



Designation: A1060/A1060M – 22

# Standard Specification for Zinc-Coated (Galvanized) Steel Welded Wire Reinforcement, Plain and Deformed, for Concrete<sup>1</sup>

This standard is issued under the fixed designation A1060/A1060M; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope\*

1.1 This specification covers zinc-coated steel welded wire reinforcement, plain and deformed, or a combination of deformed and plain wires, for reinforcement of concrete, in sizes not less than 0.080 in. [2.03 mm] and over nominal diameter for plain wire and 0.113 in. [2.87 mm] and over for deformed wire.

1.2 This specification is intended to be applicable to cold-worked wire, drawn or rolled, plain or deformed, coated in a continuous process.

1.3 An alternative to a continuous coating process of wire before fabrication is a hot-dip process, where the welded wire reinforcement is immersed in a bath of molten zinc.

NOTE 1—Data on the corrosion resistance of galvanized steels in concrete are limited. The user is cautioned that the laboratory testing performed on this material has been insufficient and may not accurately reflect the performance of the material when embedded in concrete as reinforcement.

1.4 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.5 *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.*

1.6 *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.*

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee A01 on Steel, Stainless Steel and Related Alloys and is the direct responsibility of Subcommittee A01.05 on Steel Reinforcement.

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## 2. Referenced Documents

### 2.1 ASTM Standards:<sup>2</sup>

A90/A90M Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings

A780 Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings

A1064/A1064M Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

B6 Specification for Zinc

B487 Test Method for Measurement of Metal and Oxide Coating Thickness by Microscopical Examination of Cross Section

E376 Practice for Measuring Coating Thickness by Magnetic-Field or Eddy Current (Electromagnetic) Testing Methods

### 2.2 Military Standard:<sup>3</sup>

MIL-STD-129 Marking for Shipment and Storage

### 2.3 Federal Standard:<sup>3</sup>

Fed. Std. No. 123 Marking for Shipments (Civil Agencies)

## 3. Terminology

### 3.1 Definitions of Terms Specific to this Specification:

3.1.1 *continuous coating, n*—of metallic coated steel products, the process of uninterrupted passage of long lengths of steel products, usually steel sheet, tube, pipe, or wire, through the various processing steps such as cleaning and coating.

## 4. Ordering Information

4.1 Orders for zinc-coated welded wire reinforcement under this specification shall contain the following information:

4.1.1 Quantity (weight [mass] or square area),

4.1.2 Name of material (galvanized welded wire reinforcement),

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

<sup>3</sup> Available from U.S. Government Printing Office Superintendent of Documents, 732 N. Capitol St., NW, Mail Stop: SDE, Washington, DC 20401, <http://www.access.gpo.gov>.

\*A Summary of Changes section appears at the end of this standard

- 4.1.3 Required zinc coating weight [mass] (coated before fabrication) or zinc coating thickness (coated after fabrication),
- 4.1.4 Packaging (see Section 13), and
- 4.1.5 ASTM designation A1060 [A1060M] and year of issue.

4.2 The purchaser shall have the option to specify additional requirements, including but not limited to, the following:

- 4.2.1 Wire size number, wire spacing, and sheet or roll width and length,
- 4.2.2 Minimum yield strength or Grade, and
- 4.2.3 Requirements for inspection (see Section 9),

## 5. General Requirements

5.1 The wire used in the manufacture of welded wire reinforcement shall conform to Specification A1064/A1064M. After galvanizing, the welded wire reinforcement shall meet the required mechanical properties of Specification A1064/A1064M except for the bend test requirements as prescribed in Table 1 of this specification.

5.2 Welded wire reinforcement shall be furnished either in flat sheets, or in rolls, as specified by the purchaser.

5.3 The zinc used for coating shall be any grade that conforms to Specification B6.

## 6. Galvanizing

### 6.1 Mass [Weight] Thickness of Coating and Test:

6.1.1 This specification includes six classes of coating weight [mass] when the welded wire reinforcement is coated before fabrication and four coating thickness grades when the welded wire reinforcement is coated after fabrication. The weight [mass] of zinc coating is based on the measured diameter of the wire when the stripping method is performed and the nominal diameter for all other methods, and shall conform to the requirements shown in Table 2 or Table 3. Individual results not more than 10 % below the minimum values specified in Table 2 or Table 3 are allowed if the average of at least two samples from the same coil are equal to or greater than the minimum, individual results shall be not less than 1.08 oz/ft<sup>2</sup> [330 g/m<sup>2</sup>].

6.1.1.1 When the product is coated before fabrication in a continuous coating process, coating weights are given in Table 2 for various zinc coating classes.

NOTE 2—Zinc coated wire produced as “regular coating” shall have the

**TABLE 1 Mandrel Diameters for Test for Adherence of Zinc Coating Inch-Pound Units [SI Units]**

Wire Diameter	Mandrel Diameters of Coating Classes and Grades		
	Regular and Class 1	Class 3 or A, 4, B, 5, and C	Grade 50, 60, 65, and 80
Under 0.148 [3.70]	1D <sup>A</sup>	3D	3D
0.148 [3.70] to 0.500 [12.7]	2D	4D	4D
over 0.500 [12.7]	3D	5D	5D

<sup>A</sup> D = nominal wire diameter being tested.

full surface covered with zinc, but there is no specified minimum weight of coating.

6.1.1.2 When the product is coated after fabrication in a hot-dip process, coating thickness are given in Table 3 for various zinc coating grades.

NOTE 3—At the purchaser’s request the galvanized coating may be chromate treated. This is to minimize a reaction between the reinforcing steel and fresh portland cement paste. Proprietary chromating solutions of equivalent strength are permitted in place of the generic chemical treatment specified.

6.1.2 *Magnetic Thickness Measurements*—The weight [mass] of the coating may be determined by magnetic thickness gage measurements in accordance with Practice E376. The thickness measurement is used to calculate the weight [mass] by multiplying it by the surface area of coated wire and by the zinc density. Because this form of testing can yield inconsistent and potentially unreliable results on smaller sizes of wire, one or more of the following methods shall be permitted to be used to referee and take precedence over the results obtained by magnetic thickness measurements.

6.1.2.1 *Stripping Method*—The weight [mass] shall be determined by stripping the coating from the steel wire specimen in accordance with Section 8 and Test Method A90/A90M.

6.1.2.2 *Weighing Before and After Galvanizing*—The weight [mass] shall be determined by weighing the sample before and after galvanizing. The difference between the two measurements divided by the surface area of the sample provides the weight [mass]. The original weighing shall occur after pickling and drying. The second weighing shall occur after cooling to ambient temperature.

6.1.2.3 *Microscopy*—The weight [mass] shall be determined by cross-sectional and optical measurement in accordance with Test Method B487. A cross-section sample of the steel shall be polished and examined with an optical microscope to determine the coating thickness. The coating weight [mass] shall be determined by multiplying coating thickness by the surface area of the coated sample and by the density of zinc.

6.1.3 *Number of Tests*—For determination of the coating weight [mass], three random samples shall be tested from each lot. For each magnetic thickness measurement sample, five or more measurements shall be made along the length and width of the sample so as to represent the entire surface of the sample. A total of at least fifteen measurements shall be averaged to obtain the coating thickness. For the microscopy method, five samples shall be tested per lot. Each sample shall be measured on four sides and the total of twenty measurements shall be averaged to obtain the coating thickness. For the stripping method and the weighing method, three samples per lot shall be measured.

NOTE 4—A lot shall be as follows: all wire of the same size furnished to the same steel reinforcing specification that has been galvanized within a single production shift.

### 6.2 Handling:

6.2.1 The identification of all reinforcing steel shall be maintained throughout the coating and fabrication process to the point of shipment.

**TABLE 2 Minimum Weight [Mass] of Zinc Coating, oz/ft<sup>2</sup> [g/m<sup>2</sup>] Coated Before Fabrication**

Wire Diameter in. [mm] <sup>A</sup>	Class 1	Class 2	Class 3 or A	Class B	Class 5	Class C
0.080 [2.03]	0.25 [76]	0.70 [214]	1.20 [366]	1.40 [427]	2.00 [610]	2.10 [641]
0.099 [2.50]	0.28 [85]	0.70 [214]	1.20 [366]	1.60 [488]	2.00 [610]	2.40 [732]
0.135 [3.40]	0.30 [92]	0.85 [260]	1.20 [366]	1.70 [520]	2.00 [610]	2.55 [778]
0.148 [3.80]	0.35 [107]	0.90 [275]	1.20 [366]	1.80 [550]	2.00 [610]	2.70 [824]
0.162 [4.10]	0.35 [107]	0.90 [275]	1.20 [366]	1.80 [550]	2.00 [610]	2.70 [824]
0.177 [4.50]	0.44 [134]	0.90 [275]	1.20 [366]	1.80 [550]	2.00 [610]	2.70 [824]
0.192 [4.90]	0.50 [153]	1.00 [305]	1.20 [366]	2.00 [610]	2.00 [610]	3.00 [915]
0.207 [5.30] and larger	0.53 [162]	1.00 [305]	1.20 [366]	2.00 [610]	2.00 [610]	3.00 [915]

<sup>A</sup> Coating weights [mass] for diameters other than those shown in Table 2 are the coating weights [mass] for the next smaller diameter.

**TABLE 3 Coating Thickness Grade<sup>A</sup> Coated After Fabrication**

Wire Diameter	Coating Grade	Mils	oz/ft <sup>2</sup>	µm	g/m <sup>2</sup>
Under 0.125 [3.2]	50	2.0	1.20	[50]	[355]
0.125 [3.2] to under 0.188 [4.8]	60	2.4	1.30	[60]	[390]
0.188 [4.8] to under 0.250 [6.4]	65	2.6	1.50	[65]	[460]
0.250 [6.4] and larger	80	3.1	1.90	[80]	[565]

<sup>A</sup> The values in micrometers (µm) are based on the Coating Grade. The other values are based on conversions using the following formulas: mils = µm × 0.03937; oz/ft<sup>2</sup> = µm × 0.02316; g/m<sup>2</sup> = µm × 7.067.

## 7. Finish and Adherence of Coating

7.1 The zinc coating shall have no bare spots. The coating shall be free of blisters, flux spots or inclusions, dross, and acid or black spots. To ensure large continuous length coils, welds are permitted in the finished wire. A matte gray finish appearance shall not be itself a cause for rejection.

7.2 *Adherence of Coating*—The coated wire as represented by the test specimens shall be capable of passing a bend test without cracking or flaking the coating to such an extent that any coating is removed when rubbed with the bare fingers. The bend test specimen shall withstand being bent at room temperature through 180° as prescribed in Table 1.

## 8. Number of Tests

8.1 *Testing for Coating Weight [Mass] Before Fabrication*—For the purpose of final product testing, one specimen from every ten coils of wire or fraction thereof in a lot shall be selected at random or a total of seven specimens, whichever is less.

8.1.1 A wire sample of sufficient length, approximately 4-ft [1.2-m] shall be cut from either end of each coil selected for tests described in Section 6.

8.2 *Testing for Coating Thickness After Fabrication*—The purchaser may specify the sampling and test schedule for the number and frequency of tests for coating thickness.

8.3 If the number and frequency of test are not specified by the purchaser:

8.3.1 One test specimen from every 20 000 ft<sup>2</sup> [1900 m<sup>2</sup>] of welded wire reinforcement shall be tested for compliance with Section 6.

8.4 *Retests*—If the average zinc coating weight [mass] thickness fails to meet the requirements of Table 2 or Table 3, six additional random samples from the lot shall be permitted to be tested. If the average zinc coating weight [mass] of the six samples conforms to the specified coating thickness, the lot shall be accepted.

## 9. Inspection

9.1 Inspection of the zinc-coated steel welded wire reinforcement shall be agreed upon between the purchaser and the manufacturer as part of the purchase order or contract.

9.2 The material shall be inspected at the galvanizer's plant prior to shipment. However, if specified, the purchaser shall conduct the tests which govern the acceptance or rejection of the materials in his own laboratory or elsewhere.

## 10. Rejection and Rehearing

10.1 Unless otherwise specified, any rejection shall be reported to the manufacturer within five days from the time of selection of test specimens.

10.2 Welded intersections shall withstand normal shipping and handling without becoming broken, but the presence of broken welds, regardless of cause, shall not constitute cause for rejection unless the number of broken welds per sheet exceeds 1 % of the total number of joints in a sheet, or if the material is furnished in rolls, 1 % of the total number of joints in 150 ft<sup>2</sup> [14 m<sup>2</sup>] of welded wire reinforcement and, furthermore, provided not more than one half the permissible maximum number of broken welds are located on any one wire.

10.3 *Rehearing*—Rejected materials shall be preserved for a period of at least two weeks from the date of inspection, during which time the manufacturer shall be permitted to make claim for a rehearing and retesting.

10.4 Rust formations on the cut ends of the wire and at welded intersections are inherent characteristics of this material and shall not be cause for rejection.

## 11. Repair of Damaged Coating

11.1 Prior to shipment, all coating defects other than those described in 10.4 shall be repaired with a zinc-rich formulation in accordance with Practice A780.

## 12. Certification

12.1 If outside inspection is waived, a manufacturer's certification that the material has been tested in accordance with