Designation: E3187/E3187M – 19

Standard Specification for Less Lethal Aerosol Devices Used by Law Enforcement, Corrections, and Other Public Safety Officers[1]

This standard is issued under the fixed designation E3187/E3187M; 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 addresses less lethal chemical irritant sprays used by law enforcement, corrections, and other public safety officers.

1.2 This specification is limited to duty belt-mounted canisters.

1.3 This specification is limited to sprays intended for use on humans.

1.4 This specification defines requirements for products containing liquid aerosol Oleoresin Capsicum (OC) spray (that is, pepper spray), Orthochlorobenzalmalononitrile (CS) spray (that is, 2–chlorobenzylidenemalononitrile; CAS #: 2698-41-1), or OC-CS combination spray. The formulation may be delivered as a stream, gel, foam, cone, or vapor.

1.5 This specification does not address incendiary devices or "hot gas."

1.6 Products covered by this specification may be flammable or nonflammable.

1.7 Products covered by this specification are hazardous substances as defined by 16 CFR 1500.3.

1.8 It is intended that the following related practice be used in conjunction with this specification: Practice E3215.

1.9 *Units*—The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system are not necessarily exact equivalents; therefore, to ensure conformance with the standard, each system shall be used independently of the other, and values from the two systems shall not be combined.

1.9.1 For some quantities in Sections 9, 10, and 11, only SI units are used to be consistent with industry practice.

1.10 *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.*

1.11 *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 *ASTM Standards:*[2]

E2771 Terminology for Homeland Security Applications

E3215 Practice for Certification of Less Lethal Aerosol Devices Used by Law Enforcement, Corrections, and Other Public Safety Officers

2.2 *Other Standards:*

AOAC 995.03 Capsaicinoids in Capsicums and Their Extractives Liquid Chromatographic Method[3]

CAST Standard for Police Chemical Irritant Sprays: CS and PAVA Publication Number: 23/14[4]

ISO 17034 General requirements for the competence of reference material producers[5]

ISO/IEC 9001 Quality management systems – Requirements[5]

ISO/IEC 17025 General requirements for the competence of testing and calibration laboratories[5]

16 CFR 1500.3 Definitions[6]

16 CFR 1500.121 Labeling requirements; prominence, placement, and conspicuousness[6]

[1] This specification is under the jurisdiction of ASTM Committee E54 on Homeland Security Applications and is the direct responsibility of Subcommittee E54.04 on Public Safety Equipment.

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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 AOAC International, 2275 Research Blvd., Suite 300, Rockville, MD 20850-3250, http://www.aoac.org.

[4] Available from the UK Home Office, 2 Marsham St., London, United Kingdom, SW1P 4DF, https://www.gov.uk/government/organisations/home-office.

[5] Available from International Organization for Standardization (ISO), ISO Central Secretariat, BIBC II, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, http://www.iso.org.

[6] Available from U.S. Government Printing Office, Superintendent of Documents, 732 N. Capitol St., NW, Washington, DC 20401-0001, http://www.access.gpo.gov.

29 CFR 1910.1200 Occupational Safety and Health Standards – Toxic and Hazardous Substances[6]

ANSI Z400.1 American National Standard for Hazardous Workplace Chemicals – Hazard Evaluation and Safety Data Sheet and Precautionary Labeling Preparation[7]

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *batch, n*—the formulation for a specific active ingredient percentage and delivery system.

3.1.1.1 *Discussion*—An example of a batch is 1.33 % capsaicinoid stream.

3.1.2 *controlled ambient, n*—conditions with temperature of 20 °C ± 5.5 °C [68 °F ± 10 °F] and 50 % ± 20 % relative humidity (RH). **E2771**

3.1.3 *hazardous substance, n*—any substance or mixture of substances which is toxic, corrosive, an irritant, a strong sensitizer, flammable or combustible, or generates pressure through decomposition, heat, or other means, if such substance or mixture of substances may cause substantial personal injury or substantial illness during or as a proximate result of any customary or reasonably foreseeable handling or use, including reasonably foreseeable ingestion by children. **16 CFR 1500.3**

3.1.4 *model, n*—the supplier's design, with unique specifications and characteristics, of a particular item. **E2771**

3.1.4.1 *Discussion*—An example of a model is MK2 of a particular formula and spray pattern.

3.1.5 *supplier, n*—the entity that directs and controls the following: conformant product design, conformant product manufacturing, conformant product quality assurance; or the entity that assumes the liability for the conformant product or provides the warranty for the conformant product. **E2771**

3.1.6 *test item, n*—a single article intended for testing. **E2771**

4. Significance and Use

4.1 The purpose of this specification is to provide performance requirements and test methods for the evaluation of chemical irritant sprays used by law enforcement, corrections, and other public safety officers. Included are performance requirements and test methods for both the final product and the chemical formulation in the product.

4.2 This specification may be used by suppliers, certification bodies, testing laboratories, research and development organizations, and others assessing the performance of less lethal aerosol devices.

4.3 The specification may be used by purchasers in their evaluation of products to meet their needs and requirements.

4.3.1 It is recommended that agencies or end users purchase less lethal aerosol devices certified to this specification and that the following requirements be included in purchase specifications:

"The product shall be certified to meet the requirements of ASTM Specification E3187/E3187M."

5. Design Requirements

5.1 The supplier shall declare whether the product is non-flammable or flammable in its aerosol form.

5.2 The carcinogenicity and toxicity of the product shall be verified as follows: in accordance with the *Global Harmonized System of Classification and Labelling of Chemicals (GHS)*, Part 3, Health Hazards,[8] ingredients are "allowed" or "not allowed" in the product as shown in Table 1. Ingredients categorized as "not allowed" shall not be present in the product.

5.2.1 The supplier of less lethal aerosol devices containing irritants or inflammatory agents, such as OC, CS, or OC-CS, shall disclose to the certification body all ingredients contained within the formulation, including the propellant.

5.2.1.1 These disclosures shall be for any ingredient formulation, regardless of the percentage, specifically if it is intentionally added by the product supplier or raw material supplier. This includes additives and marking agents, such as UV dyes, colorants, fluorescents, emulsifiers, stabilizers, or carriers.

5.2.1.2 Suppliers are not required to report de minimis ingredients, remnants, or chemical analogs that are present in the form of impurities related to the primary ingredients contained within the formulations.

TABLE 1 Listing of Allowed and Not Allowed Ingredients

Toxicity Type	Allowed	Not Allowed
Acute Toxicity	Category 4, 5	Category 1, 2, 3
Skin Corrosion/Irritation	Category 2, 3	Category 1
Eye Damage/Irritation	Category 2A, 2B	Category 1
Cell Mutagenicity	Category 1B, 2	Category 1A
Carcinogenicity	None	All
Reproductive Toxicity	Category 2	Category 1A, 1B
Specific Organ Toxicity	Category 3	Category 1, 2
Specific Organ Toxicity following Repeated Exposure	Category 2	Category 1
Aspiration Toxicity	Category 2	Category 1

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

[8] http://www.unece.org/trans/danger/publi/ghs/ghs_rev03/03files_e.html.

6. Performance Requirements

6.1 This section identifies product performance requirements to be assessed during testing.

6.1.1 Some requirements are for test items, and some requirements are for batches, as indicated below.

6.2 *Requirements for Test Items:*

6.2.1 A different set of three test items for a model is required for each test listed in this section.

6.2.2 The generic requirements below shall be met by all test items following relevant test procedures within this section. The test item shall:

6.2.2.1 Discharge when the actuator is activated (for example, button depressed).

6.2.2.2 Stop discharging when the actuator is de-activated (for example, button released).

6.2.2.3 Not discharge as a result of any action other than intended discharge.

6.2.2.4 Not be damaged so that the device cannot physically be discharged without remedial action (for example, actuator falls off or significant damage to the cap).

6.2.2.5 Not leak.

6.2.3 Prior to beginning each test below, the test items shall be conditioned at controlled ambient for at least 60 minutes.

6.2.4 To assess the container's resistance to crushing, each of three test items shall be tested in accordance with Section 5.3 of *Cast Standard for Police Chemical Irritant Sprays: CS and PAVA*.

6.2.4.1 The spray pattern shall subsequently be assessed as specified in Section 7 of this specification, and the spray pattern shall be reported.

6.2.4.2 The test item shall subsequently be assessed as specified in 6.2.2 of this specification to determine whether generic requirements are met, and the results shall be reported.

6.2.5 To assess the container's resistance to damage from dropping, each of three test items shall be tested in accordance with Section 5.5 of *CAST Standard for Police Chemical Irritant Sprays: CS and PAVA*, with the following modification: the surface upon which the canister is dropped may be a steel plate or a concrete floor.

6.2.5.1 The spray pattern shall subsequently be assessed as specified in Section 7 of this specification, and the spray pattern shall be reported.

6.2.5.2 The test item shall subsequently be assessed as specified in 6.2.2 of this specification to determine whether generic requirements are met, and the results shall be reported.

6.2.6 To assess operation in extreme temperatures, the following steps shall be taken on two of three test items.

6.2.6.1 The first test item shall be placed into a conditioning chamber held at high temperature for 24 h ± 15 min. The supplier shall specify the temperature. The test item shall be removed from the conditioning chamber and assessed as specified in Section 7 of this specification. The temperature and spray pattern shall be reported.

(1) The test item shall subsequently be assessed as specified in 6.2.2 of this specification to determine whether generic requirements are met, and the results shall be reported.

6.2.6.2 The second test item shall be placed into a conditioning chamber held at low temperature for 24 h ± 15 min. The supplier shall specify the temperature. The test item shall be removed from the conditioning chamber and assessed as specified in Section 7 of this specification. The temperature and spray pattern shall be reported.

(1) The test item shall subsequently be assessed as specified in 6.2.2 of this specification to determine whether generic requirements are met, and the results shall be reported.

6.2.6.3 The supplier shall state the high and low temperature extremes as the operating range in the product documentation.

6.2.7 For products declared to be nonflammable, each of three test items shall be tested for spray flammability in accordance with Section 5.9 of *CAST Standard for Police Chemical Irritant Sprays: CS and PAVA*, and there shall be no flame extension towards the test item, and the flame shall not be self-sustaining.

6.2.7.1 The test item shall subsequently be assessed as specified in 6.2.2 of this specification to determine whether generic requirements are met, and the results shall be reported.

6.2.8 For products declared to be nonflammable, each of three test items shall be tested for flammability related to electroshock weapons (ESWs) in accordance with Section 8 of this specification, and the test items shall be demonstrated to be nonflammable.

6.2.8.1 The test item shall subsequently be assessed as specified in 6.2.2 of this specification to determine whether generic requirements are met, and the results shall be reported.

6.3 *Requirements for Batches of OC Spray:*

6.3.1 The chemical concentration of the active ingredients in OC spray shall be assessed as specified in Section 9 of this specification.

6.3.1.1 Each batch of OC spray shall be tested by the supplier, either in-house or by an independent test laboratory. The supplier shall maintain test reports for every batch at least 12 months beyond the expiration date of the batch.

(1) The test laboratory shall either (*1*) be accredited to ISO/IEC 17025, or (*2*) have a documented program in place that meets the requirements outlined in Practice E3215 (see Appendix X1: Audit Checklist in E3215).

(2) At a minimum of four times per year (quarterly), a split OC spray batch sample collected for testing by the supplier's designated laboratory (either in-house or third-party) shall be sent to an ISO/IEC 17025 accredited laboratory to verify intralaboratory data quality and accuracy. This testing shall be conducted in addition to any testing specified in Practice E3215 for certification or surveillance testing. This requirement is only applicable if the supplier is not using a laboratory accredited to ISO/IEC 17025 to comply with 6.3.1.1(*1*).

6.3.1.2 The results for each batch shall be recorded and shall meet the requirements below.

(1) The percentage of capsaicin in raw materials shall be at least 55 % by weight.

(2) The percentage of major capsaicinoids, by weight, in the final formulation shall be declared by the supplier and shall be no more than 1.45 %. The measured percentage of major capsaicinoids shall be within ±5 % of that declared value.

(3) The major capsaicinoids, by weight, in the final formulation shall be no more than 1.50 %.

6.3.1.3 The supplier shall make available test reports for skin and eye testing, plus inhalation testing when applicable, at the supplier's declared value for percentage of major capsaicinoids in the final formulation (*1*) to the certification body in order to be certified and (*2*) to purchasers upon request.

NOTE 1—For a specific formulation tested at the upper limit of major capsaicinoids, that test report (skin and eye testing, plus inhalation testing when applicable) is allowed for the same formulation with a reduced level of major capsaicinoids.

6.4 *Requirements for Batches of CS Spray:*

6.4.1 The chemical concentration of the active ingredients in CS spray shall be assessed as specified in Section 10 of this specification.

6.4.1.1 Each batch of CS spray shall be tested by the supplier, either in-house or by an independent test laboratory. The supplier shall maintain test reports for every batch at least 12 months beyond the expiration date of the batch.

(1) The test laboratory shall either (*1*) be accredited to ISO/IEC 17025, or (*2*) have a documented program in place that meets the requirements outlined in Practice E3215 (see Appendix X1: Audit Checklist in E3215).

(2) At a minimum of four times per year (quarterly), a split CS spray batch sample collected for testing by the supplier's designated laboratory (either in-house or third-party) shall be sent to an ISO/IEC 17025 accredited laboratory to verify intralaboratory data quality and accuracy. This testing shall be conducted in addition to any testing specified in Practice E3215 for certification or surveillance testing. This requirement is only applicable if the supplier is not using a laboratory accredited to ISO/IEC 17025 to comply with 6.4.1.1(*1*).

6.4.1.2 The results for each batch shall be recorded and shall meet the requirements below.

(1) The recommended mass fraction of CS by weight in the final formulation should be in the range of 1 % to 5 %.

NOTE 2—This recommendation is based on products known to be in use by public safety.

6.4.1.3 The supplier shall make available test reports for skin and eye testing, plus inhalation testing when applicable, at the supplier's declared value of CS in the final formulation (*1*) to the certification body in order to be certified and (*2*) to purchasers upon request.

NOTE 3—For a specific formulation tested at a higher level, that test report (skin and eye testing, plus inhalation testing when applicable) at the higher level is allowed for the same formulation with a reduced level of CS.

6.5 *Requirements for Batches of Combination OC and CS (OC-CS) Spray:*

6.5.1 The chemical concentration of the active ingredients in combination OC and CS spray shall be assessed as specified in Section 11 of this specification.

6.5.1.1 Each batch of OC-CS blended spray shall be tested by the supplier, either in-house or by an independent test laboratory. The supplier shall maintain test reports for every batch at least 12 months beyond the expiration date of the batch.

(1) The test laboratory shall either (*1*) be accredited to ISO/IEC 17025, or (*2*) have a documented program in place that meets the requirements outlined in Practice E3215 (see Appendix X1: Audit Checklist in E3215).

(2) At a minimum of four times per year (quarterly), a split OC-CS blended spray batch sample collected for testing by the supplier's designated laboratory (either in-house or third-party) shall be sent to an ISO/IEC 17025 accredited laboratory to verify intralaboratory data quality and accuracy. This testing shall be conducted in addition to any testing specified in Practice E3215 for certification or surveillance testing. This requirement is only applicable if the supplier is not using a laboratory accredited to ISO/IEC 17025 to comply with 6.5.1.1(*1*).

6.5.1.2 The results for each batch shall be reported and shall meet the requirements below.

(1) The percentage of capsaicin in raw materials shall be at least 55 % by weight.

(2) The percentage of major capsaicinoids, by weight, in the final formulation shall be declared by the supplier and should be no more than 0.33 %. The measured percentage of major capsaicinoids shall be within ±5 % of that declared value.

(3) The mass fraction of CS by weight in the final formulation should not be greater than 2 %.

6.5.1.3 The supplier shall make available test reports for skin and eye testing, plus inhalation testing when applicable, at the supplier's declared value for percentage of major capsaicinoids and percent CS in the final formulation (*1*) to the certification body in order to be certified and (*2*) to purchasers upon request.

NOTE 4—For a specific formulation tested at the supper limit of major capsaicinoids and higher level of CS, that test report (skin and eye testing, plus inhalation testing when applicable) is allowed for the same formulation with a reduced level of major capsaicinoids, CS, or both.

6.6 *Requirements for Chemical Formulations:*

6.6.1 The product chemical formulation shall be assessed on each of three test items according to 6.3, 6.4, or 6.5 of this specification (as appropriate), except that the testing shall be performed on test items (not batches) by an independent organization other than the supplier for initial certification and for surveillance by the certification body.

6.6.2 The requirements of 6.3, 6.4, or 6.5 of this specification (as appropriate) shall be met.

7. Spray Pattern Test Method

7.1 This spray pattern test shall be conducted in a draft-free area that can be ventilated following the test.

7.2 *Equipment:*

7.2.1 Tape measure.

7.2.2 Test targets, paper sized at least size 25 cm [10 in.] larger in every direction than the expected spray pattern diameter (see 7.3.2).

7.3 *Procedure:*

7.3.1 This procedure shall be conducted twice for each test item: once at a distance of 3 m [118 in.], and once at a distance of 1 m [39 in.].

7.3.2 The supplier shall provide the following information for the product: