DEPARTMENT OF THE ARMY
OFFICE OF THE DEPUTY UNDER SECRETARY OF THE ARMY
102 ARMY PENTAGON
WASHINGTON, DC 20310-0102

JUL 27 2012

DUSA TE

MEMORANDUM FOR SEE DISTRIBUTION

SUBJECT: Endorsement of Test Operating Procedure (TOP) 8-2-502, Chemical, Biological, and Radiological Contamination Survivability (CBRCS): Material Effects Testing

1. Reference: Memorandum, DUSA-TE, 19 July 10, subject: Chemical and Biological Defense Program (CBDP) Test and Evaluation (T&E) Standards Development Plan

2. In accordance with the reference, TOP 08-2-502 was coordinated through the T&E Capabilities and Methodologies Integrated Process Team (TECMIPT) development and review process. It received signed concurrences from the members of the Decontamination Capability Area Process Action Team (CAPAT) and was approved by the U.S. Army Test and Evaluation Command (ATEC).

3. In order to support the Life Cycle Management of this TOP, to include future updates and improvements, I request that as this TOP is used, any necessary revisions be provided to the TECMIPT Chair for review. TOPs are references for T&E Strategies (TESs) and T&E Master Plans (TEMPs) and deviations could result in risk of unreliable data.

4. With the enclosed recommendation from the TECMIPT Chair, and approval by DTC, I endorse this TOP as a DoD T&E Standard for CBRCS testing, and encourage its broad use across all test phases. The T&E Standards are for government associated program use and access. They are stored in Army Knowledge Online, and in the TECMIPT share point site. To obtain access to the site, contact the site administrator, Lynn.coles@us.army.mil. My point of contact for this action is Megan Holste, megan.j.holste.ctr@mail.mil.

Encl

JAMES C. COOKE
CBRN T&E Executive

DUSA-TE
SUBJECT: Endorsement of Test Operating Procedure (TOP) 8-2-502, Chemical, Biological, and Radiological Contamination Survivability (CBRCS): Material Effects Testing

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AMXAA-CD 19 July 2012

MEMORANDUM FOR

Chemical, Biological, Radiological and Nuclear Defense Test and Evaluation Executive, Office of the Deputy Under Secretary of the Army, Taylor Building, Suite 8070, 2530 Crystal Drive, Arlington, VA 22202

SUBJECT: Test Operations Procedure (TOP) 8-2-502, Material Effects Testing.

1. The Decontamination Commodity Area Process Action Team (CAPAT) has completed their review of the subject TOP in accordance with the DUSA-TE Instructions to the TECMIPT, the Standards and Development Plan, and the TECMIPT Standard Operating Procedure (SOP). All signatory members of the CAPAT have provided their concurrence to this TOP (enclosed). The CAPAT signature sheets and the ATEC Approval for Publication memorandum are enclosed.

2. Based on the concurrence of the CAPAT, I recommend the CBRND T&E Executive endorse this TOP as a DoD Test and Evaluation (T&E) Standard.

Carl M. Eissner

Encl

CARL M. EISSNER
TECMIPT Chair

TECMIPT Test Operations Procedures (TTOP) 8-2-502, Chemical, Biological, and Radiological Contamination Survivability: Material Effects Testing

Decontamination Capability Area Process Action Team (CAPAT):

Primary Author: *William G. Davis, Dugway Proving Ground (DPG)*
Key Contributors: *Debbie Beier, Dugway Data Services Team (DDST)*
Philip Caine, Booz Allen Hamilton
Owen Applequist, Booz Allen Hamilton

CAPAT Review & Concurrence: January 2012

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.

Test Operations Procedure (TOP) 8-2-502 Material Effects Testing

DECONTAMINATION CAPAT CONCURRENCE SHEET	
Bill Davis Decon CAPAT Chair	Sean Harrison US Army Evaluation Center (AEC)
Bill Davis 3 AUG 11 Signature Date:	Sean C Harrison 4/20/12 Signature Date:
JAMES K ECK, Colonel, USAF Vice Commander Air Force Operational Test and Evaluation Center (AFOTEC)	Rob Van Alstine Marine Corps Operational Test and Evaluation Activity (MCOTEA)
James K Eck 7 JUL 11 Signature Date:	Rob Van Alstine 11/4/11 Signature Date:
LT Shallia Sapatoro Commander Operational Test and Evaluation Force (COMOPTEVFOR)	Jimmy Cornette Office of the Deputy Under Secretary of the Army-Test and Evaluation
Signature Date: 05AUG11	Signature Date: 29 Aug 11
Karen Bowen Joint Program Executive Office for Chemical Biological Defense (JPEO-CBD)	Anton Ramage, Lt Col, USAF Joint Requirements Office for Chemical, Biological, Radiological, and Nuclear Defense (JRO-CBRND)
Signature Date: 27 Aug 2011	Signature 28 Jul 11 Date:
Michael Roberts Joint Science and Technology Office (JSTO)	Gene Stark PROTECT Director T&E, Joint ~~Program~~ Manager Protection (JPM Protection)
23-AUG-2011 Signature Date:	Gene Stark 25 Aug 11 Signature Date:

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West Desert Test Center (TEDT-DPW-CTC)
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14. ABSTRACT
This Test Operations Procedure (TOP) provides basic information to facilitate planning, conducting, and reporting of material effects testing. This TOP provides standard methods for chemical, biological, and radiological (CBR) contamination survivability (CS) coupon testing of materials for use in military systems. The procedure is designed to provide material effects data for changes in critical properties after exposure to CBR contaminants, simulants, and decontaminants. This TOP describes typical facilities, equipment, and procedures used to contaminate and decontaminate material coupon samples for measured changes in material critical properties and sample for residual contamination. A process for including the data in the Department of Defense (DoD) Chemical Biological Material Effects (CBME) Database is also provided.

15. SUBJECT TERMS
CBR; chemical; biological; radiological; NBC; nuclear, biological, chemical; contamination; decontamination; survivability; hardness; decontaminability; compatibility; simulant; fallout; material effects, Chemical Biological Material Effects database

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

*Test Operations Procedure 08-2-502 22 June 2012
DTIC AD No.

CHEMICAL, BIOLOGICAL, AND RADIOLOGICAL CONTAMINATION SURVIVABILITY: MATERIAL EFFECTS TESTING

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1. SCOPE.

1.1 Purpose.

a. The primary focus of the material effects Test Operations Procedure (TOP) is to ensure that Department of Defense (DoD) mission-critical systems have a standard procedure for determining the effects of chemical, biological, and radiological (CBR) contamination and decontamination. The requirement for a procedure to determine CBR survivability is derived from DOD Instruction (DoDI) 3150.09, The Chemical, Biological, Radiological, and Nuclear (CBRN) Survivability Policy[1] and in accordance with (IAW) the requirement in the Ronald Reagan National Defense Authorization Act for fiscal year (FY) 2005, Public Law (PL) No. 108-375, 28 October 2004[2].

b. The purpose of this TOP is to outline procedures for material testing for CBR contamination survivability (CS) and the transfer of data into the Chemical and Biological Material Effects (CBME) database. This TOP will establish procedures for gathering test data in order to assist designers, engineers, testers, and evaluators in determining changes in material properties after exposure to CBR contamination and decontamination. It is the design engineer's responsibility to evaluate the material effects data as applied to each particular system tested. Assessment of the data by the design engineer is to ensure material degradation by chemical and biological (CB) contamination and decontamination does not significantly retard system performance, making the system DoDI 3150.09 non-compliant.

c. This TOP will provide the procedures for generating information on the effects of CBR contaminants, stimulants, and decontaminants on materials used in the design, construction, and manufacture of mission-critical systems. System developers can use this information to make material selection decisions during the system acquisition process.

d. The term CBR, rather than nuclear, biological, and chemical (NBC), is used in this document to reflect current DoD terminology. The North Atlantic Treaty Organization (NATO) and other U.S. allied documentation still uses the term NBC, and this will be reflected in references within this document.

1.2 Limitations.

a. This TOP will evaluate how materials of construction, not systems or system components, respond to CBR contaminants and decontaminants. This TOP will not provide a list of materials suitable for use in DoD systems.

b. This TOP will not address inherent variability in materials and coatings. The only means to address this limitation is by documenting, to the extreme, all the details of what the material is, where it is procured, what the coating is, and how the coating is applied, etc.

*Superscript numbers correspond to Appendix C, References.

c. This TOP will not address the correlation between materials tests and component mission-essential functions.

d. This TOP will not evaluate the variability in test results that may occur because of the shape of the materials. Although results from this TOP will be derived from flat coupons, the materials may contain crevices, nooks, etc., when incorporated into fielded systems.

e. The results obtained from materials effects testing must be interpreted by system developers based on the needs and requirements of the specific system under development. Therefore, both the material and system performance specifications should be reviewed before planning and test execution.

f. The material's performance specification should also be reviewed before planning test execution. For example, the decontamination process or exposure effects on the system should be considered.

g. This TOP does not address safety and security requirements when using radiological sources. Instead, this TOP describes the use of fluorescent particles as a simulant to imitate the behavior of radiological fallout particles as much as possible.

1.3 Method of Evaluation.

a. The method of evaluation is to determine the degree of change in material properties between uncontaminated materials and those contaminated by CBR agents, simulants, and/or decontaminants.

b. Test results produced may be used for materials screening to ensure appropriate materials are selected for a given application.

c. Test results following this TOP may be used to assist the system engineer/designer in determining if the resulting reaction from exposure to specific challenges produces desirable or undesirable physical characteristics, changes for materials selection, or properties optimization.

2. FACILITIES AND INSTRUMENTATION.

2.1 Facilities.

Facilities, instrumentation, and safety procedures used for CBR survivability testing are strictly controlled. The principle controlling regulations are found in Department of the Army (DA) Regulation (AR) 385-61[3] and DA Pamphlet (PAM) 385-61[4]. Additional discussion and requirements for facilities and instrumentation are included in the test procedures outlined in paragraphs 4.1 through 4.3.

Item	Requirement
Chemical surety laboratory and chemical agent storage facility.	Constructed to ensure safe and secure storage, handling, analysis, and decontamination of chemical agents and simulants used for test and evaluation.
Chemical agent test facility (chemical agent test chamber).	To house the test item during agent or simulant contamination, decontamination, and sampling. The chamber should have sufficient volume to allow free air circulation around and underneath the test item. The test facility/chamber must have the ability to control temperature, relative humidity (RH), and wind speed.
Fielded and/or experimental decontaminants.	To decontaminate the test item/material as part of the test procedure.
Standard decontaminating apparatus.	To decontaminate the surety test facilities after test completion.
Fluorescent particle (FP) and biological assay laboratories.	Required to store and prepare test quantities of biological and residual radiological contamination simulant materials, charge disseminating devices, prepare samplers, and analyze all biological agent simulant and radiological simulant (FP) materials.
Chambers for biological and residual radiological simulant testing.	Equipped with an air intake and an exhaust system that exhausts through high-efficiency particulate filters (capable of retaining 99.7 percent of particles, 0.3 μm or greater in diameter), into an exhaust system. The chamber should have sufficient volume to allow free air circulation around the test item. Biological surety regulations will be followed when using biological warfare agents (BWA).

NOTE: U.S. Government DoD test facilities that can conduct chemical surety materials testing are limited to Edgewood Chemical and Biological Center (ECBC) and U.S. Army Dugway Proving Ground (DPG). U.S. Government test facilities that can conduct non-surety materials testing include, but are not limited to: ECBC, DPG, Air Force Research Laboratory, Wright-Patterson Air Force Base (AFB), and the Naval Surface Warfare Center, Dahlgren, Virginia.

2.2 Instrumentation.

The instrumentation choices are test and test location dependent. The specific parameters, measuring device and permissible error measurement may also be test and test location dependent. The accuracy of selected instruments is outlined below. Precision is an inherent quality of the testing instrumentation, not the test methodology. Therefore, the precision required is left to the test site to be outlined in the test plan.

Parameter	Measuring Device	Permissible Error of Measurement
Air temperature (30 °C (Celsius) desired).	Thermocouple or other.	± 0.5 °C.
Relative humidity (40 percent desired).	Hygrometer or other.	± 2 percent.
Wind or air speed desired (<1 meter per second ((m/s)).	Anemometer.	± 0.1 m/s.
Photographs.	Still color camera.	Adequate to document typical test procedures, details of contamination techniques and contamination density (including mass median diameter (MMD) of drops), and any discrepancies from planned procedures necessitated by operational conditions.
Video.	Video camera.	Same as photographs above.

2.3 Chemical Test Instrumentation.

Parameter	Measuring Device	Permissible Error of Measurement
Chemical agent vapor.	Bubblers, MINICAMS (a miniature, automatic, continuous air-monitoring system), solid sorbent tubes, or equivalent.	± 5 percent liters per minute (L/min (flow rate)).

Parameter	Measuring Device	Permissible Error of Measurement
Contamination density or challenge level (g/m^2) and drop size (on the material surface) in mm.	Digital imaging device for digitally measuring or "reading" the diameter of the drops. Software for calculations. A control coupon will also be used for the calculation of the actual contamination density applied.	Contamination density, ± 10 percent. Drop size diameter, ± 10 percent
Chemical agent mass from vapor samples (µg).	Gas chromatography (GC), high-performance liquid chromatography (HPLC), liquid chromatography (LC), spectrophotometer, or equivalent.	± 15 percent of calibration curve except when the lower calibration standard is at or near the method detectable limit, the permissible error is ± 25 percent.
Chemical agent mass from liquid samples (µg).	Chemical agent mass from liquid samples can be measured using analytical balance after the liquid agent is transferred to the sampling specimen, such as silicone rubber or latex dental dam.	± 15 percent of calibration curve except when the lower calibration standard is at or near the method detectable limit, then the permissible error is ± 25 percent; extraction efficiency of solvent.

2.4 Biological Test Instrumentation.

Parameter	Measuring Device	Permissible Error of Measurement
Contamination.	Collision atomizer or equivalent.	Not applicable (NA).
Background contamination.	Microscopes, automatic colony counters (or equivalent), or swabs or wipes placed in growth medium.	± 10 percent colony-forming units (CFU)/sample.
Post-contamination verification.	Microscopes, automatic colony counters (or equivalent), or swabs or wipes placed in growth medium.	± 10 percent CFU/sample.

Parameter	Measuring Device	Permissible Error of Measurement
Post-decontamination.	Microscopes, automatic colony counters (or equivalent), or swabs or wipes placed in growth medium.	±10 percent CFU/sample.

NOTE: The instrumentation described above only refers to that needed for spore-forming organisms. The instrumentation for viruses and bio toxins are not identified here.

2.5 Radiological Test Instrumentation.

This testing must be controlled by location (e.g., Idaho National Laboratory) or by using short-life radioactive isotopes (e.g., one to two week half life isotopes) and the laboratories ability to handle radioactive materials through licensing. Currently testing is conducted using FP as a radiological simulant.

Parameter	Measuring Device	Permissible Error of Measurement
Contamination.	Collision atomizer or equivalent.	NA.
Background contamination.	Alpha, beta, or gamma-spectrometry, liquid scintillation counting, neutron flux.	± 5 Bq/g and ± 5 cGy
FP background contamination	Microscope	± 10 percent
Post-contamination verification.	Alpha, beta, or gamma-spectrometry, liquid scintillation counting, neutron flux.	± 5 Bq/g and ± 5 cGy
Post-decontamination.	Alpha, beta, or gamma-spectrometry, liquid scintillation counting, neutron flux.	± 5 Bq/g and ± 5 cGy

2.6 Chemical, Biological, and Radiological Material Effects Test Instrumentation.

a. The system engineer will choose system materials based on specific material properties. The properties of interest to the system engineer should be communicated to the

testing facility. These specific properties will frame the scope of the material effects testing. Appendix A references potential material effects properties. It is inconceivable to list all potential equipment necessary for specific material effects testing. The tester(s) should refer to industrial standards (i.e., the American Society for Testing and Materials (ASTM)) when planning material effects tests.

b. The CBR material effects information section should include all instrumentation necessary to properly evaluate the material effects to be tested. The list should be all-encompassing of equipment, both general and specific, with parameters and permissible error of measurement for the properties necessary for the material being tested.

Parameter	Measuring Device	Permissible Error of Measurement
Material properties as related to mission-essential functions.	As necessary.	Precision and accuracy requirements must be compatible with the nature of the test material and must allow detection of degradation of physical properties after completion of each contamination/decontamination (C/D) cycle.

3. REQUIRED TEST CONDITIONS.

CBR material effects testing require the use of CBR agents. Such testing is strictly controlled by AR 385-61. Throughout testing, primary emphasis must be on operator safety. Nevertheless, the importance of technical quality, scientific integrity, completeness of test data, and conformance with specified test and operating procedures cannot be overemphasized.

3.1 Test Planning.

3.1.1 Pretest Preparation.

a. Each test plan must be reviewed for technical accuracy and conformance to regulations and standard operating procedures (SOPs) or other standard methods applicable to the specific material tests being conducted. In addition, the test plan should describe the material properties to be tested. The test plan must reflect the overall purpose of establishing the effects of C/D on the material as it pertains to the system being evaluated, not as a means to evaluate the overall system. The published test records, procedures, and test case files of similar materials, material families, or items with the same material composition should be reviewed where applicable. All SOPs and procedures should be current and reviewed for safety.

b. For DoD-specific application material testing, the capabilities documents (e.g., Initial Capability Document (ICD), Capability Development Document (CDD), or Capability Production Document (CPD)) are to be reviewed. The System Evaluation Plan (SEP) and the Test and Evaluation Master Plan (TEMP) will be used to determine the overall test structure,

data required, criteria, and analysis to be used. Critical physical properties to be tested for each material will be identified in order to determine if those properties being tested are affected as a result of C/D (see Appendix A). The units of measurement as well as the precision and tolerance required for each parameter being measured will be identified. All issues concerning measurable performance and degradation will be identified. The system's Failure Definition Scoring Criteria (FDSC) may be a useful source for defining material characteristics/parameters to test.

c. For material testing of a DoD-specific application, the number of test items and the number of C/D cycles that need to be conducted on the system will be determined based on the information collected from the capabilities document, SEP, and TEMP. Coordination will be made with the customer. Historically, five cycles of C/D have been conducted on each test item to accommodate one radiological cycle, one biological cycle, and three chemical agent cycles for the three classes (nerve, persistent nerve, and blister) of chemical warfare agents (CWAs) outlined in Quadripartite Standardization Agreement (QSTAG) 747[5]. The exact number of C/D cycles shall be determined through coordination between the tester, customer, and evaluator.

d. Test methods and standards may require modification to accommodate surety and safety limitations. Any such modification must be documented in the test plan and report.

3.2 Environmental Documentation (U.S. Only).

All local, state, and federal environmental regulations will be complied and appropriate documentation will be prepared and submitted.

3.3 Safety.

Applicable safety and surety regulations will be consulted to ensure compliance of all test procedures.

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

a. Controls and limitations applicable to a specific subtest are presented in Section 4 as part of the procedure to which they apply.

b. QA is a system of management activities undertaken to ensure that a process, item, or service is of the type and quality needed by the user. QC is the activities that show process control. Test facilities employing this TOP are expected to have a QA plan in place that describes the necessary QA, QC, and other technical activities that must be implemented to ensure that the results of the work performed will satisfy the stated performance criteria. QA plans must be updated on a regular basis to reflect advances in techniques and methods, instrumentation, and performance requirements. Effective structure and execution of supporting QA/QC activities will ensure that the generation and dissemination of information derived from the use of this TOP is of known and appropriate quality and useful for its intended purpose.

c. Receipt inspection of the test material/test sample must be conducted. TOP 08-2-500[6] outlines one method of conducting receipt inspection. Inspection data, certificates of

compliance, or similar documentation should be reviewed to ensure that surfaces and finishes meet specifications. When packaging is damaged, the test material/test sample must be carefully examined to determine the extent of any damage. All receipt inspection information will be recorded and described in any test reports.

d. Decontamination. Existing system-specific decontamination procedures using fielded decontaminants or developmental decontaminants must be reviewed and incorporated into the planned test as much as possible. Any deviations from existing procedures will be documented in the test report.

e. Test Conduct. Testing must always be conducted IAW approved test documentation, such as technical manuals, doctrinal tactics, techniques, and procedures (TTPs), testing SOPs, and the test plan. Deviations from test documentation will be put in writing and approved by the appropriate authority. Data pertaining to surface materials and their finishes will be reported in a form that can be compared to pretest and posttest functional performance data. If Soldiers are desired, ensure a Test Schedule and Review Committee (TSARC) request is submitted within one year from the start of testing or as early as possible.

4. TEST PROCEDURES.

a. In general, material properties tests will first be conducted on uncontaminated specimens, and the results will be recorded. Establishment of a baseline is vital for the accuracy in the comparison of changes in the material effects due to the exposure of CB contaminants, simulants, decontaminants, and decontamination processes. Test considerations include whether the procedures are destructive or non-destructive testing. Destructive testing is defined as those test methods used to examine an object to the point of specimen failure. Non-destructive testing is defined as those test methods used to examine an object without impairing its future usefulness.

b. Any degradation of the materials must be attributed to the CBR agent, the CBR simulant, the decontaminant, or the decontamination process. The material properties must be evaluated using the specified test method. Whenever possible, ASTM International, Association of Official Analytical Chemists (AOAC) International, or American Society of Metals (ASM) International standard methods shall be used.

c. At times, contaminated specimens may be allowed to sit for an extended period of time to simulate operational scenarios before decontamination is conducted.

d. Testing may involve the selection and/or verification of chemical compounds to simulate chemical agents. TOP 08-2-196[7] provides guidance to support selection and/or verification for the selection of chemical compounds to simulate chemical agents. This selection process is a critical step in testing with simulants. Agent/simulant data will lose relevance without adequate side-by-side comparison data to confirm test procedure validity. Such agent/simulant comparison data must be obtained in a laboratory study. No single compound will simulate all of the important physical and chemical properties of an agent.

e. The simulants selected should be safe to handle and require minimum protective gear, equipment, and procedures; cause little or no environmental concern; and require minimum handling and storage problems.

f. Simulants selected for material effects testing are to be based on expected threats and should have as many appropriate physical properties, e.g., volatility, viscosity, and surface tension values similar to the agent being simulated as possible. Even if a simulant adequately mimics all of these properties, there is no assurance that the simulant will have the same effect on the test item as the actual agent. Therefore, the use of multiple simulants may be necessary for a particular agent to meet selected data requirements.

g. Likewise, simulants selected for decontaminability testing must closely match the properties listed in paragraph 4.f, the absorption/solubility in the surface and diffusion coefficient, and the solubility in the decontamination solution; have similar chemical interactions with the decontaminants used; and have a sensitive laboratory analysis procedure to detect and measure the amount of simulant present.

Test Conditions	Rationale for Testing
Uncontaminated materials.	Baseline for all properties comparison.
Agent-contaminated materials (CWA, simulants, etc.).	Compare to uncontaminated materials.
Decontaminated materials (decontaminants).	Compare to uncontaminated materials or agent-contaminated materials.
Agent-contaminated and subsequently decontaminated materials.	Compare to uncontaminated materials, agent-contaminated materials, and decontaminated materials.

4.1 Material Effects Testing.

Identify critical physical properties to be tested for each material. Refer to Appendix A for potential properties of interest.

4.1.1 Objectives.

a. Collect information on the effects of CBR agents, stimulants, and/or decontaminants on materials of construction.

b. Provide data to the CBME database.

4.1.2 Criteria and Recommended Conditions.

4.1.2.1 Criteria.

There are no criteria for general screening, as testing determines the degree of change in the material properties of interest. Testing determines what material changes occur and under what conditions. The design engineer or evaluator will determine if any recorded changes are within acceptable limits.

4.1.2.2 Recommended Conditions.

a. Standardized conditions, as described in applicable test documentation.

b. Immersion testing conditions with CWAs, as determined by the stakeholders (not a preferred test method).

c. For Chemical Challenge testing, the challenge shall be IAW QSTAG 747[5] as follows, or as determined by the stakeholders:

(1) Exterior material challenge default shall be 10 g/m^2 with a 2 to 5 µL drop (or as necessary for small material samples/coupons) for unthickened agents and 5 to 10 µL drop for thickened agents.

(2) Interior material challenge default shall be 1 g/m^2 with a 2 to 5 µL drop (or as necessary for small material samples/coupons) for unthickened agents and 5 to 10 µL drop for thickened agents.

(3) Agent drop mass can be used as the measurement by taking into account the agent's density.

(4) The purity of the chemical agents used must be known and recorded as test data. The quantity applied may be adjusted to achieve the required pure agent-contamination density. If a weapons grade agent is used, the purity must be measured and recorded as test data.

d. Biological Challenge.

(1) Aerosol suspension, as determined by the stakeholders, with a default value[5] of 1 to 5 µm to achieve a contamination density of 1×10^8 CFU on the test sample surface.

(2) Liquid suspension, as determined by the stakeholders, with a default value[5] of 1 to 5 µL to achieve a contamination density of 1×10^8 CFU on the test sample surface.

e. Radiological Challenge. Aerosol suspension, as determined by the stakeholders, with a default value[5] of 4 g/m^2 of insoluble radioactive contaminants, 37-200 µm in size, and 185 gigabecquerel (GBq)/m^2 gamma activity.

f. If testing for a specific system, the challenge should reflect the threat assessment.

4.1.2.3 Controls and Limitations.

During the course of testing, not all test conditions may be controllable; any and all deviations must be noted.

4.1.2.4 Data Required.

a. Report the following data in the units indicated. Record the data in the smallest increments that the instrumentation/procedure is designed to achieve and be easily read. If agent/simulant correlation data are being gathered, appropriate simulant property information will be included.

(1) Size (cm) and shape of material undergoing testing.

(2) Materials property data from testing the uncontaminated specimens.

(3) Materials property data from the CWA contaminated specimens.

(4) Materials property data from the decontaminated specimens.

(5) CWA properties:

(a) Name and control number.

(b) Purity in percent.

(c) Viscosity (if thickened) in centistokes (cSt) as measured at 20 °C.

(d) Age since thickened, if thickened.

(e) Quantity of dye and/or thickener (if thickened) in g/L.

(f) Quantity of agent dispensed in grams.

(g) Agent contamination density in g/m^2.

(h) Agent droplet diameter in mm.

(i) Dwell time allowed on material before decontamination begins.

(j) Dilution of agent, if applicable.

(6) BWA properties:

(a) Strain name.

(b) Lot or control numbers.

(c) Exterior contamination density: $1 \pm 0.5 \times 10^7$ CFU/m^2.

(d) Particle size: 1 to 5 µm.

(7) Radiological properties:

(a) Radioactive isotope used (when appropriate).

(b) Simulant used (when appropriate).

(c) Lot number, if applicable.

(d) Particle size range in µm.

(e) Simulant color, if applicable.

(8) Decontaminants:

(a) Name, national stock number (NSN), and lot number.

(b) Manufacturer's directions for use.

(c) Active ingredient determination, if necessary.

(d) Decontaminant application method.

(e) Equipment used to apply the decontaminant.

(f) Contact time in minutes.

b. Sample history indicating any time delays between contamination, decontamination, and analysis.

c. Contamination, dwell time, decontamination time, weathering time, and sampling times in minutes.

d. Names and titles of principal test participants.

e. Description of test specimen (i.e., surface condition (pretest), paint type, paint thickness (number of coats), paint condition, and surface cleanliness), with photographs.

f. Description and photographs of any materials degradation (e.g., corrosion) after each C/D cycle.

g. Monitored environmental conditions and data recorded at least every 15 minutes. The environmental conditions include air temperature, RH, and airflow.

4.1.2.5 Methods and Procedures.

a. The material selection rationale shall be fully documented.

b. Generally, material properties shall be tested using a specified test method established by ASTM International, AOAC International, ASM International, or another recognized standardization body.

c. Rationale for any deviation from the test procedures shall be documented.

4.1.2.6 Test Location.

a. If CWAs are used, it will be IAW AR 50-6[8].

b. If BWAs are used, it will be IAW AR 50-1[9].

4.1.3 Contamination Challenges.

a. The agents to be used are as follows:

(1) Neat nerve agent (VX) with a purity greater than 85 percent (unless weapons grade is desired). The agent may be dyed with approximately 0.5 percent (weight/volume) of a suitable dye.

(2) Neat soman agent (GD) with a purity greater than 85 percent and thickened with 5 percent (weight/volume) of Rohm and Haas Acryloid™ K125 poly (methyl methacrylate). This should provide the thickened agent with a viscosity of 1000 cSt at 20 °C. Batch-to-batch variability in viscosity can be greater than 10 percent. Complete dissolution of the polymer in GD is slow; therefore, mixing should continue until the measured viscosity is constant. The agent may be dyed with approximately 0.5 percent (weight/volume) of a suitable dye.

(3) Neat mustard agent (HD) with a purity greater than 85 percent (unless weapons grade is desired). The agent may be dyed with approximately 0.5 percent (weight/volume) of a suitable dye.

(4) Other approved challenges (e.g., contaminants, simulants, toxic industrial chemicals (TIC)/toxic industrial materials (TIM)) must be used as specified in the test documentation.

b. Simulants as specified in the test plan are to be based on the results of an agent/simulant relationship study. Simulants may be selected to produce desired chemical and/or physical properties of CBR threat agents in cases where use of the agent itself is either impossible or impractical. As simulants typically share a very small number of properties with the threat material itself, care must be taken to select appropriate simulants based upon the specific properties required.

4.1.4 Receipt Inspection.

a. Before testing, a receipt inspection will be performed on the test specimens. The test specimens will be inspected for shipping damage. Any damage or other discrepancies will be documented.

b. The surfaces will be inspected for foreign materials normally not present on the item. The materials will be inspected and found to be free of defects, corrosion, or degradation.

c. The surface condition, surface cleanliness, corrosion, materials of construction, variance from standard painting, and paint condition will be recorded.

4.1.5 Test Preparation.

a. All resources are to be in place to begin testing. For C/D cycles involving biological and radiological simulants, locations will be marked to ensure samples are taken from contiguous areas.

b. All specimens will be marked with unique identification numbers for sample tracking. The sample coding will be placed to not interfere with testing.

4.1.6 Agent Application.

4.1.6.1 Chemical Challenge Application.

a. The selected areas of the test specimen will be contaminated with agent, simulant, or other contaminant, applied with a suitable dissemination device that has been calibrated with material of similar physical properties and operated at the flow rate and pressure to achieve the drop size and contamination density specified in the test plan.

b. Photographs of drops on the contaminated surface will be taken to record the deposition effects.

4.1.6.2 Biological Challenge Application (Spore-forming Organisms Only).

a. The test item will be placed in the test chamber and the chamber will be brought to the environmental conditions specified for the test. The test item will be temperature-conditioned for a minimum of 24 hours. Temperature, RH, and wind speed will be recorded at a minimum of every 15 minutes for the duration of the test.

b. Before contamination of the test item, the first of each three 25 cm^2 sampling areas will be swab sampled to determine the background contamination level and residual substances (decontaminant) that could interfere with sample assay.

c. The air inside the chamber will be contaminated to a level of approximately 1×10^6 CFU/L of air.

d. Immediately after completion of chamber air contamination, the chamber air will be sampled for test organism concentration, using all glass impingers without pre-impingers. One hour will be allowed for contamination to settle on the test item. After the settling, the chamber will be air-washed for 1 hour to reduce chamber contamination. The 1-hour air-wash can also serve as the 1-hour weathering time.

e. Immediately after the air-wash, the second 25 cm^2 area in each set will be air-washed to determine the test item contamination density.

4.1.6.3 Radiological Challenge Application.

a. A dry disseminating apparatus will be calibrated to disperse 4 g/m^2 of particles. A time, air pressure, and contaminant quantity will be determined to contaminate the test item to the target level.

b. The background radiation will be measured before dissemination of the contaminant onto the material sample.

c. The contaminant will be disseminated onto the material sample.

d. One hour will be allowed for contamination to settle on the test item then the chamber will be air-washed for 1 hour to reduce chamber air contamination.

e. After the 1-hour air-wash and before decontamination of the test item, a second radiation measurement will be taken.

4.1.7 Decontamination.

a. Decontamination should begin after completion of agent dissemination and within the time interval specified in test documentation. Standard procedures, decontaminants, equipment, and any test item-specific procedures will be used when supplied as part of the test documentation package. This may include rinsing the residual decontaminant with water after the prescribed decontaminant soaking time.

b. Decontaminant contact time must be IAW specific procedures included in the test documentation package. If there are no instructions for contact time, then a default time of 30 minutes will be used.

c. Post-decontamination sampling must be IAW specific procedures included in the test documentation package.

d. Decontamination procedures used in the test may need to be developed to mimic standard decontamination or operational field decontamination procedures. These procedures may be material specific. Decontamination procedures, which may be developed, must have procedures that are reproducible by other personnel at other testing facilities.

e. A post-decontamination radiation measurement will be taken before material testing.

f. All procedures must be documented in the test report. Video documentation is recommended, but still photographs can be used.

4.2 Data Reduction and Analysis.

a. The degree of change will be determined between the:

(1) Uncontaminated specimen and the contaminated specimen.

(2) Uncontaminated specimen and the decontaminated specimen.

(3) Contaminated specimen and the decontaminated specimen.

(4) Uncontaminated and the contaminated/decontaminated specimen.

b. Any anomalies occurring during testing will be noted.

c. All raw data and calculations of degree of change will be placed in spreadsheet format.

4.3 Monitoring for Long-Term Material Effects.

The purpose of this Section is to outline the materials effects testing process if and when necessary to supplement the general testing process or specific CBR testing methodology outlined in Materials Effects Testing (paragraph 4.1) as it pertains to the long-term material effects.

4.3.1 Objectives.

a. Collect long-term effects information of CBR agents, simulants, and decontaminants on material.

b. Provide data to the CBME database.

4.3.2 Criteria and Conditions.

4.3.2.1 Criteria.

There are no criteria for general screening, as testing is to determine the degree of change in material properties of interest over extended periods of time. The criteria for specific materials selection will be based on the application of this material within the system. Testing is to determine what material changes occur and under what conditions. The design engineer or evaluator will determine if any recorded changes are within acceptable limits.

4.3.2.2 Recommended Conditions.

The conditions section should detail how the conditions should/would change or require alteration from the standard material effects testing to those necessary for materials effects testing when combined with long-term material effects.

a. Standardized conditions, as described in applicable test documentation.

b. Immersion testing conditions with CWA, as determined by the stakeholders.

c. Drop testing conditions, as determined by the stakeholders:

(1) Exterior material challenge default is 10 g/m^2 with a 2 to 5 µL drop for unthickened, and 5 to 10 µL drop for thickened at 30 °C.

(2) Interior material challenge default is 1 g/m^2 with a 2 to 5 µL drop for unthickened, and 5 to 10 µL drop for thickened at 30 °C.

d. Biological Challenge:

(1) Aerosol suspension, as determined by the stakeholders, with a default value of 1 to 5 µm.

(2) Liquid suspension, as determined by the stakeholders, with a default value of 1 to 5 µL.

e. Radiological Challenge, as determined by the stakeholders, with a default value of 4 g/m^2 of insoluble radioactive contaminants, 37-200 µm in size and 185 GBq/m^2 gamma activity.

f. The purity of the chemical agents used must be known and recorded as test data. The quantity applied may be adjusted to achieve the required pure-agent contamination density. If a weapons grade agent is used, the purity must be measured and recorded as test data.

g. If material coupon testing is for a specific system, the challenge should reflect the threat assessment.

4.3.2.3 Controls and Limitations.

During the course of testing, not all test conditions may be controllable; any and all deviations must be noted. The methodology differences between material effects testing and long-term material effects testing must be annotated.

4.3.2.4 Data Required.

a. The following data will be reported in the units indicated. The data will be recorded in the smallest increments that the instrumentation/procedure is designed to achieve and be easily read.

(1) Materials property data from testing the uncontaminated specimens.

(2) Materials property data from the CWA contaminated specimens.

(3) Materials property data from the decontaminated specimens.

(4) CWA properties:

(a) Name and control number.

(b) Purity in percent.

(c) Viscosity after adding thickener (if thickened) in cSt.

(d) Age since thickened, if thickened.

(e) Quantity of dye and/or thickener (if thickened) in g/L.

(f) Quantity of agent dispensed in g.

(g) Agent contamination density in g/m^2.

(h) Agent droplet diameter in mm.

(i) Dwell time allowed on material before decontamination begins.

(j) Dilution of agent, if applicable.

(5) BWA properties:

(a) Name and control number.

(b) Background concentration in CFUs.

(c) Contamination concentration in CFUs.

(d) Post-decontamination concentration in CFUs.

(6) Radiological properties:

(a) Chamber temperature in °C, RH in percent, and calculated airflow in m/sec.

(b) FP lot or control number, color, particle count/g, and particle size range in µm.

(c) FP disseminator used, operating air pressure in pounds per square inch (psi), dissemination time in seconds, mass of FP disseminated in grams, and chamber air contamination density in FP particles/L of air.

(d) Test item FP background control counts, test item FP surface contamination density counts, test item FP residual contamination counts in particles/cm^2, and FP counting control values.

(7) Decontaminants:

(a) Name, NSN, and lot number.

(b) Manufacturer's directions for use.

(c) Active ingredient determination, if necessary.

(d) Application method.

(e) Contact time in minutes.

(f) Documented decontamination method.

b. The data required should include only data specifically necessary for materials effects testing as it relates to long-term changes in critical properties. The data required should be an extension of the general data required listed in paragraph 4.12.4.

c. Sample history indicating any delays between contamination, decontamination, and analysis will be listed.

d. Contamination, dwell time, decontamination, weathering, and sampling times in minutes, hours, or days.

e. Names and titles of principal test participants will be noted.

f. Description of test specimen (i.e., surface condition (pretest), paint type, paint thickness (number of coats), paint condition, and surface cleanliness), with photographs will be

recorded. The test specimen shall be delivered, constructed, coated, and painted as ordered. It will be cleaned, except for perhaps some oil to protect it from corrosion. Care should be taken to degrease it before testing with a material specified in the test plan.

g. Description and photographs of any materials degradation (e.g., corrosion) will be noted. The materials will be inspected and found to be free from defects, corrosions, or degradations. The surface condition of corrosion panels will be important to the results. Predisposition to corrosion would invalidate the test or at least skew the results.

h. The environmental conditions should be monitored, and data should be recorded at least every 15 minutes. The environmental conditions include air temperature, RH, and airflow.

4.3.2.5 Test Location.

If CWAs are used, it will be IAW AR 50-6.

4.3.3 Agents.

The agents to be used are as follows:

a. Neat VX with a purity greater than 85 percent (unless weapons grade is desired). The agent may be dyed with approximately 0.5 percent (weight/volume) of a suitable dye.

b. Neat GD with a purity greater than 85 percent and thickened with 5 percent (weight/volume) of Rohm and Haas Acryloid™ K125 poly (methyl methacrylate). This should provide the thickened agent with a viscosity of 2300 cSt at 25 °C. Batch-to-batch variability in viscosity can be greater than 10 percent. Complete dissolution of the polymer in GD is slow; therefore, mixing should continue until the measured viscosity is constant. The agent may be dyed with approximately 0.5 percent (weight/volume) of a suitable dye.

c. Neat HD with a purity greater than 85 percent (unless weapons grade is desired). The agent may be dyed with approximately 0.5 percent (weight/volume) of a suitable dye.

d. Other approved challenges (e.g., contaminants, simulants, TICs/TIMs) as specified in the test documentation.

4.3.4 Receipt Inspection.

a. Before testing, a receipt inspection will be performed on the test specimens. Inspect for shipping damage. Any damage or other discrepancies will be noted.

b. Surfaces will be inspected for foreign materials normally not present on the item (e.g., dust, mud, grease, or marking). Foreign materials may be removed by brushing, vacuum cleaning, or washing with soapy water and a sponge. Surface condition, surface cleanliness, corrosion, materials of construction, variance from standard painting, and paint condition will be recorded.

4.3.5 Test Preparation.

a. All resources are to be in place to begin testing. Locations will be marked to ensure samples are taken from the same area.

b. All specimens will be marked with unique identification numbers for sample tracking and will be placed to not interfere with testing.

4.3.6 Agent Application.

a. Selected areas of the test specimen will be contaminated with agent using a suitable dissemination device that has been calibrated with material of similar physical properties and operated at the flow rate and pressure to achieve the drop size and contamination density specified in the test plan.

b. Photographs of droplets on the contaminated surface will be taken to record the deposition and spread effects.

4.3.7 Decontamination.

a. Decontamination should begin within the time interval specified in test documentation after completion of contamination. Standard procedures, decontaminants, equipment, and any test item-specific procedures will be used when supplied as part of the test-documentation package.

b. Decontaminant contact time must be IAW specific procedures included in the test documentation package. If there are no instructions for contact time, then a default time of 30 minutes will be used.

c. Post-decontamination must be IAW specific procedures included in the test documentation package.

d. Decontamination procedures used in the test may need to be developed to mimic standard decontamination or operational field decontamination procedures. These procedures may be material specific. Decontamination procedures, which may be developed, must have results that are reproducible.

e. All procedures must be documented in the test report. Video documentation is recommended, but still photographs can be used.

5. DATA REQUIRED.

a. Complete description of material(s) tested to include: common name(s), manufacturer's name, dimensions, coatings, etc.

b. Result of pre-contamination physical property measurement(s).

c. Challenge level of agent (CWA, BWA, TIC, decontaminant, etc.) applied to the material.

d. Weathering time or time that the agent is resident on the material surface before a physical property measurement or decontamination is conducted (in minutes).

e. Results of post-contamination physical property measurement(s), if performed.

f. Description of any rinses and the solutions used in the rinses, to include: applicator used to apply the rinse, pressure (if applicable) of the rinse, the materials used to rinse, any physical actions performed when rinsing, etc.

g. Complete description of the decontaminant used on the contaminated material, to include: manufacturer, lot number, any physical actions performed during decontamination, applicator used to apply the decontaminant, etc.

h. Contact time of the decontaminant on the agent-contaminated material (in minutes).

i. Result of post-decontamination physical property measurement(s).

6. PRESENTATION OF DATA.

For government-sponsored testing, test reports will be forwarded to the Defense Technical Information Center (DTIC) and/or the Chemical, Biological, Radiological, and Nuclear Information Analysis Center (CBRNIAC). For industry-sponsored testing, it is requested that test methods and data be forwarded to CBRNIAC with a document reference so the information can be placed in the CBME database. Data submission should follow the CBME test data template (Appendix A). A separate submission of the data to CBRNIAC in an Excel® spreadsheet may expedite data entry into the CBME database.

APPENDIX A. MATERIAL PROPERTIES MATRIX AND DATA TEMPLATE.

The material properties matrix provides a useful tool for Program Managers (PM), testers, and database developers to acquire the information needed to ensure that defense systems are survivable to the effects of the CBR C/D process. This matrix details the critical properties of materials that PMs and testers may consider when determining if mission-critical systems are survivable in a CBR environment by measuring any significant degradation to these critical properties. While survivability determinations are not limited to the materials and properties listed in this matrix, it provides a framework for data that PMs and testers should provide to the CBME database so that appropriate survivable materials can be selected during the design of new systems or system upgrades.

APPENDIX A. MATERIAL PROPERTIES MATRIX AND DATA TEMPLATE.

TABLE 1. MATERIALS AND PROPERTIES OF INTEREST

		Properties	Metals	Laminates	Adhesives/Sealants/ Joints (Including Welds)	Coatings	Potting Compounds	Optical Materials (Metal Oxides, Plastics, etc.)	Elastomers	Plastics	Composite Materials	Petroleum, Oil, and Lubricants (POL)	Textiles	Ceramics
Agent Effects	1	Agent absorption (µg/cm^2 absorbed per time period) and agent desorption (µg/cm^2 desorbed per time period)		X	X	X	X	X	X	X	X		X	X
	2	Permeation (time to breakthrough of agent)/penetration of vapors and liquids			X	X	X		X	X			X	X
	3	Weight change	X	X	X	X	X	X	X	X	X		X	X
	4	Density	X	X	X	X	X				X			X
	5	Off gassing (vapor)	X	X	X	X	X	X	X	X	X		X	X
	6	Contact hazard (liquid)	X	X	X	X	X	X	X	X	X		X	X
Mechanical Properties	7	Elastic modules	X	X	X				X	X	X			
	8	Tensile Properties (yield strength, ductility)	X	X	X		X	X	X	X	X		X	X
	9	Hydrogen embrittlement	X	X	X	X								
	10	Ultimate strength for tension (flexural)		X	X									
	11	Compressive strength	X	X	X			X		X	X			X
	12	Shear strength	X	X	X		X			X	X			X
	13	Fracture toughness (compression, bending, tensile, shear, impact)	X	X	X	X	X	X	X	X	X			X
	14	Hardness (indentation, durometer, scratch resistance)	X	X	X	X	X	X	X	X	X		X	X
	15	Resilience (capacity to absorb energy elastically)	X	X					X	X	X			X
	16	Fatigue strength (includes adhesives for structural bonds)	X	X	X					X	X			X
Mechanical Properties	17	Puncture resistance							X	X	X		X	X
	18	Creep (rupture) strength	X	X	X					X	X			
	19	Compressive spring constant							X		X			
	20	Bond strength	X	X	X						X			X

APPENDIX A. MATERIAL PROPERTIES MATRIX AND DATA TEMPLATE.

TABLE 1. MATERIALS AND PROPERTIES OF INTEREST (CONT'D).

		Properties	Metals	Laminates	Adhesives/Sealants/ Joints (Including Welds)	Coatings	Potting Compounds	Optical Materials (Metal Oxides, Plastics, etc.)	Elastomers	Plastics	Composite Materials	Petroleum, Oil, and Lubricants (POL)	Textiles	Ceramics
POL Properties	21	Thermal stability										X		
	22	Chemical compatibility										X		
	23	Lubricity										X		
	24	Solubility										X		
	25	Melting point/boiling point										X		
	26	Viscosity										X		
Physical Properties	27	Dimensional change	X	X	X	X	X	X	X	X	X		X	X
	28	Color change (discoloration, surface finish)	X	X	X	X	X	X	X	X	X		X	X
	29	Optical clarity/distortion (haze, transmittance, reflectance)				X		X		X				X
	30	Crazing, stress, corrosion, cracking	X	X	X	X	X	X		X				X
	31	Acoustic dampening		X		X					X			
	32	Glass transition temperature		X	X			X	X	X	X			X
	33	Rubber property-effects of liquids							X					
	34	Peel/lap shear strength change		X	X	X					X			
	35	Adhesion (loss of), blistering, spalling		X	X	X	X				X			X
	36	Corrosion rate	X	X	X						X			X
Thermal Properties	37	Thermal conductivity	X	X	X	X	X			X	X			X
	38	Flame resistance		X	X			X	X	X	X		X	X
	39	Flash point/ignition temperature			X	X						X	X	
Electrical Properties	40	Insulative properties (including dissipation factor)		X		X	X		X	X	X			X
	41	Dielectric constant		X	X	X	X	X	X	X	X			X
	42	Electrical conductivity	X	X	X	X	X		X	X	X			
	43	Impedance	X	X	X	X	X		X	X	X			
	44	Relative permittivity		X		X				X	X			X
	45	Polarizability (effect on radar signals)		X		X				X	X			X

APPENDIX A. MATERIAL PROPERTIES MATRIX AND DATA TEMPLATE.

TABLE 2. DATABASE ELEMENTS

SAMPLE INFORMATION							
Report_No.	Material	Sample_ No./Lot	Test_Personnel/ Titles	Property	PropertyUnits	Challenge_(agent/simulant/ decontaminant)	TradeNameTested

MATERIAL INFORMATION							
Material_Desc _Manufacturer	Material_Desc _Composition	Material_Desc _Form	Material_Desc_ Characteristics	Material_Desc_ Specifications	Material_Desc_Fabrication Method	Material_Desc _Treatments	Material_Desc _Remarks

Challenge Properties & Conditions				
Challenge_Desc _Composition	Challenge_Desc _Purification	Challenge_Desc _Prep_Method	Challenge_Desc _Amount	Challenge_Desc _Remarks

Test Specimen & Conditions														
Test_Desc_Specimen_Prep _Method/Pre-Photographs	Test_Desc_Specimen _Type	Test_Desc_Specimen _Dimensions	Test_Desc_Specimen _Count	Test_Desc_Specimen_ Preconditions	Test_Desc_Test _Equipment	Test_Desc_Test _Procedure	Test_Desc_Sample _Count	Test_Desc_Exposure _State	Test_Desc_Exposure _Conditions	Test_Desc_Exposure _Temp	Test_Desc_Sample _Exposure_History	Test_Desc_Exposure _Remarks	Test_Desc_Exposure _Time_Operator	Test_Desc_Exposure _Time	Test_Desc_Test_ Specification

Test Value														
Test_Desc_Initial_ Value_Operator	Test_Desc_ Initial_Value	Test_Desc_Initial _Value_Std_Dev	Test_Desc_Initial _Value_Low	Test_Desc_Initial _Value_High	Test_Desc_Control _Value_Operator	Test_Desc_Control _Value	Test_Desc_Control _Value_Std_Dev	Test_Desc_Control _Value_Low	Test_Desc_Control_ Value_High	Test_Desc_Delta _Value_Operator	Test_Desc_Delta _Value	Test_Desc_Delta _Value_Std_Dev	Test_Desc_Delta _Value_Low	Test_Desc_Delta _Value_High

Results											
Result_Property_ Value_Operator	Result_Property _Value	Result_Property_ Value_Std_Dev	Result_Property _Value_Low	Result_Property _Value_High	Result_Percent_Change _Operator	Result_Percent _Change	Result_Percent_ Change_Std_Dev	Result_Percent _Change_Low	Result_Percent_ Change_High	Result_Remarks	Result_Post_Testing _Photographs

APPENDIX A. MATERIAL PROPERTIES MATRIX AND DATA TEMPLATE.

TABLE 2. DATA TEMPLATE

Challenge Information								Decontamination Information				
Sample Name/Product Number	Agent/Simulant/ Decontaminant	Application/ Delivery Method (e.g., Immersion/ Droplet (MMD)/Film, etc.)	Challenge (e.g., g/m^2, etc.)	Purity	Temperature (e.g., Deg F, Deg C, etc.)	RH	Exposure Time	Method (e.g. Weathering, Wet Soak, Wet Scrub, etc.)	Decon Time Duration and Post Decon Weathering	Residual Vapor Dosage Chemical (e.g., mg·min/m^3, etc.)	Residual Biological Contamination (e.g., CFU, etc.)	Residual Radiological Contamination (e.g., particles/m^2, etc.)

APPENDIX A. MATERIAL PROPERTIES MATRIX AND DATA TEMPLATE.

TABLE 2. CONTINUED

Agent Effects						
Sample Name //Product Number	Agent Absorption ($\mu g/cm^2$ absorbed per time pd.) and Agent Desorption ($\mu g/cm^2$ desorbed per time pd.)	Permeation (time to breakthrough of agent)/ Penetration of Vapors and Liquids	Weight Change	Density	Off Gassing (vapor)	Contact Hazard (liquid)

TABLE 2. CONTINUED

Mechanical Properties (cite method, SOP, ASTM, etc. used)														
Sample Name/ Product Number	Elastic Modulus	Tensile Properties (yield strength, ductility, etc.)	Hydrogen Embrittlement	Ultimate Strength for Tension (flexural)	Compressive Strength	Shear Strength	Fracture Toughness (compression, bending, tensile, shear, impact, etc.)	Hardness (indentation, durometer, scratch resistance, etc.)	Resilience (capacity to absorb energy elastically)	Fatigue Strength (includes adhesives for structural bonds)	Puncture Resistance	Creep (rupture) Strength	Compressive Spring Constant	Bond Strength

APPENDIX A. MATERIAL PROPERTIES MATRIX AND DATA TEMPLATE.

TABLE 2. CONTINUED

Petroleum, Oils, and Lubricants Properties (cite method, SOP, ASTM, etc. used)						
Sample Name/Product Number	Thermal Stability	Chemical Compatibility	Lubricity	Solubility	Melting Point/Boiling Point	Viscosity

TABLE 2. CONTINUED

Physical Properties (cite method, SOP, ASTM, etc. used)										
Sample Name/ Product Number	Dimensional Change	Color Change (discoloration, surface finish)	Optical Clarity/ Distortion (haze, transmittance, reflectance)	Crazing, Stress Corrosion Cracking	Acoustic Dampening	Glass Transition Temperature	Rubber Property- Effects of Liquids	Peel/Lap Shear Strength Change	Adhesion (loss of), Blistering, Spalling	Corrosion Rate

APPENDIX A. MATERIAL PROPERTIES MATRIX AND DATA TEMPLATE.

TABLE 2. CONTINUED

Thermal Properties (cite method, SOP, ASTM, etc. used)			
Sample Name/Product Number	Thermal Conductivity	Flame	Flash Point/Ignition Temperature

TABLE 2. CONTINUED

Electrical Properties (cite method, SOP, ASTM, etc. used)						
Sample Name/Product Number	Insulative Properties (cite method, SOP, ASTM, etc. used) (including dissipation factor)	Dielectric Constant	Electrical Conductivity	Impedance	Relative Permittivity	Polarizability (effect on radar signals)

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APPENDIX B. ABBREVIATIONS.

AD No.	accession number
AEC	U.S. Army Evaluation Center
AFOTEC	Air Force Operational Test and Evaluation Center
AFB	Air Force Base
AMCR	U.S. Army Materiel Command Regulation
AOAC	Association of Official Analytical Chemists
AR	Army Regulation
ASM	American Society of Metals
ASTM	American Society for Testing and Materials
Bq	Becquerel
BWA	biological warfare agent
C	Celsius
C/D	contamination/decontamination
CAPAT	Commodity Area Process Action Team
CB	chemical and biological
CBME	Chemical Biological Material Effects
CBR	chemical, biological, and radiological
CBRN	chemical, biological, radiological, and nuclear
CBRNIAC	Chemical, Biological, Radiological, and Nuclear Information Analysis Center
CDD	Capability Development Document
CRDEC	U.S. Army Chemical Research, Development, and Engineering Center
CFU	colony forming units
cGY	centiGray
COMOPTEVFOR	Commander operational Test and Evaluation Force
CPD	Capability Production Document
CS	contamination survivability
cSt	centistokes
CWA	chemical warfare agents
DA	Department of the Army
DoD	Department of Defense
DoDI	Department of Defense Instruction
DPG	U.S. Army Dugway Proving Ground
DTIC	Defense Technical Information Center
DUSA TE	Deputy Under Secretary of the Army, Test and Evaluation
ECBC	Edgewood Chemical and Biological Center

APPENDIX B. ABBREVIATIONS.

FDSC	failure definition scoring criteria
FY	fiscal year
FP	fluorescent particle
GBq	gigabecquerel
GC	gas chromatography
GD	neat soman agent
HD	neat mustard agent
HPLC	high-performance liquid chromatography
IAW	in accordance with
ICD	Initial Capability Document
JPEO-CBD	Joint Program Executive Office for Chemical Biological Defense
JPM	Joint Project Manager
JRO-CBRND	Joint Requirements Office for Chemical, Biological, Radiological, and Nuclear Defense
JSTO	Joint Service and Technology Office
L/min	liters per minute
LC	liquid chromatography
m/s	meters per second
MCOTEA	Marine Corps Operational Test and Evaluation Activity
MIL-STD	military standard
MINICAMS	a miniature, automatic, continuous air-monitoring system
MMD	mass median diameter
NA	not applicable
NATO	North Atlantic Treaty Organization
NBC	nuclear, biological, and chemical
NSN	national stock number
PAM	pamphlet
PL	Public Law
PM	Program Manager
POL	petroleum, oils, and lubricants
psi	pounds per square inch
QA	quality assurance
QC	quality control
QSTAG	Quadripartite Standardization Agreement

APPENDIX B. ABBREVIATIONS.

RH	relative humidity
SEP	System Evaluation Plan
SOP	Standard Operating Procedure
T&E	Test & Evaluation
TB MED	Technical Bulletin Medical
TECMIPT	T&E Capabilities and Methodologies Integrated Process Team
TEMP	Test and Evaluation Master Plan
TIC	toxic industrial chemical
TIM	toxic industrial material
TOP	Test Operations Procedure
TSARC	Test Schedule and Review Committee
TTP	tactics, techniques, and procedures
VX	nerve agent

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APPENDIX C. REFERENCES.

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o. U.S. Army Materiel Command Regulation (AMCR) 385-100, Safety: Safety Manual, 26 September 1995.

APPENDIX D. APPROVAL AUTHORITY.

CAPAT Cover Sheet

TEST OPERATIONS PROCEDURE (TOP) 8-2-502
MATERIAL EFFECTS TESTING

Decontamination Commodity Area Process Action Team (CAPAT)

Primary Author: William G. Davis, Dugway Proving Ground (DPG)
Key Contributors: Debbie Beier, Dugway Data Services Team (DDST)
Phillip Caine, Booz Allen Hamilton
Owen Applequist, Booz Allen Hamilton

CAPAT Review & Concurrence: January 2012

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

APPENDIX D. APPROVAL AUTHORITY.

CAPAT Signature Sheet

Test Operations Procedure (TOP) 8-2-502 Material Effects Testing

DECONTAMINATION CAPAT CONCURRENCE SHEET	
Bill Davis Decon CAPAT Chair	Sean Harrison US Army Evaluation Center (AEC)
Bill Davis 3 AUG 11 Signature Date:	Sean C Harrison 7/20/12 Signature Date:
JAMES K ECK, Colonel, USAF Vice Commander Air Force Operational Test and Evaluation Center (AFOTEC)	Rob Van Alstine Marine Corps Operational Test and Evaluation Activity (MCOTEA)
James K Eck 7 JUL 11 Signature Date:	Rob Van Alstine 11/4/11 Signature Date:
LT Shallia Sapatoro Commander Operational Test and Evaluation Force (COMOPTEVFOR)	Jimmy Cornette Office of the Deputy Under Secretary of the Army-Test and Evaluation
Signature Date: 25AUG11	Signature Date: 29 Aug 11
Karen Bowen Joint Program Executive Office for Chemical Biological Defense (JPEO-CBD)	Anton Ramage, Lt Col, USAF Joint Requirements Office for Chemical, Biological, Radiological, and Nuclear Defense (JRO-CBRND)
Signature Date: 27 Aug 2011	28 Jul 11 Signature Date:
Michael Roberts Joint Science and Technology Office (JSTO)	**Gene Stark** PROTECT **Director T&E, Joint ~~Program~~ Manager Protection (JPM Protection)**
23-Aug-2011 Signature Date:	Gene Stark 25 Aug 11 Signature Date:

APPENDIX D. APPROVAL AUTHORITY.

T&E Capabilities and Methodologies Integrated Process Team (TECMIPT) Chair Endorsement

RDAM-CD 6 February 2012

MEMORANDUM FOR

Chemical, Biological, Radiological and Nuclear Defense Test and Evaluation Executive, Office of the Deputy Under Secretary of the Army, Taylor Building, Suite 8070, 2530 Crystal Drive, Arlington, VA 22202

SUBJECT: Test Operations Procedure (TOP) 8-2-502, Material Effects Testing.

1. The Decontamination Commodity Area Process Action Team (CAPAT) has completed their review of the subject TOP in accordance with the DUSA-TE Instructions to the TECMIPT, the Standards and Development Plan, and the TECMIPT Standard Operating Procedure (SOP). All signatory members of the CAPAT have provided their concurrence to this TOP. The CAPAT signature sheets are enclosed.

2. Based on the concurrence of the CAPAT, I recommend the CBRND T&E Executive endorse this TOP as a DoD Test and Evaluation (T&E) Standard.

Carl M. Eissner

Encl

CARL M. EISSNER
TECMIPT Chair

APPENDIX D. APPROVAL AUTHORITY.

Placeholder for Chemical, Biological, Radiological, and Nuclear Defense Program Test and Evaluation Executive Endorsement

APPENDIX D. APPROVAL AUTHORITY.

Approval for Publication, Director, Test Management Directorate (G9), ATEC-HQ

CSTE-TM 25 June 2012

MEMORANDUM FOR

Commanders, All Test Centers
Technical Directors, All Test Centers
Directors, US Army Evaluation Center
US Army Operational Test Command

SUBJECT: Test Operations Procedure (TOP) 08-2-502, Chemical, Biological, and Radiological (CBR) Contamination Survivability: Material Effects Testing, Approved for Publication

1. TOP 08-2-502, Chemical, Biological, and Radiological Contamination Survivability: Material Effects Testing, has been reviewed by the US Army Test and Evaluation Command (ATEC) Test Centers, the US Army Operational Test Command, and the US Army Evaluation Center. All comments received during the formal coordination period have been adjudicated by the preparing agency. An abstract of the document is as follows:

This TOP provides basic information to facilitate planning, conducting, and reporting of material effects testing. This TOP provides standard methods for chemical, biological, and radiological contamination survivability coupon testing of materials for use in military systems. The procedure is designed to provide material effects data for changes in critical properties after exposure to CBR contaminants, simulants, and decontaminants. This TOP describes typical facilities, equipment, and procedures used to contaminate and decontaminate material coupon samples for measured changes in material critical properties and sample for residual contamination. A process for including the data in the Department of Defense Chemical Biological Material Effects Database is also provided.

2. 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/.

3. Comments, suggestions, or questions on this document should be addressed to US Army Test and Evaluation Command (CSTE-TM), 2202 Aberdeen Boulevard-Third Floor, Aberdeen Proving Ground, MD 21005-5001; or e-mailed to usarmy.apg.atec.mbx.atec-standards@mail.mil.

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MICHAEL J. ZWIEBEL
Director, Test Management Directorate (G9)

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Forward comments, recommended changes, or any pertinent data which may be of use in improving this publication to the following address: Range Infrastructure Division (CSTE-TM), U.S. Army Test and Evaluation Command, 2202 Aberdeen Boulevard, Aberdeen Proving Ground, Maryland 21005-5001. Technical information may be obtained from the preparing activity: Commander, West Desert Test Center, U.S. Army Dugway Proving Ground, ATTN: TEDT-DPW, Dugway, UT 84022-5000. Additional copies can be requested through the following website: http://itops.dtc.army.mil/RequestForDocuments.aspx, 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 (AD No.) printed on the first page.