



# Standard Test Method for Effects of Gamma Radiation on Coatings for Use in Light-Water Nuclear Power Plants<sup>1</sup>

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## 1. Scope

1.1 This test method covers a standard procedure for evaluating the lifetime radiation tolerance of coatings to be used in nuclear power plants. This test method is applicable to Coating Service Levels I and II.

## 2. Referenced Documents

### 2.1 ASTM Standards:

- D 659 Test Method of Evaluating Degree of Chalking of Exterior Paints<sup>2</sup>
- D 660 Test Method for Evaluating Degree of Checking of Exterior Paints<sup>3</sup>
- D 661 Test Method for Evaluating Degree of Cracking of Exterior Paints<sup>3</sup>
- D 714 Test Method for Evaluating Degree of Blistering of Paints<sup>3</sup>
- D 772 Test Method for Evaluating Degree of Flaking (Scaling) of Exterior Paints<sup>3</sup>
- D 5139 Specification for Sample Preparation for Qualification Testing of Coatings to be Used in Nuclear Power Plants<sup>4</sup>

## 3. Significance and Use

3.1 Variations can occur in surface preparation, application, and curing of coating materials. They may affect the performance of a coating system exposed to radiation when considered in conjunction with applicable engineered safety requirements. This test method is designed to provide a uniform test to assess the suitability of coatings, used in nuclear power facilities, under continuous radiation exposure for the projected 40-year lifetime of the facilities, including radiation during a DBA. Specific plant radiation exposure may exceed or be less than the amount specified in 6.2 of this standard. The gamma dose used may exceed the actual anticipated plant gamma dose in order to account for expected beta exposure as well.

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<sup>2</sup> Discontinued; see 1993 Annual Book of ASTM Standards, Vol 06.01.

<sup>3</sup> Annual Book of ASTM Standards, Vol 06.01.

<sup>4</sup> Annual Book of ASTM Standards, Vol 06.02.

Coatings in Level II areas (outside primary containment) are expected to be exposed to lower accumulated radiation doses.

## 4. Preparation of Test Samples

4.1 *Steel Panels*—Panels shall be prepared in accordance with Specification D 5139.

4.2 *Concrete Blocks*—Blocks shall be prepared in accordance with Specification D 5139.

## 5. Sampling

5.1 Prepare and test specimens at least in duplicate, or as otherwise specified by the owner.

## 6. Procedures

### 6.1 Irradiation Dose Rate:

6.1.1 Make the gamma energy field at the position of the test specimen  $1 \times 10^6$  rads/h, or greater, unless otherwise specified by the owner. It shall be uniform to within 10 % from one position of the specimen to another.

6.1.2 Make provisions so that all areas receive the same average exposure and dose, if the specimen is irradiated by a nonuniform source.

6.1.3 Determine the dose rate by a procedure acceptable to the coating manufacturer or as otherwise specified by the owner.

6.2 *Irradiation Accumulated Dose*—Make the total accumulated dose  $1 \times 10^9$  rads, unless otherwise specified by the owner.

6.3 *Radiation Source*—Simulate conditions at a reactor site, closest to the preferred type of gamma source, such as, but not limited to, a fuel assembly.

### 6.4 Test Environment:

6.4.1 Specimens may be in air or in water during exposure to the gamma source, depending on the intended service as prescribed by the owner.

6.4.2 Do not exceed a temperature of 140°F (60°C) for the specimen during irradiation, or as otherwise acceptable to the coating manufacturer or as specified by the owner.

## 7. Examination and Reporting

7.1 Examine and evaluate specimens immediately after irradiation for the following coating defects:

7.1.1 *Chalking* (Method D 659)—Report extent.

7.1.2 *Checking* (Test Method D 660)—Report extent.

7.1.3 *Cracking* (Test Method D 661)—Report extent.

7.1.4 *Blistering* (Test Method D 714)—Report number and extent.

7.1.5 *Flaking* (Test Method D 772)—Report extent.

7.1.6 *Delamination*—Report extent.

7.1.7 *Peeling*—Report extent.

7.1.8 Report any observation of unusual appearance or deterioration.

## 8. Acceptance Criteria

8.1 Unless otherwise specified, checking, cracking, flaking, delamination, peeling, and blistering are not permitted.

## 9. Report

9.1 Report the following information:

9.1.1 The procedures and conditions relating to the test specimen preparation,

9.1.2 The type of radiation source and the test procedure and environment, and

9.1.3 Both the initial dose rate and the total accumulated dose.

## 10. Testing Laboratory

10.1 Testing shall be conducted by an independent laboratory that shall not be affiliated in any manner with the coatings manufacturer unless otherwise specified by the owner.

10.2 The testing laboratory shall be responsible for the documentation and certification of all test results.

10.3 The testing laboratory shall be responsible for meeting the quality assurance requirements of the owner.

## 11. Precision and Bias

11.1 The precision and bias of this test method is reflected in the precision and certified bias of the test instruments used.

## 12. Keywords

12.1 coatings; dose rate; gamma radiation resistance

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