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Standard Practice for Intumescent Coatings[1]

This standard is issued under the fixed designation E2924; 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 practice provides architects, specifiers and building owners various consensus recommendations to specify industry's best practices for *intumescent coatings*.

1.2 This practice covers the best practice for the following:

1.2.1 The manufacturing, testing, labeling, transportation, delivery, and storage, including shelf life, of *intumescent coatings*.

1.2.2 The *application* of the *intumescent coatings* to structural steel for the purposes of providing fire resistance.

1.2.3 The inspection, including safety and equipment, of *intumescent coatings* during and after the *application*.

1.3 *Standard Practice—This practice offers a set of instructions for performing one or more specific operations. This document cannot replace education or experience and should be used in conjunction with professional judgment. Not all aspects of this practice may be applicable in all circumstances. This ASTM standard is not intended to represent or replace the standard of care by which the adequacy of a given professional service must be judged, nor should this document be applied without consideration of a project's many unique aspects. The word "Standard" in the title means only that the document has been approved through the ASTM consensus process.*

1.4 The text of this standard references notes and footnotes which provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of the standard.

1.5 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.

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

NOTE 1—This practice references fire-test-response standards and may involve hazardous tasks. Therefore, the following caveats are also referenced. This practice references tests used to measure and describe the response of materials, products, or assemblies to heat and flame under controlled conditions, but does not by itself incorporate all factors required for fire hazard or fire risk assessment of the materials, products, or assemblies under actual fire conditions. This practice references tests used to predict or provide a quantitative measure of the fire hazard from a specified set of fire conditions involving specific materials, products, or assemblies. This assessment does not necessarily predict the hazard of actual fires which involve conditions other than those assumed in the analysis. This practice references tests used to determine certain fire-test responses of materials, products, or assemblies to heat and flame under controlled conditions by using results obtained from fire-test-response standards. The results obtained from using this practice do not, by themselves, constitute measures of fire hazard or fire risk. Fire testing is inherently hazardous. Adequate safeguards for personnel and property shall be employed in conducting these tests.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D2240 Test Method for Rubber Property—Durometer Hardness

D2794 Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)

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

E119 Test Methods for Fire Tests of Building Construction and Materials

E176 Terminology of Fire Standards

E631 Terminology of Building Constructions

2.2 *ISO Standards:*[3]

ISO 834-1 Fire-resistance Tests—Elements of Building Construction–Part 1: General Requirements

ISO/IEC 17011 Conformity Assessment—General Requirements for Accreditation Bodies Accrediting Conformity Assessment Bodies

ISO/IEC 17020 General Criteria for the Operation of Various Types of Bodies Performing Inspection

[1] This practice is under the jurisdiction of ASTM Committee E06 on Performance of Buildings and is the direct responsibility of Subcommittee E06.21 on Serviceability.

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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 International Organization for Standardization (ISO), 1, ch. de la Voie-Creuse, CP 56, CH-1211 Geneva 20, Switzerland, http://www.iso.org.

ISO/IEC 17025 General Requirements for the Competence of Testing and Calibration of Laboratories
ISO/IEC 17065 Conformity Assessment—Requirements for Bodies Certifying Products, Processes and Services
ISO/IEC Guide 65 General Requirements for Bodies Operating Product Certification Systems

2.3 *Other Standards:*
AWCI Technical Manual 12-B, Third Edition Standard Practice for the Testing and Inspecting of Field Applied Thin-Film Intumescent Fire-Resistive Materials; an Annotated Guide[4]
CAN/ULC-S101 Fire Endurance Tests of Building Construction and Materials[5]
UL 263 Fire Tests of Building Construction and Materials[6]
SSPC-PA2 Procedure for Determining Conformance to Dry Coating Thickness Requirements[7]

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of terms used in this practice and associated with fire issues, refer to the definitions contained in Terminology E176.

3.1.2 For definitions of terms used in this practice and associated with building issues, refer to the definitions contained in Terminology E631.

3.1.3 If there is a conflict between Terminology E176 and Terminology E631 definitions, Terminology E631 definitions shall apply.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *application, n*—an act of applying *intumescent coatings*.

3.2.2 *char, n*—a reacted (expanded) intumescent material, having low thermal conductivity, thus retarding heat transfer, that is quantified where no appreciable density changes occur during additional temperature rise.

3.2.3 *intumescent coating, n*—a material that produces an insulating *char* when activated by heat or flame.

4. Summary of Practice

4.1 This practice describes the best procedures for *intumescent coatings* related to the following:

4.1.1 The *application*, including safety and equipment, refers to Sections 8, 12, 13 and 14,

4.1.2 manufacturing, refer to 6.1,

4.1.3 testing, refer to 9.2.2,

4.1.4 labeling, refer to 6.2,

4.1.5 transportation, refer to 6.1,

4.1.6 delivery and storage (including shelf life), refer to 6.1 and Section 7, and

4.1.7 inspection (including safety and equipment), refer to Section 10 and Section 16.

5. Significance and Use

5.1 This practice is intended for use by material specifiers, general contractors, applicators, or any individual or group requiring information regarding the *application* of *intumescent coatings* to provide a fire resistance rating to structural steel.

5.2 This practice is not intended to replace the manufacturer's *application* instructions.

6. Materials

6.1 The *intumescent coating* shall be manufactured, transported, stored and installed in accordance with the manufacturer's specifications and quality control procedures.

6.2 Containers must be labeled in accordance with listing agency, which is either an internationally recognized:

6.2.1 certification body accredited to ISO/IEC Guide 65 or ISO/IEC 17065, or

6.2.2 test laboratory accredited to ISO/IEC 17025 and having an inspector or inspection agency accredited to ISO/IEC 17020 under Type A requirements.

NOTE 2—*Intumescent coatings* are sometimes referred to as fireproofing or intumescent paint. The term Labeled refers to *intumescent coatings* to which has been affixed a label, seal, symbol or other identifying mark of a nationally recognized testing laboratory, inspection agency or other organization concerned with product evaluation that maintains periodic inspection of the production of the above-labeled items and whose labeling indicates either that the *intumescent coating* meets identified standards or has been tested and found suitable for a specified purpose.

NOTE 3—The term Listed refers to *intumescent coatings* included in a list or directory published by an organization acceptable to the *authority having jurisdiction (AHJ)* and concerned with evaluation of products that maintains periodic inspection of production of listed *intumescent coatings* and whose listing states either that the *intumescent coating* meets identified standards or has been tested and found suitable for a specified purpose.

6.2.3 The accrediting body overseeing the certification body in 6.2.1 or the test laboratory in 6.2.2 must be recognized as operating under the requirements of ISO/IEC 17011 by the International Accreditation Forum (IAF) for ISO/IEC Guide 65 or ISO/IEC 17065, or International Laboratory Accreditation Cooperation (ILAC) for ISO/IEC 17020 and ISO/IEC 17025.

7. Delivery and Shelf Life

7.1 All materials shall be delivered to the job site in clearly labeled unopened containers. Labels shall include the name of the product as well as the manufacturer name and contact information.

7.2 Materials with a shelf life shall have it clearly designated and these materials shall be used within that period. Materials that have exceeded their shelf life shall be removed from the job site, or the manufacturer shall provide documentation attesting that the product is still usable for its original intended purpose.

8. Material Equipment and Handling

8.1 Equipment used for *application* shall be of a type recommended by the *intumescent coating* manufacturer.

[4] Available from Association of the Wall and Ceiling Industry (AWCI), 513 West Broad Street, Suite 210, Falls Church, VA 22046, http://www.awci.org.

[5] Available from ULC Standards, 171 Nepean Street, Suite 400 Ottawa, ON K2P 0B4, http://www.ul.com/canada/eng/pages.

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

[7] Available from Society for Protective Coatings (SSPC), 40 24th St., 6th Floor, Pittsburgh, PA 15222-4656, http://www.sspc.org.

Equipment shall include, but is not limited to: hand tools, *application* machines, mixing equipment, hoses, spray guns and spray tips.

8.2 The following utilities are typically provided: electricity, potable water, and lighting.

8.3 Depending on local and jobsite conditions, during *application* and curing of the *intumescent coating* the following utilities must be provided, if necessary, to ensure their proper *application* and curing in compliance with the *intumescent coating* manufacturer's installation instructions:

8.3.1 heating,
8.3.2 forced ventilation,
8.3.3 temporary enclosures,
8.3.4 dehumidification,
8.3.5 air quality control, and
8.3.6 monitoring devices.

9. Fire Resistance Ratings and Physical Properties

9.1 Required fire resistance ratings are typically specified by building codes and enforced by local governmental authority, which is often called an authority having jurisdiction (AHJ). Required fire resistance ratings are determined by construction type, occupancy, and location as well as other factors.

NOTE 4—Examples of some building codes that reference a fire resistance rating are International Building Code (IBC) and National Building Code of Canada (NBCC).

NOTE 5—One standards development organization (SDO), NFPA,[8] defines the term authority having jurisdiction (AHJ) as follows: "an organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure."

9.2 The *intumescent coating* shall be specified and along with its required fire resistance rating(s) shall be indicated in the contract documents. The contract documents shall also indicate what elements of that project are to be protected with the *intumescent coating*.

9.2.1 The specified *intumescent coating* in 9.2 shall be fire tested in accordance with the test method specified in the contract documents.

NOTE 6—Test Methods E119 and UL 263 are normally specified in contract documents issued in the United States, CAN/ULC-S101 is normally specified in contract documents issued in Canada, and ISO 834 or similar fire test methods are normally specified in contract documents issued in other international jurisdictions.

9.2.2 The specified *intumescent coating* in 9.2 shall be tested by an accredited third party testing agency accredited to ISO 17025.

9.2.3 *Intumescent coatings* shall only be used in environmental conditions where their exposure is suitable and acceptable.

9.3 The requirements for an *intumescent coating's* durability shall be specified in contract documents. At a minimum, the following test methods shall be used to ascertain the *intumescent coating's* durability.

9.3.1 Hardness of the product shall be measured in accordance with Test Method D2240, shore D.

9.3.2 Impact resistance shall be measured in accordance with Test Method D2794.

9.3.3 Abrasion Resistance shall be measured in accordance with Test Method D4060.

9.3.4 Adhesion shall be measured in accordance with Test Method D4541.

NOTE 7—Examples of exposure conditions are interior conditioned space, interior general purpose and exterior use.

10. Safety

10.1 Applicable local ordinances, codes and regulations shall be followed at all times.

NOTE 8—For example, there may be a threshold limit value (TLV) for some materials containing volatile organic compounds. "Volatile organic compounds (VOCs) are emitted as gases from certain solids or liquids. VOCs include a variety of chemicals, some of which may have short- and long-term adverse health effects. Concentrations of many VOCs are consistently higher indoors (up to ten times higher) than outdoors. VOCs are emitted by a wide array of products numbering in the thousands. Examples include: paints and lacquers, paint strippers, cleaning supplies, pesticides, building materials and furnishings, office equipment such as copiers and printers, correction fluids and carbonless copy paper, graphics and craft materials including glues and adhesives, permanent markers, and photographic solutions."[9]

10.2 Equipment shall have safety guards that meet applicable regulations.

10.3 All persons in the *application* area shall wear Personal Protective Equipment (PPE) as required by the regulatory body and as recommended by the manufacturer.

NOTE 9—Examples of PPE include respirators, gloves and protective clothing.

10.4 Access shall be provided for applicators and inspectors to the work areas meeting applicable safety requirements.

10.4.1 When required, a strong lightweight, stable scaffold in compliance with local regulations shall be used. Safety railing meeting applicable regulations shall surround floor area.

10.4.2 When required, a Personal Fall Arrest System (PFAS) shall also be used during the *application* and inspection of the *intumescent coating*.

NOTE 10—"Personal fall arrest system" means a system used to arrest an employee in a fall from a working level. It consists of an anchorage, connectors, a body belt or body harness and may include a lanyard, deceleration device, lifeline, or suitable combinations of these.

10.5 *Floors*—The floors in the work area shall be kept free of obstructions, excessive moisture, waste material, or other unsafe conditions.

NOTE 11—Examples of regulatory bodies are Occupational Safety and Health Administration (OSHA) and Health and safety Executive (HSE), which address safety regulations.

11. Mock-Up

11.1 The company or individual applying the *intumescent coating* shall provide a mock-up for evaluation of surface preparation techniques and *application* workmanship.

[8] National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA, 02169-7471, www.nfpa.org.

[9] http://www.epa.gov/iaq/voc.html.

NOTE 12—Unlike sprayed fire-resistive materials (SFRM), *intumescent coatings* are often exposed to view making their aesthetics a concern for architects and owners.

11.2 When requested, a sample of the *intumescent coating* shall be submitted to the owner or their designated representative.

11.3 Work shall not proceed until the owner or designated representative evaluates and approves mock-up.

11.4 The mock-up shall be retained and the mock-up's finish shall be maintained during construction.

NOTE 13—Samples representing 10 % of project requirements, but not exceeding 100 ft^2 (9.29 m^2), are commonly requested.

12. Substrate Preparation

12.1 Prior to the *application* of the *intumescent coating*, all areas to be sprayed or coated shall be inspected and properly prepared by the applicator to ensure a suitable surface profile in accordance with the manufacturer's recommendations.

12.2 For *applications* requiring aesthetically pleasing appearance, repair substrates to correct surface imperfections, which can project to the finished surface, that have the potential to affect the uniformity of texture and thickness. Corrections shall be made in accordance with *intumescent coating* manufacturer's specifications.

NOTE 14—Examples of conditions needing correction are projections and voids on the substrate surface.

12.3 All surfaces to receive *intumescent coating* fire protection shall be clean, dry and free of contaminants (such as, but not limited to, oil, grease, loose mill scale, dirt, dust or other materials), which would impair bond of the *intumescent coating* to the surface.

12.4 The surfaces to receive the *intumescent coating* must be compatible with it. To achieve compatibility, sometimes steel surfaces are required to be primed. When primer is required coat the steel surface with a primer compatible with the steel and recommended by the *intumescent coating* manufacturer.

12.5 The primer shall be listed as acceptable in the *intumescent coating's* listing published by an accredited listing agency, refer to 6.2.

12.6 Surfaces that are subject to overspray shall be cleaned, masked, covered or otherwise protected.

13. Application Environment

13.1 A minimum ambient air temperature and surface temperature of 50°F (10°C) shall be maintained during the *application* and drying/curing periods required for the *intumescent coating* unless otherwise recommended by the manufacturer.

13.2 The relative humidity in the work area shall not exceed the *intumescent coating* manufacturer's recommendations during the *application* and drying/curing period.

13.3 In enclosed areas, where there is insufficient ventilation, forced ventilation shall be introduced during *application* and curing.

NOTE 15—Association of the Wall and Ceiling Industry (AWCI) Technical Manual 12-B, Third Edition, Section 4-Site Conditions provides additional information regarding *application* environments.

14. Application

14.1 *intumescent coatings* shall be applied by one of the following entities:

14.1.1 A company or individual acceptable to the *intumescent coating* manufacturer, or

14.1.2 A company or individual that has received the *intumescent coating* manufacturer's training or certification, or both.

14.2 Equipment, mixing and *application* techniques shall be in accordance with the *intumescent coating* manufacturer's written specifications and *application* instructions.

14.3 *Application* shall not commence until the applicator inspects all substrates to receive protection and those substrates are found acceptable.

14.4 Work shall be coordinated with other trades so that project progress is not delayed. *Application* of the *intumescent coating* shall commence after the installation of attachments to the substrate.

15. Protection During Curing

15.1 The *intumescent coating* shall be allowed to cure without damage. Wet *intumescent coatings* are susceptible to damage from physical abuse and environmental conditions during the curing process.

15.2 When needed, temperature, ventilation and humidity control shall be provided for curing as recommended by the *intumescent coating* manufacturer.

16. Inspection Procedures

16.1 An ISO/IEC 17020 accredited inspector, or an accredited listing agency, both as defined in 6.2 shall be approved by the owner or the owner's representative, and the local governmental authority, or both because the *application* and inspection of the *intumescent coating* is a life safety issue.

16.2 The approved inspector or inspection agency shall attend the pre-construction meetings related to the *application* of the *intumescent coating*.

16.3 The approved inspector or inspection agency in 16.1 shall inspect the *application* of the *intumescent coating* for the following:

16.3.1 conformance to the specifications, and

16.3.2 conformance to local building code requirements, as well as

16.3.3 conformance to the *intumescent coating* manufacturer's recommended installation procedures.

16.4 The inspection of the *intumescent coating* shall include, but is not limited to, the following stages:

16.4.1 pre-*application* substrate inspection,

16.4.2 curing controls during *application*,

16.4.3 dry thickness of *application*,

16.4.4 condition of finished *application*,

16.4.5 patch work, refer to Section 17, and

16.4.6 remediation work, for example, due to inadequate initial thickness or *application* discontinuities.

16.5 When required, test and inspection reports shall be submitted to the local governmental authority. Results of testing shall be made available to the *intumescent coating's* applicator.

NOTE 16—Thickness of an *intumescent coating* is typically evaluated and determined in accordance with SSPC-PA2.

NOTE 17—Industry publications, such as the AWCI Technical Manual 12-B, Third Edition, provide useful information regarding inspection procedures.

16.6 When specified, the *intumescent coating* shall be tested upon curing for cohesion and adhesion in accordance with Test Method D4541.

17. Patching

17.1 When the *intumescent coating* is removed or damaged, it shall be repaired and replaced using the same *intumescent coating* as used for the original *application*.

17.2 All repaired areas shall be patched using the *intumescent coating* in 17.1 in accordance with the manufacturer's written instructions.

NOTE 18—Sometimes the same *intumescent coating* used for the original *application* is no longer available. When this is the case, the repair area should be patched with a compatible *intumescent coating* considered acceptable to the original *intumescent coating* manufacturer and an *intumescent coating* with supporting test data that is compatible with the original fire resistance rating. Otherwise the coating should be removed; the substrate repaired and prepared to accept the new *intumescent coating*, and replaced with an *intumescent coating* meeting the requirements of Section 9.

18. Clean Up

18.1 *Miscellaneous*—Upon completion of the *application*, all waste materials shall be removed from the work area and disposed of in accordance with manufacturer's recommendations as well as applicable regulations and laws.

18.2 *Intumescent coating* overspray and fallout shall be removed from surfaces of other construction in accordance with the *intumescent coating* manufacturer's recommendations.

19. Keywords

19.1 application; intumescent coating; intumescent, fireproofing; intumescent paint, inspection