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AMERICAN SOCIETY FOR TESTING AND MATERIALS
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Standard Specification for Steel Sheet, Electrolytic Zinc-Coated, for Light Coating Weight [Mass] Applications[1]

This standard is issued under the fixed designation A 591/A 591M; 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.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 This specification covers zinc coatings produced by electro-deposition for light coating weight [mass] applications on steel sheet. This product is available in four zinc-coating designations which are listed in Table 1. For electrolytic zinc-coated steel sheet with coating masses heavier than described in this specification, see Specification A 879.

1.2 This product is intended for applications requiring some degree of corrosion resistance with or without requirements for formability, strength, paintability, or a combination thereof. The coating is used to provide some enhancement in corrosion performance as compared to an uncoated product. It is not intended to withstand outdoor exposure without chemical treating and painting.

1.3 The steel sheet used as the substrate shall be as described in one of the following specifications, as specified in the order: A 366/A 366M, A 569/A 569M, A 570/A 570M, A 606, A 607, A 611, A 620/A 620M, A 622/A 622M, A 659/A 659M, A 715, A 794, A 812/A 812M, A 963/A 963M, and A 969/A 969M.

1.3.1 This coating process has essentially no effect on the base metal mechanical properties and can be used on any grade or quality of hot or cold-rolled steel sheet.

1.4 For purposes of determining conformance with this specification, values shall be rounded to the nearest unit in the right-hand place of figures used in expressing the limiting values in accordance with the rounding method of Practice E 29.

1.5 The values stated in either inch-pound or SI units are to be regarded separately as standard. Within the text, the SI units are shown in brackets. The values stated in each system are not exact equivalents; therefore, each system must be used independently of the other.

TABLE 1 Coating Class and Minimum Coating Limits Coating Minimum Requirements Per Side

Inch-Pound Units			
Coating Designation	Coating Name	Weight, oz/ft.^{2}	Thickness, mils.
10Z	Flash	0.01	0.017
20Z	Intermediate	0.02	0.034
40Z	Full	0.04	0.068
80Z	Double	0.08	0.136
SI Units			
Coating Designation	Coating Name	Mass, g/m^2	Thickness, µm
03G	Flash	3	0.42
06G	Intermediate	6	0.84
12G	Full	12	1.68
24G	Double	24	3.36

2. Referenced Documents

2.1 *ASTM Standards:*

A 90/A 90M Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings[2]

A 366/A 366M Specification for Commercial Steel (CS) Sheet, Carbon, (0.15 Maximum Percent) Cold-Rolled[3]

A 568/A 568M Specification for Steel, Sheet, Carbon and High Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for[3]

A 569/A 569M Specification for Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip Commercial[3]

A 570/A 570M Specification for Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Steel[3]

A 606 Specification for Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled with Improved Atmospheric Corrosion Resistance[3]

A 607 Specification for Steel, Sheet and Strip, High-Strength, Low-Alloy, Columbium or Vanadium, or Both, Hot-Rolled and Cold-Rolled[3]

A 611 Specification for Structural Steel (SS), Sheet, Carbon, Cold-Rolled[3]

A 620/A 620M Specification for Drawing Steel (DS), Sheet, Carbon, Cold-Rolled[3]

A 622/A 622M Specification for Drawing Steel (DS), Sheet, and Strip, Carbon, Hot-Rolled[3]

A 659/A 659M Specification for Commercial Steel (CS), Sheet and Strip, Carbon (0.16 maximum to 0.25 Maximum

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[2] *Annual Book of ASTM Standards*, Vol 01.06.

[3] *Annual Book of ASTM Standards*, Vol 01.03.

Percent), Hot-Rolled[3]

A 700 Practices for Packaging, Marking, and Loading Methods for Steel Products for Domestic Shipment[4]

A 715 Specification for Steel Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled, and Steel Sheet, Cold-Rolled, High- Strength, Low-Alloy, with Improved Formability[3]

A 754/A 754M Test Method for Coating Weight [Mass] by X-Ray Fluorescence[2]

A 794 Specification for Commercial Steel (CS), Sheet (Carbon 0.16 % Maximum to 0.25 % Maximum), Cold-Rolled[3]

A 879 Specification for Steel Sheet, Zinc-Coated by the Electrolytic Process for Applications Requiring Designation of Coating Mass on Each Surface[2]

A 902 Terminology Relating to Metallic Coated Steel Products[2]

A 917 Specification for Steel Sheet, Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface (General Requirements)[2]

A 963/A 963M Specification for Deep Drawing Steel (DDS), Sheet, Carbon, Cold-Rolled[3]

A 969/A 969M Specification for Extra Deep Drawing (EDDS), Steel, Sheet, Carbon, Cold-Rolled[3]

B 504 Test Method for Measurement of Thickness of Metallic Coatings by the Coulometric Method[5]

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications[6]

3. Terminology

3.1 *Definitions*—For definitions of general terms used in this standard, refer to Terminology A 902.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *surface treatment*, *n*—(1) a passivating chemical treatment applied to zinc coated steel sheet to retard corrosion (storage stain) during shipment and storage, or (2) a phosphatized treatment to prepare the zinc coating for post painting.

3.2.1.1 *Discussion*—The inhibiting characteristics of the passivating chemical treatment are limited; if a lot becomes wet in shipment or storage it should be used or dried immediately.

3.2.1.2 *Discussion*—Passivating chemical treatment is sometimes undesirable because it may inhibit further processing such as phosphatizing or painting.

3.2.2 *oiling*, *n*—a coating applied to zinc-coated steel sheet alone or in addition to chemical treatment for further protection against the onset of storage corrosion; the oil coating is intended as a corrosion inhibitor only and not as a rolling or drawing lubricant.

3.2.2.1 *Discussion*—Electrolytic zinc-coated steel sheet is not normally produced with oiling.

4. Classification

4.1 The steel base metal is classified by steel sheet designation as Commercial Steel (CS), Drawing Steel (DS), Deep Drawing Steel (DDS), Extra Deep Drawing Steel (EDDS), Structural Steel (SS), and High Strength-Low Alloy Steel (HSLAS).

4.2 The zinc coating is classified by thickness, coating designation or coating name.

4.3 *Surface Treatments*—Treatments for the zinc-coated surface, when specified, are passivating chemical treatment, or phosphating treatment, either alone or in combination with oiling.

5. Ordering Information

5.1 Material shall be ordered to a decimal thickness for both coils and cut lengths. The thickness is the total of the base metal and the coating.

5.2 Orders for material under this specification shall include the following, as required, to describe the required material:

5.2.1 Name of material (electrolytic zinc-coated steel sheet),

5.2.2 ASTM designation and year of issue (A 591– ____ for inch-pound units [A 591M– ____ for SI units]),

5.2.3 ASTM designation of the specification for the steel sheet substrate to which the zinc coating is applied, including all necessary ordering information enumerated in that specification, including the steel designation,

5.2.4 Coating class,

5.2.4.1 Type of surface treatment,

5.2.5 Oiled or not oiled,

5.2.6 Dimensions (including thickness, width, and length (if cut lengths),

5.2.7 Coil size requirements (specify maximum outside diameter, acceptable inside diameter, and maximum weight),

5.2.8 Packaging requirements,

5.2.9 Certification, if required, and whether heat analysis, mechanical properties, and coating mass report is to be furnished,

5.2.10 Application (show part identification and description), and

5.2.11 Special requirements (if any).

NOTE 1—A typical ordering description in inch-pound units is as follows: Electrolytic zinc-coated steel sheet, to ASTM A 591–____; with steel sheet substrate conforming to ASTM A 366, Commercial Steel; zinc coating designation 20Z (Intermediate Coating), not surface treated, not oiled; 0.063 in. by 36 in. by coil; coil requirements — 56 in. max outer diameter, 24 in. inner diameter, 20 000 lb max; for painted school locker panels. A typical ordering description in SI units is as follows: Electrolytic zinc-coated steel sheet to ASTM A 591M–____; with steel sheet substrate conforming to ASTM A 366M, Commercial Steel; zinc coating designation 06G (Intermediate Coating), not surface treated, not oiled; 1.00 mm nominal by 900 mm by coil; coil requirements — 1500 mm max outer diameter, 609.6 mm inner diameter, 10 000 kg max; for painted school locker panels.

6. Coating Properties

6.1 Coating weight [mass] shall conform to the requirements as given in Table 1. The weight [mass] of the coating is the single spot value on each surface of the sheet in oz/ft^2 [g/m^2].

6.2 *Coating Mass and Thickness Tests*:

6.2.1 The weigh-strip-weigh method (see Test Method A 90/A 90M) is a destructive test that determines coating mass by measuring the difference in weight [mass] between a coated

[4] *Annual Book of ASTM Standards*, Vol 01.05.
[5] *Annual Book of ASTM Standards*, Vol 02.05.
[6] *Annual Book of ASTM Standards*, Vol 14.02.

and a stripped (uncoated) sample. If one surface is protected suitably during the initial stripping, coating mass can be determined for each surface independently. Conversion of the coating mass to coating thickness is possible only if the density of the coating is known precisely.

6.2.2 Coating thickness measurements by X-ray fluorescence (see Test Method A 754) is a nondestructive test that determines coating mass by converting X-ray fluorescence measurements to coating mass values. This method is readily adaptable to the continuous monitoring of coating mass during coating. Thus modern electroplating facilities are frequently equipped with X-ray fluorescence gages that provide feedback to control the coating mass. These devices are permitted for use as a basis for determining suitability for shipment provided that they have been calibrated properly.

6.2.3 Measurement by Coulometric method (see Test Method B 504) is a destructive test that determines coating mass and or thickness electrochemically. The method is rapid and versatile for light coating mass applications.

6.2.4 The referee method to be used shall be as agreed upon between the producer and the consumer. In the absence of such agreement, Test Method A 90/A 90M shall be used as the referee method.

6.2.5 Estimate the coating thickness from the coating weight [mass] by using the following relationships:

6.2.5.1 *Inch-Pound Units*—1 oz/ft^2 coating weight = 1.7 mils coating thickness; 1 mil coating thickness = 0.59 oz/ft^2 coating weight.

6.2.5.2 *SI Units*—1 g/m^2 coating mass = 0.14 µm coating thickness; 1 µm coating thickness = 7.14 g/m^2 coating mass.

6.3 *Coating Mass Test*:

6.3.1 One test specimen shall be taken from the lift of cut lengths or coils such that no portion of the specimen is closer than 1 in. [25 mm] to the edge of the as-received sheet.

6.4 *Coating Bend Test*:

6.4.1 For all steel sheets other than Structural (physical) and High Strength Low-Alloy, the coated sheet shall be capable of being bent 180° flat on itself (Ot) in any direction without flaking of the coating on the outside of the bend only. Flaking of the coating within ¼ in. [6 mm] of the edge of the bend specimen shall not be a cause for rejection.

6.4.2 For Structural Steel sheets, the bend test specimens shall be capable of being bent through 180° in any direction without flaking of the coating on the outside of the bend only. Flaking of coating within ¼ in. [6 mm] of the edge of the bend specimen shall not be cause for rejection. The ratio of the bend diameter to the thickness of the specimen for Structural steel shall be as outlined in the Bend Test Requirements table of Specification A 611.

6.4.3 For High Strength Low-Alloy Steel sheets, the bend test specimens shall be capable of being bent according to the provisions of Appendix X1 of Specification A 607 without flaking of the coating on the outside of the bend only. Flaking of coating within ¼ in. [6 mm] of the edge of the bend specimen shall not be cause for rejection.

6.4.4 Coating bend test specimens shall be 2 to 4 in. [50 to 100-mm] wide. The specimen shall be cut not less than 2 in. [50 mm] from the edge of the test sheet.

6.4.5 Electrolytic zinc coatings are usually tightly adherent even when used for difficult forming operations; however, powdering or flaking can occur if the material is severely formed or “coined” during fabrication.

7. Dimensions and Permissible Variations

7.1 Material furnished under this specification shall meet all applicable requirements of the current edition of Specification A 568/A 568M for the steel designation specified, unless otherwise specified herein.

8. Certification

8.1 When required by the purchase order, a certificate of compliance or a test report, or both, shall be furnished to the purchaser.

8.1.1 The certificate of compliance shall include a certification that the product has been manufactured and tested in accordance with the requirements of the product specification, and that the test results conform to the requirements of that specification.

8.1.2 The test report shall show the heat analysis and the results of all tests required by the product specification and the order.

8.1.3 These documents shall provide information necessary to identify the product represented; for example, the manufacturer’s name or brand, ASTM specification, coating designation, grade (when required), ordered thickness, width, length (if cut length), and unit identification (heat number, coil number, etc...).

8.1.4 A signature is not required. However, the certification documents shall clearly identify the organization submitting the information. Notwithstanding the absence of a signature, the organization submitting the documents is responsible for the accuracy of the information.

8.2 The furnishing of a certificate of compliance or test report, or both, shall not restrict the right of the purchaser to sample and test the product furnished.

9. Packaging and Package Marking

9.1 It is common practice to use the methods of packaging as listed in the latest revision of Practices A 700.

9.1.1 Purchaser shall specify the packaging methods, if other than as described in 9.1.

9.2 As a minimum requirement, the material shall be identified by having the manufacturer’s name, ASTM designation, weight, purchaser’s order number, and material identification legibly shown on a tag attached to each coil or shipped unit.

10. Keywords

10.1 coatings, metallic; coating zinc; steel products, electrodeposited coatings; steel sheet, zinc coated (electrolytic process); corrosion, steel; zinc coatings

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