside of the boot.

b. A tube will be placed inside the foot form (Figure A-2), which will extend at least into the toe area of the form. This will be the tube through which the makeup air enters. The tube that draws the sample air will only extend to the ankle area of the form. The purpose of this setup is to ensure that the supply air has time to mix with the potentially contaminated air inside the SUT before it is drawn into the sample tube.

Figure A-2. Currently used boot form for chemical agent resistance testing of boot systems.

APPENDIX A. INSTRUMENTATION.

c. The SUT and foot form assembly are mounted and sealed at the boot cuff-to-fixture interface (part of the fixture described in Figure A-2).

A.4. TEST FIXTURES.

a. A fixture contains the form(s) and CWA vapor and the environmental conditions required for the test. The two fixtures at DPG that currently meet these requirements are:

(1) Simulant Agent Resistance Test Manikin (SMARTMAN) fixture. The SMARTMAN fixture is large enough to mount four SUTs simultaneously and has access ports that allow the SUT to be individually challenged with liquid CWA and/or CWA vapor. This fixture is illustrated in Figure A-3.

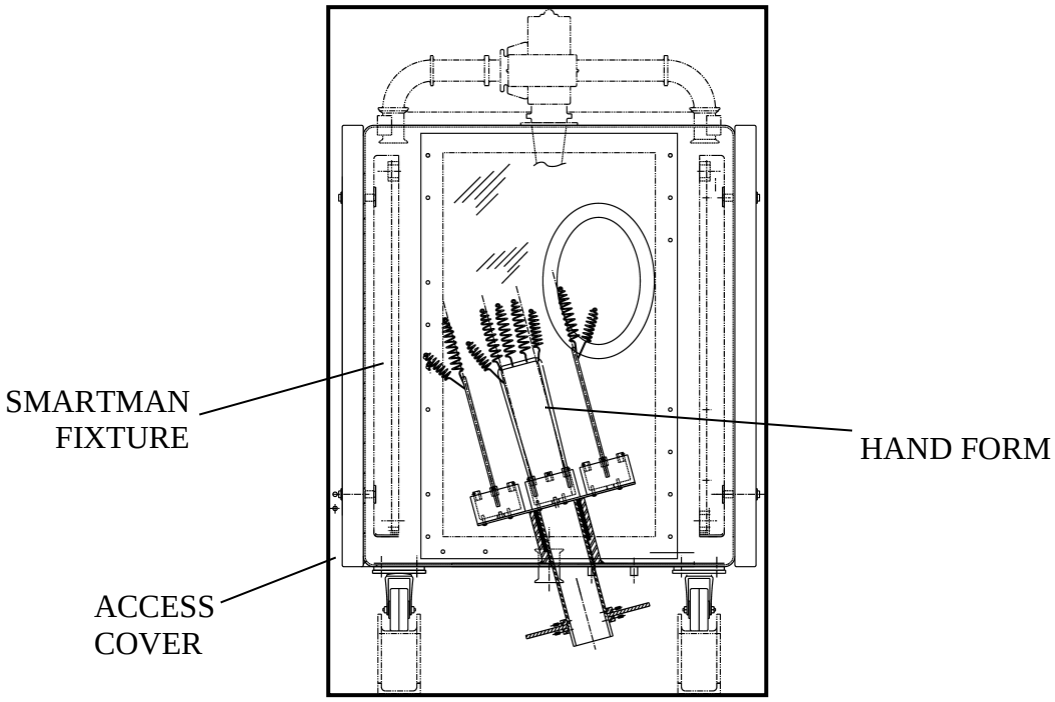


Figure A-3. SMARTMAN fixture for chemical agent resistance testing of glove systems.

(2) The SMARTMAN fixture was originally designed for testing protective masks, but can be configured for glove testing by removal of the head form and installation of the carousel assembly (Figure A-4). This fixture, with associated equipment, provides a fully controlled environment.

APPENDIX A. INSTRUMENTATION.

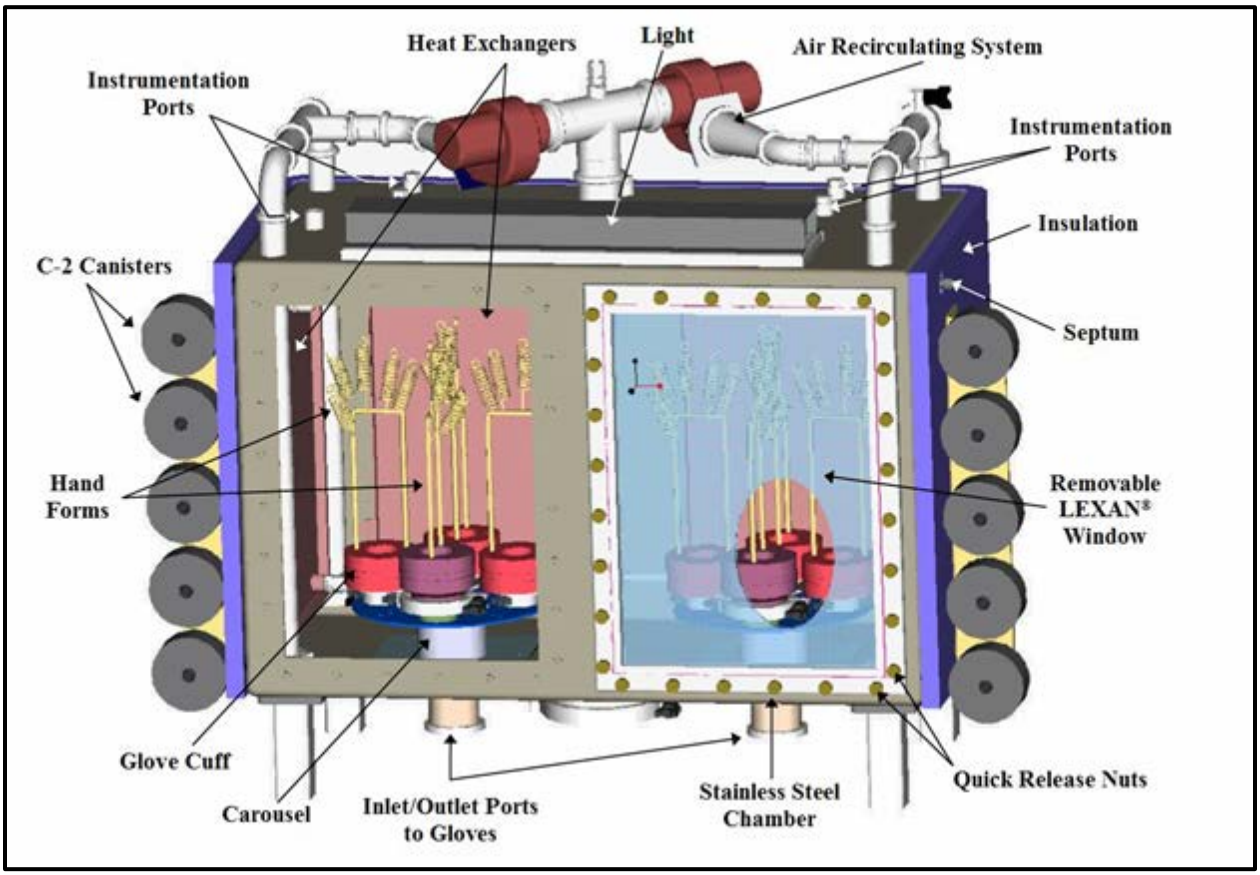


Figure A-4. Fixture for chemical agent resistance testing of glove systems.

(3) The ability to rotate the hand form to any of four positions facilitates liquid CWA application. The hand forms are tested in the vertical position. The system manifold and bulkheads allow for instrumentation and flow into the fixture and the SUT. The four sampling air exit ports from the interior of the SUT are connected to the manifold with flexible tubing.

(4) The SMARTMAN fixture is designed for L/V and V/V testing. The fixture uses a recirculating airflow to return the air back into the fixture. The fixture also has an associated fixture airflow as air depletes through the canister filters.

b. Glove fixture.

(1) The glove fixture can also control temperature and humidity, but can accommodate 8 gloves or 4 boots per trial.

(2) The glove fixture cannot be used in its current configuration to conduct V/V testing.

APPENDIX A. INSTRUMENTATION.

(3) The glove fixture uses two carousels for SUT testing. The carousel allows each SUT to be contaminated with liquid CWAs. The glove fixture has a unique removable plate that can be replaced with the boot sealing hardware. This plate allows each SUT to be contaminated with liquid CWA.

(4) A schematic of the glove fixture can be found in Figure A-3.

c. Samplers.

(1) General. Two types of samplers have been used in SUT testing: SST cumulative samplers and NRT sampler/analyzers. When SSTs are used, the air to be sampled is drawn through the sampler for a fixed period of time at a controlled flow rate, generally 1 L/minute. Airflows are controlled by mass flow controllers or meters. The inlet to the vacuum pump must be suitably filtered to remove any chemical vapor that may have "slipped" through the sampler, and the exhaust of the vacuum pump must be vented into a chemical fume hood.

(2) SSTs. Solid sorbent tubes are either metal (stainless steel is preferred) or glass tubes that contain a small quantity of a solid sorbent such as Porapak Q® or Tenax-GC® (these have been previously used for collection of GB and HD, respectively). A typical SST sampler is shown in Figure A-5. This sampler is aspirated for a prescribed period of time. Following the prescribed sampling period, the SST can be replaced with a fresh tube using a sample sequencer. The sample is produced by passing an extraction solvent through the sorbent bed. The extraction solvent picks up the analyte being tested. An aliquot of the solvent is then analyzed conventionally on the GC to measure the chemical. The tubes are then cleaned by simultaneously heating and purging with nitrogen. The results obtained by the solid sorbent sampler are averaged over the sampling period.

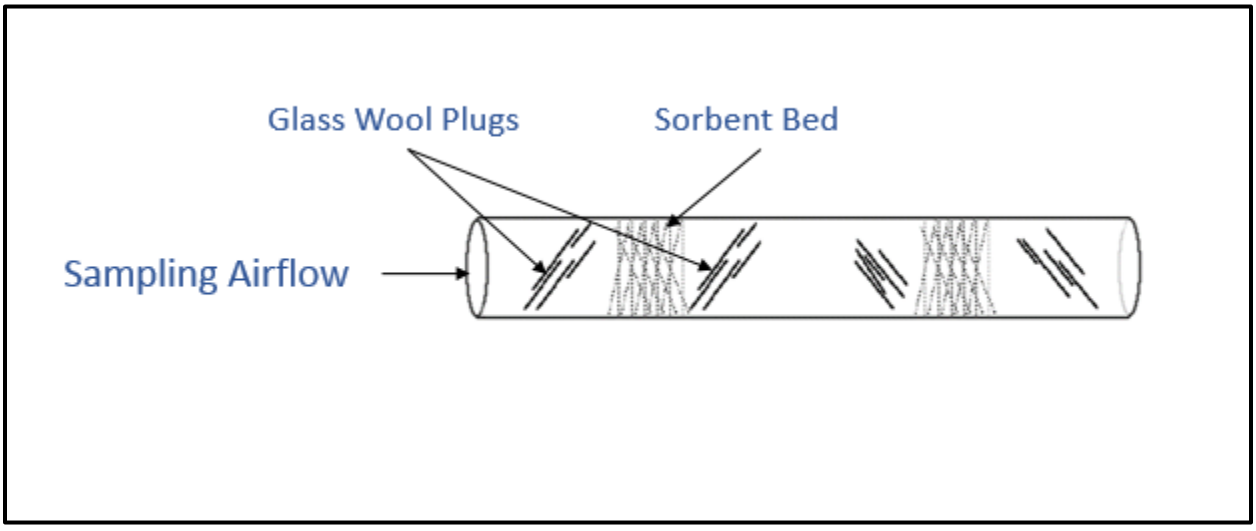


Figure A-5. Typical solid sorbent tube sampler.

(3) When cumulative SSTs are used, the minimum quantification limit (MQL) must be considered in determining sampling intervals. If too many sampling intervals are used, the MQL for a sampling interval may exceed the allowable permeation pass/fail criteria when totaled for the cumulative value.

d. MINICAMS®.

(1) This instrument contains a SST, a GC, and the connections, ovens, etc., necessary to automatically sample an air stream and analyze the sample for a selected compound. The air stream is sampled for a selected interval of time with the internal SST. Any chemical absorbed by the SST is then thermally desorbed into the GC for analysis of the vapor collected. The SST is automatically cycled between the collection and the thermal desorption, or GC, stages. Four standard cycle-periods are programmed: 3, 5, 10, or 15 minutes with air sampling performed at a maximum flow rate of 1 L/minutes for 1, 3, 8, or 13 minutes, respectively. The time difference between the sample time and the total time is the purge time for the instrument.

(2) When operating on the 3-minute cycle (1 minute of air sampling at 1 L/min), the MINICAMS® can measure chemical agent vapors in the air at the Surgeon General's 8-hour time-weighted average concentration. Longer cycle times provide longer air sampling periods and lower detection levels. This instrument is capable of giving NRT estimates of the amount of chemical passing through a single SUT item. A single instrument should be dedicated to sample a single SUT item. An automated stream selection system can be used to cause a single MINICAMS® to sequentially sample a series of SUTs.

(3) Such sequential sampling increases the time between data points obtained from any single SUT item but provides information for several SUT items. Suitable care must be given to the choice of air sampling lines, airflow rates, and material of construction of the sequencing valve. This care is necessary to minimize the possibility of losses of the chemical through sorption on surfaces and possible time delays caused by stagnant air in the sampling lines leading to the sequencing valve. The advantage of MINICAMS® is the instrument is not a cumulative sampler meaning there are many samples taken over the sampling period. A test item breakthrough concentration profile can be constructed to determine the time of breakthrough of a test item within the interval of sampling. A fixture concentration profile can be constructed and overlaid on the test item concentration profile to observe the relevant challenge concentration.

e. M8 Chemical Agent Detector Paper. This is a standard detector paper that develops a colored spot when exposed to liquid chemical agent. The amount of HD agent needed to provide a visible spot is 0.7 μg (a 0.1 mm diameter drop). A slightly smaller mass of other agent will give a positive response. Use of M8 chemical agent detector paper is qualitative, lacks sensitivity, and the colored spots formed are frequently very difficult to see.

f. M9 Chemical Agent Detector Paper. This is a standard detector paper that has the same capabilities and limitations as the M8 chemical agent detector paper.

APPENDIX B. ABBREVIATIONS.

ATEC	U.S. Army Test and Evaluation Command
ATTN	attention
BFC	battlefield contaminant
°C	degrees Celsius
CAPAT	Capability Area Process Action Team
cm	centimeter
CoC	chain of custody
CWA	chemical warfare agent
DAS	data acquisition system
DoE	Design of Experiment
DPG	U.S. Army Dugway Proving Ground
DTIC	Defense Technical Information Center
DTP	Detailed Test Plan
°F	degrees Fahrenheit
GB	sarin
GC	gas chromatograph(y)
GD	soman
HD	distilled mustard
HPLC	high-performance liquid chromatography
IAW	in accordance with
iwg	inches water gauge
JP8	jet propulsion fuel number 8
LC	liquid chromatography
L/V	liquid challenge/vapor penetration
µL	microliter
mg	milligram
mL	milliliter
mql	minimum qualification limit

APPENDIX B. ABBREVIATIONS.

ng	nanogram
NRT	near-real time
PPE	personal protective equipment
POL	petroleum, oils, and lubricants
QA	quality assurance
QC	quality control
RH	relative humidity
RSDL	Reactive Skin Decontamination Lotion
SAR	safety assessment report
SDS	safety data sheet
SEP	System Evaluation Plan
SICN	sample identification control number
slpm	standard liter per minute
SMARTMAN	Simulant Agent Resistance Test Manikin
SOP	Standing Operating Procedure
SSP	system support package
SST	solid sorbent tube
SUT	system under test
TECMIPT	Test and Evaluation Capability and Methodology Integrated Process Team
TIIN	test item identification number
TOP	Test Operations Procedure
V/V	vapor challenge/vapor penetration

APPENDIX C. REFERENCES.

1. TOP 08-2-196 Simulant Selection for Laboratory, Chamber, and Field Testing, 25 April 2011.

2. TOP 08-2-140, Establish an Agent-Simulant Technology Relationship (ASTR), 14 April 2017.

3. TOP 08-2-500A, Receipt and Inspection of Chemical-Biological (CB) Materiel, 31 August 2017.

4. U.S. Army Nuclear and Chemical Agency (USANCA), Springfield, Virginia, Department of the Army (DA) Approved Nuclear, Biological, and Chemical (NBC) Contamination Survivability Criteria for Army Materiel, 30 May 2005.

(This page is intentionally blank.)

APPENDIX D. APPROVAL AUTHORITY.

CSTE-CI 23 June 2020

MEMORANDUM FOR

Commander, U.S. Army Operational Test Command
Director, U.S. Army Evaluation Center
Commanders, ATEC Test Centers
Technical Directors, ATEC Test Centers

SUBJECT: Test Operations Procedure 08-2-138, Glove and Boot Testing, Approved for Publication

1. Test Operations Procedure (TOP) 08-2-138, Glove and Boot Testing, has been reviewed by the U.S. Army Test and Evaluation Command (ATEC) Test Centers, the U.S. Army Operational Test Command, and the U.S. Army Evaluation Center. All comments received during the formal coordination period have been adjudicated by the preparing agency.

2. Scope of the document. This TOP provides the standardized procedures for preparation, planning, conduct, and reporting of glove and boot testing. This TOP addresses quantification tests for vapor permeation or penetration of vapor and liquid chemical warfare agents through protective gloves or boots.

3. This document is approved for publication and has been posted to the Reference Library of the ATEC Vision Digital Library System (VDLS). The VDLS website can be accessed at https://vdls.atc.army.mil/.

4. Comments, suggestions, or questions on this document should be addressed to U.S. Army Test and Evaluation Command (CSTE-CI), 6617 Aberdeen Boulevard-Third Floor, Aberdeen Proving Ground, MD 21005-5001; or e-mailed to usarmy.apg.atec.mbx.atec-standards@mail.mil.

ZWIEBEL.MICHA
EL.J.1229197269

MICHAEL J. ZWIEBEL
Director, Directorate for Capabilities Integration (DCI)

APPENDIX D. APPROVAL AUTHORITY.

TECMIPT Test Operations Procedure (TTOP) 08-2-138 for Glove and Boot Testing

Warfighter Protection Capability Area Process Action Team (CAPAT):

U.S. Army Dugway Proving Ground (DPG)

CAPAT Review & Concurrence: July 2019

Test and Evaluation Capabilities and Methodologies Integrated Process Team (TECMIPT) Participants:

DISTRIBUTION A. Approved for public release: distribution unlimited.

REFERENCES:
(a) *Chemical and Biological Defense Program (CBDP) Test and Evaluation (T&E) Standards Development Plan*, dated 19 July 2010.
(b) *Memorandum of Understanding (MOU) Among the Department of National Defence of Canada the Secretary of State for Defense of the United Kingdom of Great Britain and Northern Ireland and the Secretary of Defense on Behalf of the Department of Defense of the United State of America concerning the Research, Development and Acquisition of Chemical, Biological and Radiological Defense Materiel*, dated June 2000. Amendment One, dated August 2006.

APPENDIX D. APPROVAL AUTHORITY.

TECMIPT Test Operations Procedure (TTOP) 08-2-138 for Glove and Boot Testing

The Warfighter Protection CAPAT recommends approval of the TECMIPT Test Operations Procedure (TTOP) 08-2-138 for Glove and Boot Testing. If a representative non-concurs, a dissenting position paper will be attached.

Organization	Signature	Date
Deputy Under Secretary of the Army Test and Evaluation (DUSA-TE)	OBRIEN.SEAN.P.1230553501 Sean P. O'Brien	
Joint Program Executive Office of Chemical Biological Defense (JPEO-CBD) Test & Evaluation	RYBAK.JOSEPH.MICHAEL.1364953735 Joseph Rybak	
Joint Requirements Office for Chemical, Biological, Radiological and Nuclear Defense (JRO-CBRND)	MCMANUS.PAUL.MAR SHALL.1155992537 LTC Paul M. McManus, USA	
Joint Science and Technology Office (JSTO)	Tom Yazuk	09 Oct '19
US Army Evaluation Center (AEC)	YOST.EMILY.D.1245776124 Emily Yost	
Operational Test and Evaluation Force (OPTEVFOR)	CAPT R Ramirez, USN	15 JUL 2019
Air Force Operational Test and Evaluation Center (AFOTEC)	Carlton W. McGuire, GS-13, USAF	5 Jul 19
Marine Corps Operational Test & Evaluation Activity (MCOTEA)	WADLEY.MICHAEL.CRAIG.1130810841 Michael Wadley	Oct 03 2019
Warfighter Protection CAPAT Co-Chair	FITHIAN.ROBERT.C.1401863199 Robert Fithian	
Warfighter Protection CAPAT Co-Chair	DRESSEN.BRIAN.MICHAEL.1387124179 Brian Dressen	

(This page is intentionally blank.)

Forward comments, recommended changes, or any pertinent data, which may be of use in improving this publication to the Policy and Standardization Division (CSTE-CI-P), U.S. Army Test and Evaluation Command, 6617 Aberdeen Boulevard, Aberdeen Proving Ground, Maryland 21005-5001. Technical information may be obtained from the preparing activity: Commander, West Desert Test Center, US Army Dugway Proving Ground, ATTN: TEDT-DPW, Dugway, UT 84022-5000. Additional copies can be requested through the following website: https://www.atec.army.mil/publications/documents.html, or through the Defense Technical Information Center, 8725 John J. Kingman Rd., STE 0944, Fort Belvoir, VA 22060-6218. This document is identified by the accession number (DTIC AD No.) printed on the first page.