Designation: E3105 – 17

Standard Specification for Permanent Coatings Used to Mitigate Spread of Radioactive Contamination[1]

This standard is issued under the fixed designation E3105; 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 is intended to provide a basis for identification of non-removable permanent coatings and fixatives as a long-term measure used to immobilize radioactive contamination, minimize worker exposure, and to protect uncontaminated areas against the spread of radioactive contamination.

1.2 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.3 *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 determine the applicability of regulatory limitations prior to use.*

1.4 *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]

D4060 Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser

D4541 Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers

3. Terminology

3.1 *Definitions:*

3.1.1 *contamination, n*—radioactive material in an unwanted location.

3.1.2 *environmental conditions, n*—external factors that may contribute to the performance of the coating, including, but not limited to, temperature, humidity, and ventilation.

3.1.3 *long-term measure, n*—greater than six months.

3.1.4 *lower flammability limit (LFL), n*—the lower end of the concentration range over which a flammable mixture of gas or vapor in air can be ignited at a given temperature and pressure.

3.1.5 *permanent coating, n*—a non-removable, durable film-forming product used to physically or chemically hold or bind radioactive particulate.

3.1.6 *waste acceptance criteria (WAC), n*—the criteria that a material must meet for acceptance in a waste disposal site; these criteria may vary per disposal site.

3.1.7 *working time, n*—the time period between the opening of the material storage container or mixing of components until the prepared material can no longer be successfully applied to a surface.

4. Significance and Use

4.1 Some of these specifications may prove difficult to meet. A product that meets some, but not all, of the performance specifications herein may have value, and this specification may be used as a guide by which to evaluate such products.

4.2 This specification establishes performance specifications for permanent coatings that are intended to immobilize dispersible radioactive contamination deposited on buildings and equipment as might result from anticipated to unanticipated events to include normal operating conditions, decommissioning, and radiological release.

4.3 The coating is intended to be a permanent, non-removable, long-term material used for decommissioning and operations. It is intended to reduce: *(1)* migration of the contamination into or along buildings, equipment, and other surfaces; *(2)* resuspension of contamination into the air; and *(3)* the spread of contamination as a result of external forces such as pedestrian traffic.

[1] This test method is under the jurisdiction of ASTM Committee E10 on Nuclear Technology and Applications and is the direct responsibility of Subcommittee E10.03 on Radiological Protection for Decontamination and Decommissioning of Nuclear Facilities and Components.

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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.

4.4 The permanent coating is intended to reduce the airborne intake hazards of the radioactive contamination.

4.5 The permanent coating shall be applicable to both vertical and horizontal surfaces.

4.6 The permanent coating should be able to work within a range of environmental and radiological conditions.

4.7 The permanent coating should be applicable to both porous and nonporous materials such as concrete, wood, metal, ceramics, and plastics.

4.8 The permanent coating may include constituents that will physically or chemically bind and hold radioactive contamination.

5. Mechanical Properties

5.1 The permanent coating shall be compatible with at least one of the following application systems: conventional or remote spray, foam, brush, fog, or roll.

5.2 The permanent coating shall immobilize radioactive contamination physically, chemically, or both.

5.3 The permanent coating shall have sufficient mechanical properties to withstand long term wear associated with incidental abrasion and abrasive foot traffic that are likely to cause resuspension or transport of the stabilized contaminant.

5.4 For use in areas of surveillance and maintenance, a desirable characteristic is to have a surface that is easily decontaminated.

5.5 The permanent coating should be readily applied to the desired surface without significant surface preparation (cleaning, sanding, primer layer, etc.)

5.6 The permanent coating should have sufficient mechanical properties to withstand contingency events such as earthquakes as outlined in a facilities' safety design basis document.

6. Chemical Properties

6.1 The permanent coating shall not include nor generate toxic by-products as defined by the U.S. Occupational Safety and Health Administration (OSHA) during preparation, application, or removal for disposal under normal conditions. A Safety Data Sheet must be provided so that appropriate personal protective equipment can be selected.

6.2 The permanent coating shall not generate flammable by-products above 20% of the lower flammability limit (LFL).

6.3 The permanent coating should seek to limit the propagation of flame across the surface.

6.4 The permanent coating should seek to limit smoke production upon incident flame.

6.5 The permanent coating should not sustain a flame upon removal of an ignition source.

6.6 The permanent coating shall be non-volatile after curing with respect to chemical interaction.

6.7 The permanent coating shall maintain a near neutral pH (5-8) before curing.

6.8 The permanent coating should not attract or be a foodstuff for animals, insects, pests, or undesirable bacteria.

6.9 The permanent coating shall be chemically nonhazardous after curing as defined by the U.S. Environmental Protection Agency (EPA).

7. Performance Requirements

7.1 *Shelf Life*—The permanent coating shall have a shelf life in accordance with 8.1.

7.2 *Working Time*—The permanent coating shall exhibit a working time sufficient to meet a realistic application rate. Working time is heavily dependent on the method of application. The application method is purposely left unconstrained and is up to the manufacturer to prescribe.

7.3 *Cure Time*—The permanent coating shall exhibit a curing time sufficient to meet realistic operational and environmental conditions (that is, <24 h).The permanent coating shall form a film that meets the physical, mechanical, and other requirements listed in Sections 4–8 of this specification.

7.4 The permanent coating shall prevent release of radioactive particles when applied to the following surfaces commonly found in a working environment under normal wear conditions: concrete, asphalt, granite, limestone, brick, aluminum, stainless steel, painted and unpainted steel, painted and unpainted wood, glass, and plastic.

7.5 The permanent coating shall maintain a film such that significant amounts of respirable particles (<10 μm) of the coating material are not generated during instantaneous events having a 3 min duration such as abrasion, impact, or earthquake.

7.6 The permanent coating shall remain intact in accordance with Section 8.

7.7 The permanent coating should be impermeable to water present from both leakage sources and ambient humidity.

7.8 The permanent coating should be compatible with temperature cycles ranging from -40 to 120 °F for facilities without environmental regulating systems.

7.9 The permanent coating should be compliant with waste acceptance criteria (WAC) for potential disposition in those instances where required. The permanent coating should be easily segregated to allow for ease of waste package such that compliance with WAC can be easily satisfied.

7.10 The permanent coating shall immobilize contamination material that is both respirable (<10 μm) and non-respirable (≥10 μm).

8. Minimum Performance Criteria

8.1 *Shelf Life*—Minimum of 2 years.

8.2 *Adhesion (Test Method D4541)*— ≥50 psi (345 kPa) on concrete under normal environmental conditions.

8.3 *Abrasion Resistance (Test Method D4060)*— <0.002 oz (50 mg) loss.

8.4 *Dry/Cure Time*—Forms film satisfying the above mechanical criteria within 24 h of application.

8.5 *Airborne Release Fraction*—No minimum, however a desirable characteristic would be to provide ≥95 % immobilization of ≥10 μm particles when disturbed by 50 psi air burst.

8.6 *Respirable Fraction*—No minimum, however a desirable characteristic would be to provide ≥95 % immobilization of <10 μm particles when disturbed by 50 psi air burst.

8.7 *Radiation Resistance*—– 1 MRad over the projected lifetime of the material.

8.8 *Minimum Performance Time*—5 years.

9. Keywords

9.1 cleanup; contain; encapsulate; immobilize; permanent coating; radioactive contamination; radionuclide; resuspension

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