Standard Method of Test for

Mass [Weight] of Coating on Aluminum-Coated Iron or Steel Articles

AASHTO Designation: T 213M/T 213-23[1]

Technically Revised: 2023

Technical Subcommittee: 4f, Metals

ASTM Designation: A428/A428M-21

AASHTO

American Association of State Highway and Transportation Officials
555 12th Street NW, Suite 1000
Washington, D.C. 20004

AVA Documents
Document Sharing Hub

Full document details: AASHTO T 213M - T 213-23

Standard Method of Test for

Mass [Weight] of Coating on Aluminum-Coated Iron or Steel Articles

AASHTO Designation: T 213M/T 213-23[1]

Technically Revised: 2023

Technical Subcommittee: 4f, Metals

ASTM Designation: A428/A428M-21

1. SCOPE

1.1. This test method covers procedures for determining the mass [weight] of coating on aluminum-coated iron or steel sheets and wire, and on other aluminum-coated iron and steel articles.

1.2. The final results determined by this test method shall be expressed in SI or inch-pound units, depending on the units used in the material specification to which the results are to be compared. Certain portions of the procedure involving determination of specimen mass [weight] traditionally have been performed in SI units, and corresponding inch-pound units are not included.

1.3. For sheet products, the final results are expressed as either coating mass [weight] total both sides, or coating mass [weight] separately on each side, depending on the specified requirements.

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 and health practices and determine the applicability of regulatory limitations prior to use*. For a specific precautionary statement, see Note 1.

1.5. Current regulation codes and hazard classifications for chemicals used in this test method are listed in 29 CFR 1910.1200.

1.6. *The quality of the results produced by this standard are dependent on the competence of the personnel performing the procedure and the capability, calibration, and maintenance of the equipment used. Agencies that meet the criteria of R 18 are generally considered capable of competent and objective testing/sampling/inspection/etc. Users of this standard are cautioned that compliance with R 18 alone does not completely assure reliable results. Reliable results depend on many factors; following the suggestions of R 18 or some similar acceptable guideline provides a means of evaluating and controlling some of those factors.*

2. REFERENCED DOCUMENTS

2.1. *AASHTO Standards*:

- R 18, Establishing and Implementing a Quality Management System for Construction Materials Testing Laboratories
- T 213M/T 213-08, Mass [Weight] of Coating on Aluminum-Coated Iron or Steel Articles

AVA Documents
Document Sharing Hub

Full document details: AASHTO T 213M - T 213-23
© 2023 by the American Association of State Highway and Transportation Officials.

2.2. *ASTM Standards*:

- D1193, Standard Specification for Reagent Water
- E29, Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
- E177, Standard Practice for Use of the Terms Precision and Bias in ASTM Test Methods
- E691, Standard Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

2.3. *Federal Standard*:

- Fed. Std. No. 29, CFR 1910.1200 OSHA Hazard Communication Standard; see also Permissible Exposure Limits—Annotated Tables, available at https://www.osha.gov/dsg/annotated-pels/

3. SIGNIFICANCE AND USE

3.1. This test method provides a standard method of determining the mass [weight] of coating for comparison with specification requirements. A coating of aluminum on iron or steel articles provides protection against corrosion by forming a relatively inert barrier. Specifications for aluminum-coated articles occasionally provide for different masses [weights] of coating so that the purchaser can select the coating mass [weight] most suited to his needs. The heavier coating will provide greater protection against mechanical damage, which may break the coating.

3.2. This test method determines the average coating mass [weight] over a specified area, from which the average thickness can be calculated. Other test methods not described herein can determine the thickness directly at point locations on the coating: in such cases, the required test method is described in that material specification or by reference to another appropriate test method standard.

4. REAGENTS

4.1. *Purity of Reagents*—Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents shall conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available.[2] Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

4.2. *Purity of Water*—Water used in preparation of reagent solutions shall conform to ASTM D1193, Type IV or better.

4.3. *Antimony Trichloride Solution*—Dissolve 200 g of antimony trichloride ($SbCl_3$) in 1000 mL of concentrated hydrochloric acid (HCl, sp gr 1.18 to 1.19) without heating.

4.4. *Hydrochloric Acid (*sp gr 1.18 to 1.19*)*—Concentrated hydrochloric acid (HCl).

4.5. *Sodium Hydroxide Solution*—(20 percent). Dissolve 20 parts by mass [weight] of sodium hydroxide (NaOH) in 80 parts of water.

4.6. *Stannous Chloride Solution*—Dissolve 100 g of stannous chloride ($SnCl_2 \cdot 2H_2O$) in 1000 mL of concentrated hydrochloric acid (HCl, sp gr 1.18 to 1.19) without heating. Add a few granules of reagent-grade tin.

AVA Documents
Document Sharing Hub

Full document details: AASHTO T 213M - T 213-23
© 2023 by the American Association of State Highway and Transportation Officials.

4.7. *Hydrochloric Acid (1+1)*—Mix 500 mL of HCl (sp gr 1.18 to 1.19) with 500 mL of reagent water and cool to room temperature.

Note 1—**Warning**: Small amounts of the poisonous gas stibine (SbH_3) may be evolved during the stripping process using the hydrochloric acid–antimony trichloride–stannous chloride method. Hydrochloric acid fumes are present, and hydrogen gas is evolved in the stripping process. Therefore, the test should be performed under conditions of adequate ventilation. A fume hood is recommended for large numbers of samples or where the test is to be carried out frequently over extended periods of time.

5. SAMPLING

5.1. *Aluminum-Coated Sheets*—Samples for mass-of-coating [weight-of-coating] determination shall be secured as designated in the appropriate specification. Test specimens shall have a minimum area of 2000 mm^2 [3 $in.^2$] of sheet, but preferably approximately 3300 mm^2 [5 $in.^2$] of sheet.

Note 2—For results to be reported in SI units, the specimen should have an area of 3300 mm^2 of sheet (57.7 ± 0.1-mm square or 65.1 ± 0.1 mm in diameter). For convenience in calculating test results in inch-pound units, the specimen should have an area of 5.08 $in.^2$ of sheet (2.25 ± 0.01-in. square or 2.54 ± 0.01 in. in diameter). The mass [weight] of coating in grams on a specimen of that area is numerically equal to the mass [weight] of coating in ounces per square foot of sheet.

5.2. *Aluminum-Coated Wire*—Samples shall be secured as designated in the appropriate specification. The specimen of aluminum-coated wire may be of any length greater than 300 mm [approximately 12 in.], but preferably about 600 mm [approximately 24 in.]. Where a continuous length is not available, shorter lengths totaling more than 300 mm, but preferably about 600 mm, shall be used. Because the density of the steel is known (7830 kg/m^3 or 0.283 $lb/in.^3$), it is not necessary to use a specific length of specimen.

5.3. *Aluminum-Coated Articles Other Than Sheet or Wire*—Samples for mass [weight] of coating determination shall be secured as designated in the appropriate specification. Except as otherwise provided, the specimens should have a minimum area of 1935 mm^2 [3 $in.^2$] of aluminum-coated surface. For very small items, several pieces may have to be stripped to obtain the minimum area.

5.3.1. In the case of threaded articles, such as bolts and screws, the determination shall be made on a portion of the article that does not include any thread.

6. PROCEDURE

6.1. Strip the aluminum coating from the specimens by using one of the following methods—the sodium hydroxide–hydrochloric acid method (Method A), the hydrochloric acid–antimony trichloride–stannous chloride method (Method B), or the dilute hydrochloric acid method (Method C).

Note 3—Methods A and B are the most common methods used for sheets.

6.2. Clean the specimens immediately before determining the mass [weight] by washing in petroleum ether or other suitable solvent, and dry thoroughly.

6.3. Determine the mass [weight] of the specimens individually to the nearest 0.01 g.

6.4. *Sodium Hydroxide-Hydrochloric Acid Method (Method A)*—Heat the NaOH solution to approximately 90°C [195°F] (Note 4) and immerse each specimen in the hot solution until the strong reaction ceases. With silicon-free coatings, evolution of gas for considerable time is likely, but do not leave the specimens in the solution for more than a few minutes. Longer immersion inhibits the removal of coating during subsequent dips. Immersion of several specimens

AVA Documents
Document Sharing Hub

Full document details: AASHTO T 213M - T 213-23
© 2023 by the American Association of State Highway and Transportation Officials.