Designation: E 2411 – 07

Standard Specification for Chemical Warfare Vapor Detector (CWVD)[1]

This standard is issued under the fixed designation E 2411; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

INTRODUCTION

The primary function required for the chemical warfare vapor detector (CWVD) is as a chemical warfare agent (CWA) point detector that can be used to detect, identify, quantify, and warn personnel of the presence of vapor or gas phase CWAs. The CWVD will provide visual and audible indicators and alarms, it will display the CWA class and point concentration, and it will record and store CWA concentrations as a function of time. This information will be made available locally and for transmission to a remote location.

1. Scope

1.1 This specification covers the technical and mission requirements for the use of a CWVD and relates each of the performance and electrical shock and fire parameters to a detector requirement. Refer to Table 1 for reference material correlation.

1.2 This specification also defines the interfaces between the CWVD, communication systems, service platforms, and power sources. Refer to Table 1 for reference material correlation.

1.3 The CWVD will be used to sample air and report concentrations of the following nerve and blister CWAs: GA, GB, GD, GF, VX, HD, L, and HN_3. The CWVD is required to distinguish between agent types with the exception of G type agents. The CWVD may work in conjunction with other detection devices to provide a broader range of detection and identification.

1.4 The definitions in this specification apply only to this specification and shall be the determining factors(s) when interpreting any word or combination(s) of words. Definitions for selected terms are in Section 3. The reader is strongly encouraged to review these definitions before reading the requirements section.

1.5 The values given in SI units are to be considered the standard. The values given in parentheses are for information only.

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and to determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:* [2]

D 543 Practices for Evaluating the Resistance of Plastics to Chemical Reagents

D 2240 Test Method for Rubber Property—Durometer Hardness

2.2 *Federal Standards:*[3]

10 CFR 30 Rules of General Applicability to Domestic Licensing of Byproduct Material

10 CFR 31 General Domestic Licenses for Byproduct Material

AMCR 385-100 Army Materiel Command Regulation

AR 190-59 Chemical Agent Security Program

AR 200-2 Environmental Effects of Army Actions

AR 50-6 Chemical Surety

ATT 178 Edgewood Chemical and Biological Center, Applied Test Team - Method for Evaluating Detectors

CFR 40 Protection of Environment

49 CFR, Parts 171 -179, International Civil Aviation Organization—Technical Instructions for Safe Transportation of Dangerous Goods by Air (ICAO-TDGA)

FM 3-5 Army Study Guide - NBC Decontamination

MIL-HDBK-217F Reliability Prediction of Electronic Equipment

MIL-HDBK-781A Department of Defense Handbook for Reliability Test Methods, Plans, and Environments for Engineering, Development Qualification, and Production

MIL-STD-461E Department of Defense Interface Standard:

[1] This specification is under the jurisdiction of ASTM Committee E54 on Homeland Security Applications and is the direct responsibility of Subcommittee E54.01 on CBRNE Sensors & Detectors.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, http://www.dodssp.daps.mil.

TABLE 1 Test Method Matrix

Requirement	Test Method
4.1.2 In the personal detector application (see Table 2, which includes detector, alarm, and battery), shall weigh 5 lbs (2.25 kg) or less and be 40 in3 (655 cm3) or less in volume.	00-LC-S0314
4.1.3 In survey, fixed site, and mobile applications, shall weigh 20 lbs (9 kg) or less and be 0.5 ft3 (0.014 m3) or less in volume.	00-LC-S0315
6.1.1 Provide the functional modes described in Table 3.	00-LC-S0315
6.1.2 Allow no more than 15 min for setup and initialization, not including establishment of communication links.	00-LC-S0316
6.1.3 Provide a confidence check for operational use.	00-LC-S0317
6.1.4 Provide a design in which the personal detector system, with or without add-on(s), can meet all other application characteristics as described in Table 2.	00-LC-S0316
6.1.5 Operate in accordance with the characteristics described in Table 2.	00-LC-S0317
6.2.1 Automatically and simultaneously detect, identify, and quantify chemical agent vapors by agent class of nerve, blister, and blood and identify by specific agent type (G, VX, HD, L, and HN3).	ATT 178 AR 50-6, AR 190-59
6.2.2 Detect and provide an alarm for nerve agent vapors, and blister agent vapors, within the response times at the threshold concentrations listed in Table 4. The detection success rate shall be at least 90 % under all conditions.	ATT 178 AMCR 385-100
6.2.3 Detect and provide an alarm for nerve agent vapors, and blister agent vapors, without degradation in the presence of the interferents listed in Table 5 in accordance with Table 4. The false positive alarm rate shall not exceed 10 %.	ATT 178 AR 200-2
6.2.4 Reject the common environmental interferents as identified in Table 5 while maintaining detection capabilities in accordance with Table 4 with a detection success rate of 90 % or more.	ATT 178 AR 50-6, AR 190-59
6.2.5 Measure agent concentration (mg/m3) throughout the concentration range listed in Table 4. The measurement shall be within 10 % of the actual sample concentration, where the actual sample concentration is measured by independent method of at least ±5 % accuracy.	ATT 178, MIL-HDBK-217F
6.2.6 Reset to no-alarm status (cleardown) automatically, within 2 minute, after the CWA concentration falls within the no hazard level.	ATT 178 MIL-HDBK-781A
6.3.1 Provide audible and visual alarms or trouble signals, or both, in accordance with Table 4.	CENELEC EN ISO 3741, incl. rev. through 2002, UL 2034, §3.2, §3.15, §3.16, §60, 79.1 l), §80.1 f), §SA NFPA 72 – 02-2: 04/16/03, Chapter 7, §7.4.2, §7.4.3
6.3.2 Display agent class, agent type, and point concentration within 5 s of an alarm. Display changes in concentration at least every 15 s while in an alarm.	ANSI/ISA S12.13.01-2002, §3.2.7.2, §3.2.7.2 UL 2034, §3.2, § 3.15, §3.16, §3.19 ATT 178
6.3.3 Provide the minimum light output and flash rate for the alarm visual indicator(s) in accordance with Standard UL 1638, Visual Signaling Appliances – Private Mode Emergency and General Utility Signaling	UL 1638, §S11 UL 864, §3.60, §33, §39.2.5
6.3.4 Provide variable intensity control that produces not less than 15 candelas for all visual displays.	UL 1638, §S13
6.3.5 Provide a variable intensity audible alarm consisting of a minimum sound power of 80 dBA at 1.5 m (3 ft) with a maximum setting not to exceed 120 dBA at 1.5 m (3 ft) for the applications indicated in Table 2.	CENELEC EN ISO 3741, incl. rev. through 2002, UL 2034, §3.2, §3.15, §3.16, §60, 79.1 l), §80.1 f), §SA NFPA 72 – 02-2: 04/16/03, Chapter 7, §7.4.2, §7.4.3
6.3.6 Provide a muting capability while maintaining visual displays.	UL 864, §39.2
6.3.7 Provide an auxiliary visual indicator device capable of use in high ambient noise environments.	UL 1638.4, §13.8, §32.1 e), §33.1 e),
6.3.8 Provide a specific audible and visual trouble signal, different from the alarm that warns the operator to a malfunction of the detector.	UL 864, §3.101, §33, §34, §38.2, § 38.3, §40.3.2.12, §52, §53 UL 2034, § 4.5, §3.2, §3.5, §3.15, §3.16, §37, §SA
6.3.9 Provide an audible or visual low-power trouble signal, or both.	UL 2034, §36.2, §37.3, §52, § 59
6.3.10 Provide an audible or visual trouble signal, or both, that memory is nearly full, giving operator time to download collected data or to confirm overwrite.	UL 864, §54 UL 1998, §A2
6.3.11 Display date/time in a standard, easily understandable format, e.g. ddmmyyy, hh:mm:ss.	UL 2034, §79.1 b
6.4.1 Provide a data port for upload or query.	ANSI/TIA-232-F-1997 (R2002)
6.4.2 Accommodate future software upgrades to improve instrument performance.	UL 864, §54.1.4, 54.2
6.4.3 Provide an internal mechanism that stores and maintains data collected for 40 h of operation.	UL 864, §54.1.5, 54.1.6, 54.1.7 to be migrated into 00-LC-S0317
6.4.4 Operate the data port concurrently with normal CWVD functions in the operation mode.	UL 864, §54
6.4.5 Provide within CWVD data stream the following information: the detector identification, detector status, agent class, agent type, agent concentration, date and time of the last reset of the CWVD, self-test and diagnostic status, memory status, and internal clock time.	UL 864, §39
6.4.6 Record the concentrations of CWAs as a function of date and time as part of the CWVD data stream.	UL 864, §39.2.5 c) 2), §71
6.4.7 Perform the following system operational functions when remotely activated through the data port: activate or deactivate audible and visual indicators, conduct self-test cycle, and reset (restart) detector and determine operating status of detector.	00-LC-S0318
6.4.8 Allow data to be erased or overwritten only with confirmation. Provide security mechanism to avoid errors or loss of data.	UL 864, §54.2
6.4.9 Transmit data to the data port within 5 s of alarm, if configured for real time download.	NFPA 72, clause 8.5.3.1.5 to be migrated into 00-LC-S0317
6.5.1 Provide CWVD training features that are embedded in the CWVD and may include a self-training module that is not integral to the CWVD, for example compact disc, video, etc..	00-LC-S0317
6.5.2 When using the embedded training system, the CWVD shall allow transition between the normal operation and training modes without compromising the normal operation of the detector.	UL 1998 UL 864, §39
6.5.3 When using the embedded training system while in the presence of a CWA, the CWVD shall automatically transition to the normal operational mode and properly detect, alarm, and identify the CWA.	UL 1998 UL 864, §33.2
6.6.1 Monitor and identify 100% of mission critical failures and 80 % of noncritical failures.	MIL-HDBK-217F
6.6.2 Provide a means to check, test, and verify that all visual and audible indicators function on demand.	UL 2034, §40
6.6.3 Provide capability to perform diagnostics on CWVD either directly or through the data port.	00-LC-S0318

TABLE 1 *Continued*

Requirement	Test Method
7.1.1 Provide a MTBOF of 750 h and a MTBHF of 2400 h for man-mounted, survey, and ground vehicle applications.	MIL-HDBK-781A
7.1.2 Provide a MTBOF of 1200 h and a MTBHF of 2400 h for fixed-site applications.	MIL-HDBK-781A
7.1.3 Mean time between false alarms (MTBFA) shall be 168 h or more.	MIL-HDBK-781A
7.2.1 Provide a design that allows basic operator level corrective maintenance to be performed in less than 30 min.	UL 2034, §13.3, §14.1.4, §14.1.5, § 56, §63, §72A.8.1, §79.1 m), Appendix E1
7.2.2 Provide a design that uses common (standard) maintenance tools.	UL 1678.4 §2.5
7.2.3 If calibration is required, provide a design so that the time between calibrations is greater than six months.	UL 2075, §15.6.1
7.2.4 Provide a design so that all spare and repair parts are interchangeable between units without adjustment or modification.	UL 864, §56.2, §61.6.1.8, §86.5.1, § 89.1.9, §90.17
7.3 Storage Maintenance—Provide a design that requires no storage maintenance.	MIL-HDBK-217F MIL-HDBK-781A
8.1.1 Provide a means to allow the detector to be used as a survey instrument, installed for fixed site detection, and mounted for detection on the move.	00-LC-S0318
8.1.2 In the personal application, provide a design compatible with the first responder's activities and equipment.	OSHA Technical Manual, Section VIII: Chapter 1, Chemical Protective Clothing NFPA 1981.2002, 1982.2003, 1994.2001 revisions through 2/4/04
8.2.1 Provide for an open system, industry standard, and nonproprietary interface to support remote communications.	CAN/CSA-ISO/IEC 11179 and UL 864, § 40.3.1.1 to be migrated into 00-LC-S0317,
8.2.2 Provide security access control that identifies and authenticates with passwords, keys, or security certificates, or a combination thereof.	00-LC-S0320
8.2.3 Provide security integrity that identifies the source of data and prevents acceptance of unauthorized, modified or retransmitted messages or displays, if CWVD has capability of receiving messages/displays.	UL 864.9, §54 UL 1998, §A2
8.2.4 Provide a standard physical interface in accordance with ANSI/TIA-232-F-1997 (R2002).	ANSI/TIA-232-F-1997 (R2002)
8.3.1 Provide built-in noise, over-voltage, spike suppression, and automatic system reset.	UL 864.9, §78, §79 IEC 61000-4-3 UL 2075, §32
8.3.2 Capable of using commercially available rechargeable or non-rechargeable batteries without hardware modifications that provide 12 h of use at 15°C without replacement/recharge.	UL 1642 UL 217, §3.10, §3.11, §3.12, § 14, §15, §16, §35, §36.3, §44.7.2, §47, § 48.1, §56.2, §61.2.3, §63, §68, §69, §70.3 UL 864, §23.2, §50.3 c), §81
8.3.3 Provide the capability to recharge the battery when connected to an external power source.	UL 1642, §4.3, §11 UL 864, §50.3.4, §63, §50.2.3 UL 2089
8.3.4 Automatically change between external and internal power without interruption.	UL 864, §50.1
8.3.5 Provide a design where external power overrides internal power.	UL 864, §50
8.4.1 Provide a design that protects controls from inadvertent activation.	UL 864, §33.3.4 d), §51.6.3
8.4.2 Provide a design so that CWVD can be installed, operated, and removed by one operator dressed in Level A ensemble.	OSHA Technical Manual, Section VIII: Chapter 1, Chemical Protective Clothing NFPA 1981.2002, 1982.2003, 1994.2001 revisions through 2/4/04
8.4.3 Provide a design such that an operator wearing a Level A ensemble can replace the power source within 5 min.	NFPA 1994.2001 revisions through 2/4/04
8.4.4 Provide displays in English and readable from 1 m away under all light conditions.	ULC-S527-99 §3.11.1.6,
9.1.1.1 Operating temperature—Operate within temperature range of -32 to 49°C.	MIL-STD-810F Methods 501.4 and MIL-STD-810F Methods 502.4
9.1.1.2 Storage temperature—Survive the stored temperature range of -39 to 71°C.	MIL-STD-810F Methods 501.4 and MIL-STD-810F Methods 502.4 UL 2034
9.1.1.3 Solar radiation—Operate while exposed to direct sunlight at 49°C.	MIL-STD-810F Method 505.4
9.1.1.4 Humidity—Operate within relative humidity range of 5 to 95 %.	UL 2034 Section §46A, §41.3
9.1.1.5 Blowing rain—Operate during and after exposure to blowing rain.	MIL-STD-810F Method 506.4
9.1.1.6 Dust—Operate during and after exposure to blown dust.	MIL-STD-810F Method 510.4
9.1.1.7 Freezing rain—Operate during and after exposure to ice buildup as a result of rain, drizzle, fog, or splash after exposed ports are freed from ice or frozen debris.	MIL-STD-810F Method 521.2
9.1.2.1 Shock (1) Survive a 3 foot operator drop without protection. (2) Survive a 4 foot transit drop while in the transport mode.	MIL-STD-810F Method 516.5
9.1.2.2 Vibration (1) Operate while subject to vibration of common wheeled vehicles. (2) Survive loose cargo vibration profiles of common wheeled vehicles in the transport mode.	MIL-STD-810F Method 514.5
9.1.3.1 Meet EMI requirements set forth in MIL-STD-461E excluding space systems.	MIL-STD-461E MIL-STD 462D
9.1.3.2 Survive the lightning environment as specified in MIL-STD-464A, Section, 5.4, Table IIB, Electromagnetic Fields from Near Strike Lightning (Cloud-to-Ground).	MIL-STD 464A
9.1.4 Explosive Environment	MIL-STD-810F Method 511.4
9.1.4.1 Operate safely in an atmosphere of explosive vapors.	UL 913 and UL 1203
9.1.4.2 Operate safely in proximity to explosives/munitions.	NFPA 70.2005, Articles 500-505
10.1.1 Transportable by air, land, and sea without restrictions.	UL 2075, Section 29.2
10.1.2.1 Provide a design such that the function or operation of the system components is not compromised during shipment and storage.	CENELEC EN 61779-1 section 4.4.14
10.1.2.2 If applicable, provide special packaging and handling procedures to comply with hazardous material regulatory requirements (49 CFR, Parts 171-179 and ERG2004 (IMO-IMDGC) and ESD packaging protection.	CSA C22.2 No. 152 section 6.6.2 MIL-STD-810F for "air" and "sea" references
10.1.3.1 Provide a design such that packaging materials shall not compromise the performance the CWVD by off-gassing as a result of storage and shipment conditions.	

TABLE 1 *Continued*

Requirement	Test Method
10.1.3.2 Use ESD protective handling, packaging, and labeling in accordance with best practices.	
11.1 Corrosion control and finishing:	Test Method D 2240
(1) Resist surface degradation by chemical agents (as specified in Table 4) and	Practices D 543
(2) Resist surface degradation by decontamination solutions of water, soap, and bleach.	FM 3-5
11.2 Electrical Safety--Not generate stray voltage or discharges.	UL 61010, §6
	UL 498.14 including rev. 3-15-2006
	UL 60065.7 including rev. 3-20-2006 §9
	UL 817.10 including rev. 5-3-1999
	UL 746B.3 including rev. 2-16-2006
	UL 746C.5 including rev. 11-05-2002
	UL 217 including rev. 8-15-06, §58
	NFPA 70.2005
	IEC 61000-4-2:1995
11.3 Electrostatic Discharge (ESD)—Protect ESD-sensitive items from ESD.	UL 217.5 including rev. 8-15-06, §58
	IEC 61000-4-2:1995
11.4 Materials—The product shall include marking information within the operator's manual or on the product, or both, that clearly states the disposal guidelines for the product and batteries. The information shall include, but is not limited to the following; "Chemical Warfare Vapor Detectors and their batteries shall be disposed of in accordance with CFR 440 and all appropriate local, state, and national codes."	CFR 40
11.5 Workmanship—Ensure CWVD components are free of burrs, sharp edges, rust, discoloration, tool marks, imperfections of grinding, or any other damage or defect that could make the component unsatisfactory for the purpose intended.	UL 217 Section 58
	UL 1439
11.6.2 Provide an NRC materials license with proper exemption under Title 10 of the Code of Federal Regulations, Part 30.20 if CWVD uses a radioactive source.	00-LC-S0322

Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment

MIL-STD 462D Department of Defense Interface Standard: Test Method Standards for Measurement of Electromagnetic Interference Characteristics

MIL-STD 464A Department of Defense Interface Standard: Electromagnetic Environmental Effects Requirements for Systems

MIL-STD-810F Method 506.4 Department of Defense Test Method Standards Environmental Engineering Considerations and Laboratory Tests: Laboratory Test Methods - Rain

MIL-STD-810F Method 510.4 Department of Defense Test Method Standards Environmental Engineering Considerations and Laboratory Tests: Laboratory Test Methods - Sand and Dust

MIL-STD-810F Method 511.4 Department of Defense Test Method Standards Environmental Engineering Considerations and Laboratory Tests: Laboratory Test Methods - Explosive Atmosphere

MIL-STD-810F Method 514.5 Department of Defense Test Method Standards Environmental Engineering Considerations and Laboratory Tests: Laboratory Test Methods - Vibration

MIL-STD-810F Method 516.5 Department of Defense Test Method Standards Environmental Engineering Considerations and Laboratory Tests: Laboratory Test Methods - Shock

MIL-STD-810F Method 521.2 Department of Defense Test Method Standards Environmental Engineering Considerations and Laboratory Tests: Laboratory Test Methods - Icing/Freezing Rain

MIL-STD-810F Methods 501.4 Department of Defense Test Method Standards Environmental Engineering Considerations and Laboratory Tests: Laboratory Test Methods - High Temperature

MIL-STD-810F Methods 502.4 Department of Defense Test Method Standards Environmental Engineering Considerations and Laboratory Tests: Laboratory Test Methods - Low Temperature

MIL-STD-810F Methods 505.4 Department of Defense Test Method Standards Environmental Engineering Considerations and Laboratory Tests: Laboratory Test Methods - Solar Radiation (Sunshine)

MIL-STD-1916 Department of Defense Preferred Methods for Acceptance of Products

NFPA 70 National Electrical Code[4]

NFPA 72 National Fire Alarm Code[4]

NFPA 1981 Standard on Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services[4]

NFPA 1982 Standard on Personal Alert Safety Systems (PASS)[4]

NFPA 1994 Standard on Protective Ensembles for First Responders to CBRN Terrorism Incidents[4]

OSHA Technical Manual, Section VIII: Chapter 1 Occupational Safety & Health Administration Technical Manual - Chemical Protective Clothing[5]

2.3 *Industry Standards:*

ANSI/ASQC Z1.4-1993 Sampling Procedures and Tables for Inspection by Attributes[6]

ANSI/ISA S12 Electrical Apparatus for Use in Class 1 Hazardous (Classified) Locations[6]

ANSI/TIA-232-F-1997 (R2002) Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange[6]

[4] Available from National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA 02169-7471, http://www.nfpa.org.

[5] Available from Occupational Safety and Health Administration (OSHA), 200 Constitution Ave., NW, Washington, DC 20210, http://www.osha.gov.

[6] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

CAN/CSA-ISO/IEC 11179 Information Technology – Specifications and Standardization of Data Elements[7]
CENELEC EN ISO 3741 Acoustics - Determination of sound power levels of noise sources using sound pressure - Precision methods for reverberation rooms
CENELEC EN 61779-1 Electrical Apparatus for the Detection and Measurement of Flammable Gases- General Requirements and Test Methods
CSA C22.2 No. 152 Combustible Gas Detection Instruments[7]
ERG2004 2004 Emergency Response Guidebook International Maritime Organization -International Maritime Dangerous Goods Code (IMO-IMDGC)
IEC 61000-4-2 Electromagnetic Compatibility (EMC) – Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity tests. Basic EMC publication
IEC 61000-4-3 Electromagnetic Compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test[8]
ISO 9000.1 Quality management and quality assurance standards - Guidelines for selection and use[9]
ISO/IEC Guide 65 General requirements for bodies operating product certification systems[9]
ISO/IEC 17025 General requirements for the competence of testing and calibration laboratories[9]
UL 217 Standard for Single and Multiple Station Smoke Alarms[10]
UL 498 Standard for Attachment Plugs and Receptacles[10]
UL 746 Standard for Polymeric Materials[10]
UL 817 Standard for Cord Sets and Power-Supply Cords[10]
UL 864 Control Units and Accessories for Fire Alarm Systems[10]
UL 913 Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1, Hazardous (Classified) Locations[10]
UL 1203 Standard for Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations[10]
UL 1439 Standard for Tests for Sharpness of Edges on Equipment[10]
UL 1638 Visual Signaling Appliances- Private Mode Emergency and General Utility Signaling[10]
UL 1642 Standard for Lithium Batteries
UL 1678.4 Household, Commercial, and Professional-Use Carts and Stands for Use With Audio/Video Equipment
UL 1998 Standard for Software in Programmable Components[10]
UL 2034 Standard for Single and Multiple Station Carbon Monoxide Alarms[10]
UL 2075 Standard for Gas and Vapor Detectors and Sensors[10]
UL 2089 Standard for Vehicle Battery Adapters
UL 60065 Audio, Video and Similar Electronic Apparatus - Safety Requirements
UL 61010 Standard for Safety for Electrical Equipment for Laboratory Use[10]
ULC-S527-99 Bulletin on Field Programmable Fire Alarm Control Units
00-LC-S0314 Size and Weight[11]
00-LC-S0315 Functional Mode, Setup, Initialization and Confidence Check[11]
00-LC-S0316 Application Requirements[11]
00-LC-S0317 Data/Communications and Communication Interface[11]
00-LC-S0318 Embedded Training[11]
00-LC-S0320 CWVD Security[11]
00-LC-S0322 NRC Materials License Requirements[11]

NOTE 1—The interested party may use, with government approval, standards, specifications, or handbooks that are technically equivalent or superior to the standards listed above. In the event of a conflict between the text of this specification and the references cited, this specification takes precedence. Nothing in this specification, however, supersedes applicable laws and regulations unless a specific exemption has been obtained. Any deviation from this standard shall be noted in the documentation certifying compliance.

3. Terminology

3.1 *Definitions*—The definitions in this section apply to all chemical warfare vapor detector (CWVD) related documentation and will be the determining factor(s) when interpreting any word or combination(s) of words.

3.1.1 *add-on*, *n*—additional parts that provides tailoring of the personal detector's functionality for specific applications.

3.1.2 *agent type*, *n*—designations of specific chemical warfare agents (for example, GA, GB, GD, GF, HD, and L).

3.1.3 *automatic system reset*, *n*—function that reinitializes the system in event of system hang-up resulting from power interruptions, internal failures, and faults.

3.1.4 *calibration*, *n*—set of operations that establish, under specific conditions, the relationship between values indicated by a measuring instrument or system and the true values.

3.1.5 *class*, *n*—common classifications of chemical warfare agents are choking agents, nerve agents, blood agents, vomiting agents, blister agents, and tear agents, though there are other classifications.

3.1.6 *cleardown*, *v*—reset to no alarm status after exposure and alarm to CWA or simulant, indicating a reduction in concentration below the alarm level.

3.1.7 *collected data*, *n*—information that the CWVD collects and stores during its initialization and operational modes.

3.1.8 *common (standard) maintenance tools*, *n*—standard hand tools.

3.1.9 *component, limited life*, *n*—component that is expected to fail, but provides a minimum of one year service, and

[7] Available from Canadian Standards Association (CSA), 5060 Spectrum Way, Mississauga, ON L4W 5N6, Canada, http://www.csa.ca.
[8] Available from International Electrotechnical Commission (IEC), 3 rue de Varembé, Case postale 131, CH-1211, Geneva 20, Switzerland, http://www.iec.ch.
[9] Available from International Organization for Standardization (ISO), 1 rue de Varembé, Case postale 56, CH-1211, Geneva 20, Switzerland, http://www.iso.ch.
[10] Available from Underwriters Laboratories (UL), 333 Pfingsten Rd., Northbrook, IL 60062-2096, http://www.ul.com.

[11] Newly developed methods have been issued temporary document numbers. Once validated, these methods will be published with a standard numbering scheme and will be made available to ASTM Committee E54.

be periodically replaced and whose failure is supervised, if failure of the component affects normal operation or sensitivity.

3.1.9.1 *Discussion*—Typical examples of such components include incandescent lamps, electronic tube heaters, functional heating elements, sensors and elements of sensors and batteries.

3.1.10 *confidence check*, *n*—means to check the CWVD system to ensure correct functionality and performance prior to or during operation often through the use of a simulant.

3.1.11 *critical failure*, *n*—any fault, failure, or malfunction that results in the loss of any of the mission's essential functions.

3.1.12 *detection*, *n*—analysis of the surrounding atmosphere specifically to identify the presence of chemical warfare agent vapors.

3.1.13 *embedded training*, *n*—provides on-board operator training that allows the user to exercise the system in the absence of an actual threat.

3.1.14 *exposure concentration*, *n*—agent concentration to which an instrument is exposed during test in order to measure the response time.

3.1.15 *external power*, *n*—source of power external to the CWVD detector that provides power without the use or consumption of the internal CWVD power.

3.1.16 *failure*, *n*—event in which an item does not perform one or more of its required functions within the specified limits under specified conditions; it is also the condition in which a mechanical or structural part or component of an item is found to be deficient or inoperative.

3.1.17 *false alarm*, *n*—when the CWVD indicates the presence of CWA or simulant when none is present (false positive).

3.1.18 *functional acceptance tests*, *n*—tests performed to determine that an instrument is operational and capable of performing its intended function.

3.1.19 *hardware failure*, *n*—event (fault, failure, or malfunction) that requires a hardware maintenance action to restore the device to operational availability.

3.1.20 *initialization mode*, *n*—performed automatically upon start up (power on) of the CWVD and includes warm-up, self test and diagnostics.

3.1.21 *Level A protective clothing ensemble*, *n*—personal protective equipment that provides an individual maximum protection against hazardous vapor and liquid materials.

3.1.21.1 *Discussion*—Equipment includes a fully encapsulating, chemical-resistant suit, gloves, and boots, and a pressure-demand, self-contained breathing apparatus (SCBA) or pressure-demand supplied air respirator (air hose) and escape SCBA.

3.1.22 *man portable*, *adj*—capable of being carried by one person, usually less than 40 lbs.

3.1.23 *mean time between false alarms (MTBFA)*, *n*—total operational time divided by the total number of false alarms.

3.1.24 *mean time between hardware failures (MTBHF)*, *n*—total hardware operation time divided by the total number of hardware failures.

3.1.25 *mean time between operational failures (MTBOF)*, *n*—total operating time divided by the total number of operational failures.

3.1.26 *noncritical failure*, *n*—any fault, failure, or malfunction of any component or function that does not preclude accomplishment of the mission's essential functions.

3.1.27 *operation time*, *n*—total accumulated time that the system has power applied.

3.1.28 *operational mode*, *n*—state of the CWVD after power up and initialization when air sampling, analysis and detection are possible.

3.1.29 *probability of detection*, *n*—probability that the CWVD will detect a chemical agent above exposure thresholds while within the required humidity and temperature ranges and in the presence of interferents.

3.1.30 *receipt inspection*—tests performed on each instrument to ensure all components are included and to identify any physical abnormalities that may affect instrument operation.

3.1.30.1 *Discussion*—Inspection shall also include verification of start up and confidence check of the instrument.

3.1.31 *remote alarm interface*, *n*—capable of being connected to a remote alarm system via hardwire or wireless connection.

3.1.32 *response time*, *n*—time it takes for a detector to respond, indicating an alarm to the operator, when exposed to a chemical warfare agent vapor.

3.1.33 *security certificate*, *n*—small data file that contains information about the sender and is issued to the sender by a third party and is the method used to add security to open media like the worldwide web.

3.1.34 *simulant*, *n*—chemical compound that simulates certain properties of a chemical warfare agent, often used to safely challenge a CWVD and verify or test detection capability or accuracy, or both.

3.1.35 *storage maintenance*, *n*—maintenance such as repair or calibration that may be required while the system is in storage.

3.1.36 *survey instrument*, *n*—handheld device used to locate chemical agent contamination or confirm decontamination of personnel, equipment, and facilities or both.

3.1.37 *transport mode*, *n*—configuration of a non-operating CWVD stored in a transport case, if applicable, for transportation.

3.1.38 *transportable*, *adj*—while being packaged or in a protective case, CWVD capable of being transported by sea, land, and air vehicles.

3.1.39 *trouble signal*, *n*—visual or audible signal, differing from the alarm signal, intended to indicate a fault or trouble condition.

3.1.39.1 *Discussion*—Examples of trouble signal conditions include an open or shorted condition of a component in the device, an open or ground in the connecting wiring, loss of AC power, or the need for replacement of a limited life component. The signal shall be repeated until the trouble signal condition is corrected.

3.2 *Acronyms:*

3.2.1 *AMCR*, *n*—Army materiel command regulation

3.2.2 *AR*, *n*—Army regulation

3.2.3 *ASQC*, *n*—American Society for Quality Control
3.2.4 *ATT*, *n*—applied test team at Edgewood Chemical and Biological Center, Maryland
3.2.5 *CENELEC*, *n*—European Committee for Electrotechnical Standardization
3.2.6 *CFR*, *n*—code of federal regulations
3.2.7 *CWA*, *n*—chemical warfare agent
3.2.8 *CWVD*, *n*—chemical warfare vapor detector
3.2.9 *EIA/TIA*, *n*—Electronic Industries Alliance/Telecommunications Industry Association
3.2.10 *EMI*, *n*—electromagnetic interference
3.2.11 *ESD*, *n*—electrostatic discharge
3.2.12 *FM*, *n*—field manual, U.S. Army
3.2.13 *GA*, *n*—nerve agent—tabun
3.2.14 *GB*, *n*—nerve agent—sarin
3.2.15 *GD*, *n*—nerve agent—soman
3.2.16 *GF*, *n*—nerve agent—GF
3.2.17 *HAZMAT*, *n*—hazardous material
3.2.18 *HD*, *n*—blister agent—distilled mustard
3.2.19 HN_3, *n*—blister agent—nitrogen mustard
3.2.20 *IMO-IMDGC*, *n*—International Maritime Organization—International Maritime Dangerous Goods Code
3.2.21 *L*, *n*—blister agent—lewisite
3.2.22 *MIL-HDBK*, *n*—military handbook
3.2.23 *MIL-STD*, *n*—military standard
3.2.24 *MTBFA*, *n*—mean time between false alarms
3.2.25 *MTBHF*, *n*—mean time between hardware failures
3.2.26 *MTBOF*, *n*—mean time between operational failures
3.2.27 *NBC*, *n*—nuclear, biological, and chemical
3.2.28 *RAM*, *n*—reliability, availability, and maintainability
3.2.29 *RH*, *n*—relative humidity
3.2.30 *TIC*, *n*—toxic industrial chemical or compound
3.2.31 *TRADOC*, *n*—training and doctrine command, U.S. Army
3.2.32 *ULC*, *n*—Underwriter's Laboratory Canada
3.2.33 *US*, *n*—United States
3.2.34 *VX*, *n*—nerve agent—VX

4. Physical Properties

4.1 *Size and Weight*
4.1.1 Man portable in all of its applications.
4.1.2 In the personal detector application (see Table 2, which includes detector, alarm, and battery), shall weigh 2.25 kg (5 lb) or less and be 655 cm^3 (40 $in.^3$) or less in volume.
4.1.3 In survey, fixed site, and mobile applications, shall weigh 9 kg (20 lb) or less and be 0.014 m^3 (0.5 ft^3) or less in volume.

5. System Requirements

5.1 *Operational Concept*
5.1.1 The CWVD will provide emergency response personnel with a detector configurable into four operational modes: personal detector, fixed installation detector, vehicle-mounted detector, and chemical survey detector. The CWVD will act as a point detector, monitoring CWA vapor concentration and transmitting data when necessary. If the presence of a CWA is detected, emergency personnel will follow local procedures for responding to a CWA event. The CWVD will be used under all conditions when use of, or exposure to CWAs is possible.
5.1.2 The CWVD will provide chemical HAZMAT teams with a portable, post attack monitor as well as a stationary detector for monitoring interior or exterior spaces, vehicles, and other appropriate structures to determine contamination. The introduction of CWVD should not impact current personnel decontamination procedures.
5.1.3 Since CWVD is a vapor detector, it shall not be required to detect chemical agents in solid/liquid form below their vaporization level. However, once the solid/liquid agent reaches vaporization level, CWVD will be able to detect the agent (at designated concentrations) as it "off gasses." Because of the inherent limitations of any vapor detector, specific tactics, techniques, procedures, or design, or a combination thereof, may be necessary to maximize the CWVD's performance in environmental conditions that increase the difficulty of detecting chemical agent vapors, such as cooler air temperatures that inhibit the creation of vapors by solid/liquid agent deposits and wind conditions that tend to dissipate the agent vapor.

TABLE 2 CWVD Application Characteristics

Characteristic	Survey Instrument	Fixed Sites/Advanced Warning	Ground Vehicle (Wheeled)	Personal Detector
Application Description	Handheld CWVD capable of checking cargo/equipment/personnel/facilities. Display agent and concentration detected.	Semi permanently mounted on a fixed site stand or placed in or around a potentially contaminated location. Display agent and concentration detected. Send remote alarms and may be networked over a commercially available data link.	Semi permanently mounted on the interior or exterior of a ground vehicle. Display agent and concentration detected. Send remote alarms and may be networked over a commercially available data link.	Capable of being worn on/carried by a first responder. Display agent and concentration detected.
Concentration	Table 4	Table 4	Table 4	Table 4
External Power	Internal battery for operation. Recharge on external power.	110-240 VAC 50 to 60 Hz, one phase/internal battery.	12-28 VDC	Internal battery for operation. Recharge on external power.
Internal Backup Power	Rechargeable	Rechargeable	Rechargeable	Rechargeable and non-rechargeable
Mounting/ Interface	None	Ground mount	40 G shock mount	Interface with responder equipment
Remote Interface	N/A	Yes	Yes	Yes

5.2 *Summary of Operational Concepts*—Table 2 summarizes the application descriptions and lists the unique application characteristics for each of the CWVD applications (the detailed functional requirement can be found in Table 3).

5.3 *Functional Characteristics*—The CWVD will accommodate each of the functional modes described in Table 3.

6. Performance Requirements

6.1 *General*

6.1.1 Provide the functional modes described in Table 3.

6.1.2 Allow no more than 15 min for setup and initialization, not including establishment of communication links.

6.1.3 Provide a confidence check for start up and operational use.

TABLE 3 Functional Modes

Mode	Description
Setup	The CWVD is mounted in the position from which it will operate. The CWVD is powered up and communications established (if necessary).
Initialization	The initialization mode is composed of warm-up and self-test and diagnostics.
Warm-up	The operator activates the CWVD. The CWVD responds to and acknowledges the operator's commands. This mode continues until the CWVD's operations and temperatures are stable and within operating limits.
Self-test and diagnostic	The self-test and diagnostic functions are automatically performed. If the CWVD passes, it proceeds to the operational mode. If it fails, the failure shall be identified either on the display or within the data stream. If possible, the operator or maintainer will perform corrective maintenance or repair, or submit the CWVD for repair at a maintenance facility.
Operation	In the operation mode, self-test and diagnostic is performed periodically. In the operation mode, the operator may conduct a confidence check using a simulant to verify detector operation. After a successful initialization, the system automatically samples the surrounding air to detect and identify classes and types of CWAs at concentrations identified in Table 4. If agent is detected, the system will alarm. When the agent concentration falls below the detector alarm thresholds, the system will automatically stop alarming.
Detection and identification	The CWVD performs the required detection and identification functions as identified in this standard.
Warning and reporting	The CWVD performs the required warning and reporting functions as identified in this standard.
Embedded training	The CWVD will maximize the use of embedded training capability.
Upload/query	The CWVD is controlled through the data port by an external system: software updates may be uploaded, stored data downloaded, and functions identified.
Off	In the off mode, the CWVD is inert and requires further action by the operator to proceed into another mode. Recharging of the internal power source from an external power source is permitted in the off mode.
Transport and long-term storage (non-operational)	The CWVD is powered down, power source removed, with all of its external connections for communications and power removed, and is detached from other accessories. The system is not operational and is in its transport case.
Storage (short-term, operational or less than three months, non-operational)	The CWVD is powered down and power source and required accessories installed.

6.1.4 Provide a design in which the personal detector system, with or without add-on(s), can meet all other application characteristics as described in Table 2.

6.1.5 Operate in accordance with the characteristics described in Table 2.

6.2 *Detection and Identification*

6.2.1 Automatically and simultaneously detect, identify, and quantify chemical agent vapors by agent class of nerve, and blister, and identify by specific agent type (G, VX, HD, L, and HN_3).

6.2.2 Detect and provide an alarm for nerve agent vapors, and blister agent vapors, within the response times at the threshold concentrations listed in Table 4. The detection success rate shall be at least 90 % under all conditions.

6.2.3 Detect and provide an alarm for nerve agent vapors, and blister agent vapors without degradation in the presence of the interferents listed in Table 5 in accordance with Table 4. The false positive alarm rate shall not exceed 10 %.

6.2.4 Reject the common environmental interferents as identified in Table 5 while maintaining detection capabilities in accordance with Table 4 with a detection success rate of 90 % or more.

6.2.5 Measure agent concentration (mg/m^3) throughout the concentration range listed in Table 4. The measurement shall be within 10 % of the actual sample concentration, where the actual sample concentration is measured by independent method of at least ±5 % accuracy.

6.2.6 Reset to no-alarm status (cleardown) automatically, within 2 min, after the CWA concentration falls within the no hazard level.

6.3 *Display, trouble, and alarm functions*

6.3.1 Provide audible and visual alarms or trouble signals, or both, in accordance with Table 4.

6.3.2 Display agent class, agent type, and point concentration within 5 s of an alarm. Display changes in concentration at least every 15 s while in an alarm.

6.3.3 Provide the minimum light output and flash rate for the alarm visual indicator(s) in accordance with UL 1638.

6.3.4 Provide variable intensity control that produces not less than 15 candelas for all visual displays.

6.3.5 Provide a variable intensity audible alarm consisting of a minimum sound power of 80 dBA at 1.5 m (5 ft) with a

TABLE 4 Maximum Response Time at Concentration

Agent	Threshold Exposure Concentration, mg/m^3	Threshold Exposure Response Time Max, s	Relative Humidity (% RH) Range	Temperature Range,°C
VX	1	≤10	5-95	+9 to +49 at 1 mg/m^3–6 to +49 at 0.0007 mg/m^3
	0.0007	≤120		
GA, GB, GD, and GF[A]	1	≤10	5-95	–28 to +49
	0.0044	≤120		
HD	10	≤10	5-95	–5 to +49 at 10 mg/m^3–18 to +49 at 0.06 mg/m^3
	0.06	≤300		
L	10	≤10	5-95	–14 to +49
	0.003	≤300		
HN_3	10	≤10	5-95	+16 to +49
	0.06	≤300		

[A] If detector cannot differentiate between G-agent types, then a default G designator may be displayed.

TABLE 5 Interferents

Category 1:
Fuels (vapor, burning, exhaust) and propellant byproducts (gas, diesel, kerosene, JP4, JP8, jet exhaust, helicopter exhaust)
Combustion products (explosives, small arms fire)
Engine products (motor oil, brake fluid, power steering fluid, transmission fluid, antifreeze)
Category 2:
Organics and burning organics (wood, grass, green brush, doused fire)
Burning man made materials (tire, plastic (PVC), menthol or high tar cigarette, dry wall/sheet rock material)
Category 3:
Commercial chemical products (methanol, ethanol, Freon fire suppressants, carpet or construction adhesive, latex paint, toluene, isopropanol)
Household chemical products (ammonia, bleach, flooring wax, menthol, lawn fertilizer)

maximum setting not to exceed 120 dBA at 1.5 m (5 ft) for the applications indicated in Table 2.

6.3.6 Provide a muting capability while maintaining visual displays.

6.3.7 Provide an auxiliary visual indicator device capable of use in high ambient noise environments.

6.3.8 Provide a specific audible and visual trouble signal, different from the alarm that warns the operator to a malfunction of the detector.

6.3.9 Provide an audible or visual low-power trouble signal, or both.

6.3.10 Provide an audible or visual trouble signal, or both, that memory is nearly full, giving operator time to download collected data or to confirm an overwrite.

6.3.11 Display date/time in a standard, easily understandable format, e.g. ddmmyyyy hh:mm:ss.

6.4 *Data/Communications*

6.4.1 Provide a data port for upload or query.

6.4.2 Accommodate future software upgrades to improve instrument performance.

6.4.3 Provide an internal mechanism that stores and maintains data collected for 40 h of operation.

6.4.4 Operate the data port concurrently with normal CWVD functions in the operation mode.

6.4.5 Provide within CWVD data stream the following information: the detector identification, detector status, agent class, agent type, agent concentration, date and time of the last reset of the CWVD, self-test and diagnostic status, memory status, and internal clock time.

6.4.6 Record the concentrations of CWAs as a function of date and time as part of the CWVD data stream.

6.4.7 Perform the following system operational functions when remotely activated through the data port: activate or deactivate audible and visual indicators, conduct self-test cycle, and reset (restart) detector and determine operating status of detector.

6.4.8 Allow data to be erased or overwritten only with confirmation. Provide security mechanism to avoid errors or loss of data.

6.4.9 Transmit data to the data port within 5 s of an alarm, if configured for real time download.

6.5 *Embedded Training*

6.5.1 Provide CWVD training features that are embedded in the CWVD and may include a self-training module that is not integral to the CWVD, for example compact disc, video, etc..

6.5.2 When using the embedded training system, the CWVD shall allow transition between the normal operation and training modes without compromising the normal operation of the detector.

6.5.3 When using the embedded training system while in the presence of a CWA, the CWVD shall automatically transition to the normal operational mode and properly detect, alarm, and identify the CWA.

6.6 *Self-Test and Diagnostic Capabilities*

6.6.1 Monitor and identify 100 % of mission critical failures and 80 % of noncritical failures.

6.6.2 Provide a means to check, test, and verify that all visual and audible indicators function on demand.

6.6.3 Provide capability to perform diagnostics on CWVD either directly or through the data port.

7. Reliability, Availability, and Maintenance (RAM) Requirements

7.1 *Reliability*

7.1.1 Provide a MTBOF of 750 h and a MTBHF of 2400 h for man-mounted, survey, and ground vehicle applications.

7.1.2 Provide a MTBOF of 1200 h and a MTBHF of 2400 h for fixed-site applications.

7.1.3 Mean time between false alarm (MTBFA) shall be 168 h or more.

7.2 *Maintainability*

7.2.1 Provide a design that allows basic operator level corrective maintenance to be performed in less than 30 min.

7.2.2 Provide a design that uses common (standard) maintenance tools.

7.2.3 If calibration is required, provide a design so that the time between calibrations is greater than six months.

7.2.4 Provide a design so that all spare and repair parts are interchangeable between units without adjustment or modification.

7.3 *Storage Maintenance*—Provide a design that requires no storage maintenance.

8. Interface Requirements

8.1 *Application Interface*—The CWVD shall have specific interfaces as follows:

8.1.1 Provide a means to allow the detector to be used as a survey instrument, installed for fixed site detection, and mounted for detection on the move.

8.1.2 In the personal application, provide a design compatible with the first responder's activities and equipment.

8.2 *Communication Interfaces*

8.2.1 Provide for an open system, industry standard, and nonproprietary interface to support remote communications.

8.2.2 Provide security access control that identifies and authenticates with passwords, keys, or security certificates, or a combination thereof.

8.2.3 Provide security integrity that identifies the source of data and prevents acceptance of unauthorized, modified or retransmitted messages or displays, if CWVD has capability of receiving messages/displays.

8.2.4 Provide a standard physical interface in accordance with ANSI/TIA-232-F-1997 (R2002).

8.3 *Electrical Interfaces*

8.3.1 Provide built-in noise, over-voltage, spike suppression, and automatic system reset.

8.3.2 Capable of using commercially available rechargeable or non-rechargeable batteries without hardware modifications that provide 12 h of use without replacement/recharge.

8.3.3 Provide the capability to recharge the battery when connected to an external power source.

8.3.4 Automatically change between external and battery power without interruption.

8.3.5 Provide a design where external power overrides battery power.

8.4 *Operator Interfaces*

8.4.1 Provide a design that protects controls from inadvertent activation.

8.4.2 Provide a design so that CWVD can be installed, operated, and removed by one operator dressed in Level A ensemble.

8.4.3 Provide a design such that an operator wearing a Level A ensemble can replace the power source within 5 min.

8.4.4 Provide displays in English and readable from 1 m away under all light conditions.

9. Environmental Requirements

9.1 The CWVD shall meet the functionality described in Table 3 during and after exposure to the operational environments and after exposure to the storage environments identified below. The CWVD shall meet the following environmental requirements:

9.1.1 *Operational Environments*:

9.1.1.1 *Operating temperature*—Operate within temperature range of −32 to 49°C.

9.1.1.2 *Storage temperature*—Survive the stored temperature range of −39 to 71°C.

9.1.1.3 *Solar radiation*—Operate while exposed to direct sunlight at 49°C.

9.1.1.4 *Humidity*—Operate within relative humidity range of 5 to 95 %.

9.1.1.5 *Blowing rain*—Operate during and after exposure to blowing rain.

9.1.1.6 *Dust*—Operate during and after exposure to blown dust.

9.1.1.7 *Freezing rain*—Operate during and after exposure to ice buildup as a result of rain, drizzle, fog, or splash after exposed ports are freed from ice or frozen debris.

9.1.2 *Induced Environment*:

9.1.2.1 *Shock*:

9.1.2.1.1 Survive a 0.91-m (3-ft) operator drop without protection.

9.1.2.1.2 Survive a 1.22-m (4-ft) transit drop while in the transport mode.

9.1.2.2 *Vibration*:

9.1.2.2.1 Operate while subject to vibration of common wheeled vehicles.

9.1.2.2.2 Survive loose cargo vibration profiles of common wheeled vehicles in the transport mode.

9.1.3 *Electromagnetic Interference (EMI)*:

9.1.3.1 Meet EMI requirements set forth in MIL-STD-461E excluding space systems.

9.1.3.2 Survive the lightning environment as specified in MIL-STD-464A, Section, 5.4, Table IIB, Electromagnetic Fields from Near Strike Lightning (Cloud-to-Ground).

9.1.4 *Explosive Environment*:

9.1.4.1 Operate safely in an atmosphere of explosive vapors.

9.1.4.2 Operate safely in proximity to explosives/munitions.

10. Transportation, Packaging, and Marking

10.1 The CWVD shall meet the following transportation and packaging requirements:

10.1.1 Transportable by air, land, and sea without restrictions.

10.1.2 For all shipments packaging shall:

10.1.2.1 Provide a design such that the function or operation of the system components is not compromised during shipment and storage.

10.1.2.2 If applicable, provide special packaging and handling procedures to comply with hazardous material regulatory requirements (49 CFR, Parts 171 -179 and ERG2004 (IMO-IMDGC) and ESD packaging protection.

10.1.3 Packaging Materials and Design

10.1.3.1 Provide a design such that packaging materials shall not compromise the performance the CWVD by off-gassing as a result of storage and shipment conditions.

10.1.3.2 Use ESD protective handling, packaging, and labeling in accordance with best practices.

11. Design, Construction, and Workmanship

11.1 *Corrosion Control and Finishing*:

11.1.1 Resist surface degradation by chemical agents (as specified in Table 4), and

11.1.2 Resist surface degradation by decontamination solutions of water, soap, and bleach.

11.2 *Electrical Safety*—Not generate stray voltage or discharges.

11.3 *Electrostatic Discharge (ESD)*—Protect ESD-sensitive items from ESD.

11.4 *Materials*—The product shall include marking information within the operator's manual or on the product, or both, that clearly states the disposal guidelines for the product and batteries. The information shall include, but is not limited to the following; "Chemical Warfare Vapor Detectors and their batteries shall be disposed of in accordance with CFR 40 and all appropriate local, state, and national codes."

11.5 *Workmanship*—Ensure CWVD components are free of burrs, sharp edges, rust, discoloration, tool marks, imperfections of grinding, or any other damage or defect that could make the component unsatisfactory for the purpose intended.

11.6 *Safety Parameters*:

11.6.1 Provide a design that is safe to operate, store, and maintain in its intended environment throughout its life cycle, as specified in Section 9.

11.6.2 If the CWVD uses a radioactive source, provide evidence of an appropriate "specific" U.S. Nuclear Regulatory Commission license under 10 CFR 30, or ensure the device may be distributed pursuant to a "general" license as outlined in 10 CFR 31.

12. Test Methods

12.1 *The following tests will be conducted by the certifying organization*:

12.1.1 *Receipt Inspection*—Shall be performed on each instrument to ensure all components necessary for certification testing are included and to identify any physical abnormalities that may affect instrument operation. Inspection shall also include verification of start up and confidence check of the instrument.

12.1.2 *Functional Acceptance Tests*—Shall be performed to determine that an instrument is operational and capable of performing its intended function in accordance with all the requirements outlined in this standard. Test methods for each requirement are outlined in Table 1.

13. Inspection

13.1 Sampling levels for testing shall be established by the certification organization to ensure reliability and confidence that products certified to this standard with zero failures are compliant. It is estimated that a minimum sample of seven items will be required for certification. (For guidance refer to MIL-STD-1916 or ANSI/ASQC Z1.4-1993.)

14. Certification

14.1 The pass/fail testing described in this standard shall be performed by a laboratory accredited to ISO/IEC 17025 for certification of a chemical warfare vapor detector. This pass/fail testing provides a qualitative assessment of detector performance.

14.2 All CWVD that are labeled as being compliant with this specification shall meet or exceed all applicable requirements for this specification and shall be certified by an ANSI accredited laboratory or organization in accordance with ISO/IEC Guide 65 and ISO/IEC 17025.

14.3 Compliant items will be specifically labeled by the certifying organization.

14.4 Manufacturers shall not be authorized to use any label or reference to the certification organization on products that are not compliant with this specification.

15. Quality Assurance

15.1 The manufacturer shall provide and maintain a quality assurance program in accordance with ISO 9000.1. Documentation shall be provided to the certifying organization.

16. Keywords

16.1 blister agents; chemical warfare agents; detect; identify; nerve agents; point detector; response time; survey instrument; vapor concentration; vapor detector; warn

APPENDIX

(Nonmandatory Information)

X1. Maintenance/Service

X1.1 Provide a design so that the service of reliable parts and general maintenance (other than operator level corrective actions) turn around time does not exceed 7 days from the time the product is received at the service center.