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Standard Specification for Ruggedness Requirements for HAZMAT Instrumentation[1]

This standard is issued under the fixed designation E2851/E2851M; 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.

1. Scope

1.1 This specification describes the ruggedness requirements for equipment used during Hazardous Material (HAZMAT) operations. The conditions defined by this specification include those related to equipment storage, transport, and field use.

1.2 This specification does not address passive personal protective equipment (PPE) such as respirators and protective suits.

1.3 The equipment addressed by this specification includes devices used to detect or monitor for hazardous material.

1.4 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.5 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use. When using a HAZMAT instrument, follow the manufacturer's guidance and appropriate safety practices for the threat expected or suspected in the environment where the instrument will be used.*

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *NFPA Standard:*[2]

National Fire Protection Association (NFPA) 1994, 2007 Edition Cold Temperature: -25°C (-13°F)

2.2 *ANSI Standards:*[3]

NA42.32 American National Standard Performance Criteria for Alarming Personal Radiation Detectors for Homeland Security

N42.33 American National Standard for Portable Radiation Detection Instrument for Homeland Security

N42.34 American National Standard for Performance Criteria for Hand-Held Instruments for the Detection and Identification of Radionuclides

N42.35 American National Standard for Evaluation and Performance of Radiation Detection Portal Monitors for Use in Homeland Security

2.3 *IEC Standards:*[4]

IEC 60068-1 Environmental Testing—Part 1: General and Guidance

IEC 60068-2-18 Environmental Testing—Part 2-18: Tests—Test R and Guidance: Water

IEC 60068-2-75 Environmental Testing—Part 2-75: Tests—Tests Eh: Hammer Tests.

IEC 60529 Degrees of Protection Provided by Enclosures (International Protection Rating or IP Code)

IEC 61000-4-1 Electromagnetic Compatibility (EMC)—Part 4-1: Testing and Measurement Techniques—Overview of IEC 61000-4 Series

IEC 61000-4-2 Electromagnetic Compatibility (EMC)—Part 4-2: Testing and Measurement Techniques—Electrostatic Discharge Immunity Test

IEC 61000-4-3 Electromagnetic Compatibility (EMC)—Part 4-3: Testing and Measurement Techniques—Radiated, Radio-Frequency, Electromagnetic Field Immunity Test

2.4 *Underwriters Laboratories:*[5]

UL 2075 Gas and Vapor Detectors and Sensors

[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 Detection and Decontamination.

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

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

[4] Available from International Electrotechnical Commission (IEC), 3, rue de Varembé, P.O. Box 131, CH-1211 Geneva 20, Switzerland, http://www.iec.ch.

[5] Available from Underwriters Laboratories (UL), 2600 N.W. Lake Rd., Camas, WA 98607-8542, http://www.ul.com.

2.5 *Federal Standard:*[6]

MIL-Standard 810 Department of Defense Test Method Standard for Environmental Engineering Considerations and Laboratory Tests

2.6 *Code of Federal Regulations:*[7]

CFR Telecommunications Chapter 1, Rule 15 Unintentional Radiators

3. Terminology

3.1 *Definitions:*

3.1.1 *body-worn*—a HAZMAT instrument that typically weighs no more than 5.4 kg [12 lb] and is no larger than 65 cm (sum of the sides).

3.1.2 *hand-carried*—a HAZMAT instrument that typically weighs no more than 2.3 kg [5 lb] and is no larger than 40 cm (sum of the sides).

3.1.3 *installed*—a HAZMAT instrument that is permanently mounted at a location.

3.1.4 *mobile*—a HAZMAT instrument that is larger than a man-portable, which is mounted to a mobile device to permit relocation of the instrument as necessary for monitoring of HAZMAT; the instrument may be operational while in motion.

3.1.5 *portable*—a HAZMAT instrument that physically weighs no more than 16 kg [35 lb] and is no larger than 120 cm (sum of the sides).

3.1.6 *transportable*—a HAZMAT instrument that typically weighs no more than 22.7 kg [50 lb] and is no larger than 200 cm (sum of the sides).

3.2 A summary of the above can be found in Table 1.

4. Purpose

4.1 The purpose of this specification is to define for design and test purposes the environment in which HAZMAT equipment will likely be exposed during storage, transportation, and use. The environments addressed by this specification are related to equipment that are typically man-portable, body-worn, hand-carried, transportable, mobile, or installed. This could include extremes that range from mid-winter Alaska to mid-summer Death Valley environments.

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

[7] Available from U.S. Government Printing Office Superintendent of Documents, 732 N. Capitol st., NW, Mail Stop: SDE, Washington, DC 20401, http://www.access.gpo.gov.

TABLE 1 HAZMAT Instrumentation Size and Weight

Instrument Type	Maximum Weight in kg/lb	Maximum Size[A] Sum of Sides in cm
Portable	16/35	120
Body-Worn	5.4/12	65
Hand-Carried	2.3/5	40
Transportable	22.7/50	200
Mobile	No Limit	No Limit
Installed	No Limit	No Limit

[A] Not including attachments such as handles, nipples, filter cartridges, and hoses.

5. Materials and Manufacture

5.1 Materials resistant to extremes of temperature should be used in the manufacture of HAZMAT instrumentation.

5.2 Materials used in the manufacture of body-worn and hand-carried equipment must not support combustion. They should be self extinguishing if they do get hot enough to combust.

5.3 Materials used in the manufacture of body-worn and hand-carried equipment must not flow when melted.

6. Physical Properties

6.1 HAZMAT instrumentation should be built from strong, inert, weather-resistant materials with rugged finishes to withstand prolonged use in very harsh environments.

6.2 HAZMAT instrumentation should resist the effects from and remain operational when exposed to the following:

6.2.1 Saltwater, when used in coastal environments.

6.2.2 Temperatures as stated in Table 2 and Table 3, both natural and man-made.

6.2.3 Acidic chemicals found during fires and accidents.

6.2.4 Caustic chemicals found during fires and accidents.

7. Mechanical Properties

7.1 Mechanical components of HAZMAT instrumentation shall be constructed so that they remain operational in their intended environment of use.

7.2 HAZMAT instrumentation shall be constructed so that they remain operational when exposed to the following conditions:

7.2.1 Impacts from use and transport.

7.2.2 Transport vibration.

7.2.3 Expansion or contraction due to hot or cold temperatures.

7.2.4 Corrosion from harsh environments, that is, salt mist.

8. Performance Requirements

8.1 There is a broad spectrum between the different environmental conditions equipment are exposed to during storage and use. Refer to Table 2 for specific environmental conditions for each category of HAZMAT instrumentation.

8.1.1 HAZMAT equipment shall be operable in rain, humidity, heat, and cold at the levels defined in this specification. Environments could also include smoke, toxic chemicals (for example, chlorine, ammonia), caustic chemicals, and extreme heat. Meeting these requirements shall be by agreement between the manufacturer and the user.

8.1.2 Body-worn HAZMAT equipment should endure firefighter environments (heat, water, smoke, cold) on a regular basis.

8.1.3 Storage of HAZMAT equipment varies widely. Some agencies store their HAZMAT equipment inside a temperature controlled area while others use trucks or containers located in uncontrolled environments.

NOTE 1—Agencies surveyed regarding temperature and temperature shock to HAZMAT equipment almost all agree that -30 to 120°F is an appropriate operating range. This temperature range also encompasses most of the extreme temperatures the equipment would be exposed to

TABLE 2 Environmental Conditions

Equipment Type	Storage	Transport	Use
Portable	Temperature (controlled and uncontrolled), Humidity (condensing and non-condensing), Mold	Mechanical shock, vibration (vehicle-based), temperature shock, condensing moisture, rain, electrostatic discharge, microphonics	Person-based shock and vibration, electrostatic discharge, magnetic field, wide range temperature (-30 to 120°F), rain, radio frequency (RF), emissions, relative humidity (RH), dust, condensing moisture, temperature shock, microphonics
Body-Worn	Temperature (controlled and uncontrolled), Humidity (condensing and non-condensing), Mold	Mechanical shock, vibration (vehicle based), temperature shock, condensing moisture, rain, electrostatic discharge, microphonics	Person-based shock and vibration, electrostatic discharge, magnetic field, wide range temperature (-30 to 120°F), rain, RF emissions, RH, dust, condensing moisture, temperature shock, microphonics
Hand-Carried	Temperature (controlled and uncontrolled), Humidity (condensing and non-condensing), Mold	Mechanical shock, vibration (vehicle based), temperature shock, condensing moisture, rain, electrostatic discharge, microphonics	Hand-carried shock and vibration, electrostatic discharge, magnetic field, wide range temperature (-30 to 120°F), rain, RF emissions, RH, dust, condensing moisture, temperature shock, microphonics
Transportable	Temperature (controlled and uncontrolled), Humidity (condensing and non-condensing), Mold	Mechanical shock, temperature change, condensing moisture, microphonics, rain, jetted water, vehicle based vibration.	Installed equipment shock and vibration, power variations, conducted RF, RF susceptibility, line noise, temperature, RH, rain, jetted water for cleanup, dust
Mobile	Temperature (controlled and uncontrolled), Humidity (condensing and non-condensing), Mold, Rain	Mechanical shock, temperature change, condensing moisture, microphonics, rain, jetted water, vehicle based vibration	Vehicle based shock and vibration (platform dependent), RF, power variations, temperature, RH, rain, jetted water, dust
Installed	N/A	N/A	Low levels vibration, RF susceptibility, line noise, power quality, temperature, RH, rain, jetted water (orientation specific for rain and jetted water)

TABLE 3 Field Use Temperature Requirements

Use Environment	Temperature Range
Portable	-34 to +55°C [-30 to +131°F]
Body-Worn	-34 to +49°C [-30 to 120°F]
Hand-Carried	-34 to +49°C [-30 to +120°F]
Transportable	-34 to +55°C [-30 to +131°F]
Mobile	-34 to +55°C [-30 to +131°F]
Installed in uncontrolled environment	-34 to +55°C [-30 to +131°F]
Installed in controlled environment	+5 to +40°C [+41 to +104°F]

during storage. Equipment used by firefighters could very easily be exposed to high temperatures of +165°F or more during a fire.

8.1.4 Most HAZMAT detection equipment requires a warm up and stabilization period prior to use. The manufacturer shall state the time required for the system to become operational.

8.2 *Operator Interface:*

8.2.1 Displays and interfaces shall be designed to remain operational during expected conditions of use.

8.2.2 Displays shall be visible in bright sunlight (>10 000 lux) or low light (<150 lux) conditions as required by the user. A useful feature is an LCD that will automatically adjust contrast based on ambient lighting.

8.2.3 Users wearing thermal gloves or those gloves typically worn by firefighters should be able to manipulate controls as needed.

8.3 *Audible Alerts/Alarms:*

8.3.1 Audible alerts and alarms shall be designed to remain operational during expected conditions of use (temperature, moisture, etc.).

8.3.2 For hand-held or body-worn equipment, the frequency of an audible indication should be within the range of 1000 to 4000 Hz and have a volume at a distance of 30 cm from the emission source (instrument, remote speaker) of at least 85 dB (A) and shall not exceed 100 dB (A).

8.3.3 For other devices, volume and frequency requirements shall be by agreement between the manufacturer and the user.

9. Environmental Requirements

9.1 *Ambient Temperature:*

9.1.1 *Field-Use:*

9.1.1.1 The manufacturer shall state the field-use temperature range. Table 3 provides temperature ranges for each instrument type based on expected usage environments. The ranges stated shall be used unless otherwise required by the user, such as firefighters who may require and upper temperature limit of 74°C [165°F].

9.1.1.2 The manufacturer shall state the temperature range for displays or user interface components intended for use in weather-protected locations.

9.1.1.3 Verification testing should be done using a temperature change rate of not more than 10°C/h with a minimum of 2 h exposure at each temperature extreme. The equipment being tested should remain operational during the entire test.

9.1.2 *Storage:*

9.1.2.1 Unless otherwise stated, equipment shall be able to withstand long-term storage over a temperature range from -40 to +71°C [-40 to 160°F].

NOTE 2—Certain equipment may be stored in more extreme temperature climates (that is, an enclosed container located in the desert). These conditions will require different temperature limits such as +85°C [185°F].

9.1.2.2 If specific components may be damaged by exposure to the stated temperature range, they should be stored separately. This information shall be provided by the manufacturer.

9.1.2.3 Verification testing should be performed with the equipment unpowered. The temperature change rate should be 10°C/h with a 24-h exposure to the low temperature set point and a 2-h exposure for the high temperature set point.

9.2 *Temperature Shock:*