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Standard Guide for Use of Protective Coating Standards in Nuclear Power Plants¹

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INTRODUCTION

Protective coatings (paints) have been used extensively in the nuclear industry to protect the surfaces of facilities and equipment from corrosion and contamination by radioactive nuclides in accordance with ALARA. In the absence of a standard method of selecting, testing, and evaluating coatings, many sites evaluated paints by empirical tests to determine which were useful in their particular operation. Understandably, the methods of testing were not uniform throughout the industry. It has been very difficult, consequently, to compare the results obtained at one site with those obtained at another. Standard tests whereby industrial (nuclear) users of paints systematically prepare specimens and subject them to selected evaluations, thus permitting uniform comparisons, are advantageous, internationally as well as domestically.

The designer of light water-moderated nuclear reactor systems must consider the possibility of a Design Basis Accident (DBA) and the subsequent events which might lead to the release or expulsion of a fraction of the fission-product inventory of the core to the reactor containment facility. Engineered safety features, principally a reactor containment facility, are provided to prevent the release of fission products to the biological environment during and after this improbable event. The design, fabrication, quality assurance, and testing of these engineered safety features ensure reliable operation and safety under all anticipated conditions.

Large areas of the reactor-containment facility are painted with safety-related coatings. If severe delamination, peeling, or flaking causes significant portions of the coating to be discharged into the common water reservoir, the performance of the safety systems could be seriously compromised by the plugging of strainers, flow lines, pumps, spray nozzles, and core coolant channels. Safety-related coatings may also exist outside of the reactor-containment.

This guide is the result of a comprehensive examination of the experience and data that have been developed on protective coatings in the nuclear industry over approximately 50 years. Standards pertaining to nuclear coatings have historically been covered by ANSI N5.12, ANSI N101.2, and ANSI N101.4. Responsibility for updating, rewriting, and issuing appropriate ANSI replacement standards has been transferred to ASTM, specifically ASTM Committee D33, on Protective Coating and Lining Work for Power Generation Facilities.

The objective of this guide is to provide a common basis on which protective coatings for the surfaces of nuclear power generating facilities may be qualified and selected by reproducible evaluation tests. This guide also provides guidance for application and maintenance of protective coatings. Quality assurance in the nuclear industry is a mandatory requirement for all aspects of safety-related nuclear coatings work. Licensees of nuclear power plants are required to determine if coated surfaces are within the scope of 10CFR50.65, "The Maintenance Rule." Any coated surfaces found to be within the scope of 10CFR50.65 must satisfy the requirements of 10CFR50.65. ASME Section XI, Subsection IWE contains the requirements for periodic evaluation of the reactor-containment steel pressure boundary.

1. Scope

1.1 This guide provides a common basis on which protective coatings for the surfaces of nuclear power generating facilities may be qualified and selected by reproducible evaluation tests. This guide also provides guidance for application and maintenance of protective coatings. Under the environmental operating and accident conditions of nuclear power generation facilities, encompassing pressurized water reactors (PWRs) and boiling water reactors (BWRs), coating performance may be affected by exposure to any one, all, or a combination of the following conditions: ionizing radiation; contamination by radioactive nuclides and subsequent decontamination processes; chemical and water sprays; high-temperature high-pressure steam; and abrasion or wear.

1.2 The content of this guide includes:

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Terminology	3
Significance and Use	4
Coating Material Testing	5
Thermal Conductivity	5
Surface Preparation, Coating Application, and Inspection for Shop and Field Work	6
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1.2.1 In addition, this guide addresses technical topics within ANSI N5.12 and ANSI N101.2 that are covered by separate ASTM standards, for example, surface preparation, (shop and field) and coating application, (shop and field).

1.2.2 Applicable sections of this guide and specific acceptance criteria may be incorporated into specifications and other documents where appropriate.²

1.3 The values stated in inch-pound units are to be regarded as standard. No other units of measurement are included in this standard.

1.4 *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.*

1.5 *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.*

¹ This guide is under the jurisdiction of ASTM Committee D33 on Protective Coating and Lining Work for Power Generation Facilities and is the direct responsibility of Subcommittee D33.02 on Service and Material Parameters.

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² Certain ASTM standards are available in compilation form (which includes this guide), as *Compilation of ASTM Standards for Use of Protective Coating Standards in Nuclear Power Plants* for expedient reference and usage by personnel involved in nuclear coating work.

2. Referenced Documents

2.1 ASTM Standards:³

- [C177 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus](#)
- [D3843 Practice for Quality Assurance for Protective Coatings Applied to Nuclear Facilities](#)
- [D3911 Test Method for Evaluating Coatings Used in Light-Water Nuclear Power Plants at Simulated Design Basis Accident \(DBA\) Conditions](#)
- [D3912 Test Method for Chemical Resistance of Coatings and Linings for Use in Nuclear Power Plants](#)
- [D4060 Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser](#)
- [D4082 Test Method for Effects of Gamma Radiation on Coatings for Use in Nuclear Power Plants](#)
- [D4227 Practice for Qualification of Coating Applicators for Application of Coatings to Concrete Surfaces](#)
- [D4228 Practice for Qualification of Coating Applicators for Application of Coatings to Steel Surfaces](#)
- [D4537 Guide for Establishing Procedures to Qualify and Certify Personnel Performing Coating and Lining Work Inspection in Nuclear Facilities](#)
- [D4538 Terminology Relating to Protective Coating and Lining Work for Power Generation Facilities](#)
- [D4541 Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers](#)
- [D5139 Specification for Sample Preparation for Qualification Testing of Coatings to be Used in Nuclear Power Plants](#)
- [D5163 Guide for Establishing a Program for Condition Assessment of Coating Service Level I Coating Systems in Nuclear Power Plants](#)
- [D7167 Guide for Establishing Procedures to Monitor the Performance of Safety-Related Coating Service Level III Lining Systems in an Operating Nuclear Power Plant](#)
- [D7230 Guide for Evaluating Polymeric Lining Systems for Water Immersion in Coating Service Level III Safety-Related Applications on Metal Substrates](#)
- [D7234 Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers](#)
- [D7491 Guide for Management of Non-Conforming Coatings in Coating Service Level I Areas of Nuclear Power Plants](#)
- [E84 Test Method for Surface Burning Characteristics of Building Materials](#)
- [E648 Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source](#)
- [E1461 Test Method for Thermal Diffusivity by the Flash Method](#)

³ 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.