Designation: A641/A641M – 19

Standard Specification for Zinc–Coated (Galvanized) Carbon Steel Wire[1]

This standard is issued under the fixed designation A641/A641M; 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 U.S. Department of Defense.

1. Scope*

1.1 This specification covers soft, medium, and hard temper zinc-coated (galvanized) carbon steel wire in coils for general use.

1.2 The supplementary requirements of this specification cover zinc-coated weights [masses] for nails, staples, and wire from which nails and staples are cut and formed.

1.3 This specification is applicable to orders in either inch-pound units (as A641) or SI units (as A641M). Values stated in either inch-pound units or SI units are to be regarded separately as the standard. Within the text, the SI units are shown in brackets. The values stated in the two systems are not exact equivalents; therefore, each system shall be used independent of the other, without combining values in any way.

1.4 This specification and some referenced specifications are expressed in both inch-pound and SI units. If the order specifies the applicable "M" specification designation, the product shall be furnished to SI units.

1.5 The text of this specification references notes and footnotes which provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of the specification.

1.6 *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.*

1.7 *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.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

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

A700 Guide for Packaging, Marking, and Loading Methods for Steel Products for Shipment

A902 Terminology Relating to Metallic Coated Steel Products

B6 Specification for Zinc

E8 Test Methods for Tension Testing of Metallic Materials [Metric] E0008_E0008M

E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

F1667 Specification for Driven Fasteners: Nails, Spikes, and Staples

3. Terminology

3.1 *Definitions*—For definitions of terms used in this specification, refer to Terminology A902.

4. Classification

4.1 *Temper*—The wire is classified with regard to mechanical properties by temper, which is related to tensile strength and stiffness. The temper designations are soft, medium, and hard.

4.2 *Zinc Coating*—Zinc coating on the wire is classified in a number of classes (Class 1, 2, 3, or A, 4, B, 5, C (see Table 1, Table 2, Table 3, and Table S1.1)) and as "regular coating."

NOTE 1—Class 2 coating has been eliminated since it is no longer generally specified by users except for nails, staples, and wire from which nails and staples are cut and formed, as presented in the Supplementary Requirements.

5. Ordering Information

5.1 Orders for material under this specification shall include the following information:

5.1.1 Quantity (weight [mass]),

[1] This specification is under the jurisdiction of ASTM Committee A05 on Metallic-Coated Iron and Steel Products and is the direct responsibility of Subcommittee A05.12 on Wire Specifications.

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[2] 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.

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

TABLE 1 Minimum Weight [Mass] of Zinc per Unit Area of Uncoated Wire Surface (Inch-Pound Units)

Wire Diameter in.[A]	Class 1	Class 3 or A Coating, oz/ft^2	Class 4 Coating, oz/ft^2	Class B Coating, oz/ft^2	Class 5 Coating, oz/ft^2	Class C Coating, oz/ft^2
0.035	0.15	0.45	n/a	0.90	n/a	1.35
0.041	0.15	0.50	n/a	1.00	n/a	1.50
0.048	0.15	0.55	n/a	1.10	n/a	1.65
0.054	0.20	0.60	n/a	1.20	n/a	1.80
0.062	0.20	0.65	n/a	1.20	n/a	1.80
0.072	0.20	0.65	n/a	1.20	n/a	1.80
0.076	0.25	0.70	1.20	1.40	2.00	2.10
0.080	0.25	0.70	1.20	1.40	2.00	2.10
0.092	0.28	0.75	1.20	1.50	2.00	2.25
0.099	0.28	0.80	1.20	1.60	2.00	2.40
0.106	0.30	0.80	1.20	1.60	2.00	2.40
0.120	0.30	0.85	1.20	1.70	2.00	2.55
0.135	0.30	0.85	1.20	1.70	2.00	2.55
0.148	0.35	0.90	1.20	1.80	2.00	2.70
0.162	0.35	0.90	1.20	1.80	2.00	2.70
0.177	0.44	0.90	1.20	1.80	2.00	2.70
0.192	0.50	1.00	1.20	2.00	2.00	3.00
0.207 and larger	0.53	1.00	1.20	2.00	2.00	3.00

[A] Coating weights [mass] for diameters other than those shown in Table 1 are the coating weights [mass] for the next smaller diameter.

TABLE 2 Minimum Weight [Mass] of Zinc per Unit Area of Uncoated Wire Surface (SI Units)

Wire Diameter, mm	Class 1 Coating, g/m^2
0.20 to under 0.25	20
0.25 to under 0.40	25
0.40 to under 0.50	30
0.50 to under 0.60	35
0.60 to under 0.80	40
0.80 to under 1.10	45
1.10 to under 1.50	55
1.50 to under 1.90	65
1.90 to under 2.30	75
2.30 to under 3.20	85
3.20 to under 4.00	100
4.00 to under 4.90	115
4.90 to under 5.90	150
5.90 and over	190

5.1.2 Coated wire diameter,

5.1.3 Intended use, when the wire is to be used for nails or staples (see Supplementary Requirement S1),

5.1.4 Class of coating (see Table 1, Table 2, or Table 3 (or Table S1.1 when applicable)),

5.1.5 Temper (soft, medium, or hard) (Table 4 or Table 5), tensile strength-mechanical properties other than specified in Table 4 or Table 5 can be ordered upon agreement between the purchaser and producer,

5.1.6 ASTM designation and year of issue as A641 –____ for inch-pound units, or A641M –____ for SI units,

5.1.7 Supplementary Requirements (if required).

NOTE 2—A typical ordering description (inch-pound units) is as follows: 50 000 lb, 0.120 in., zinc-coated wire, Class 1 coating, soft temper in 1500–lb coils on tubular carriers to ASTM A641 –____.

NOTE 3—A typical ordering description (SI units) is as follows: 50 000 kg, 3.00 mm., zinc-coated wire, Class 1 coating, soft temper in 1000–kg coils on tubular carriers to ASTM A641M –____.

6. Materials and Manufacture

6.1 The steel from which the wire is produced shall be made by any commercially accepted steel making process.

6.2 The slab zinc when used shall be any grade of zinc conforming to Specification B6.

7. Mechanical Properties

7.1 The zinc-coated wire, as represented by the test specimens tested in accordance with Test Methods E8, shall conform to the tensile strength requirements prescribed in Table 4 or Table 5. Tensile strength-mechanical properties other than specified in Table 4 or Table 5 can be ordered upon agreement between the purchaser and producer.

7.2 Test specimens found to contain a weld or obvious imperfections shall be discarded and another test specimen obtained to verify conformance to the tensile strength requirements.

8. Permissible Variations

8.1 The permissible variation in diameter of the zinc-coated wire as represented by the test specimens shall meet the requirements shown in Table 6 or Table 7.

9. Weight [Mass] of Coating

9.1 The zinc-coated wire, as represented by the test specimens tested in accordance with Section 12 and Test Method A90/A90M, shall conform to the requirements of Table 1, Table 2, or Table 3 for minimum weight [mass] of zinc coating of the class specified. Individual results not more than 10 % below the minimum values specified in Table 1, 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 value specified in Table 1, Table 2, or Table 3.

9.2 Zinc-coated wire produced as “regular coating” shall have the full surface covered with zinc, but there is no specified minimum weight of coating.

10. Adherence of Coating

10.1 The zinc-coated wire as represented by the test specimens shall be capable of being wrapped in a close helix at a

TABLE 3 Minimum Weight [Mass] of Zinc per Unit Area of Uncoated Wire Surface (SI Units)

Diameter, mm[A]	Class 3 or A Coating, g/m^2	Class 4 Coating, g/m^2	Class B Coating g/m^2	Class 5 Coating, g/m^2	Class C Coating g/m^2
0.90	137	n/a	275	n/a	412
1.00	153	n/a	305	n/a	458
1.20	168	n/a	336	n/a	504
1.40	183	n/a	366	n/a	549
1.60	198	n/a	366	n/a	549
1.80	198	n/a	366	n/a	549
1.90	214	366	427	610	641
2.00	214	366	427	610	641
2.30	229	366	458	610	687
2.50	244	366	488	610	732
2.70	244	366	488	610	732
3.00	259	366	519	610	778
3.40	259	366	519	610	778
3.80	275	366	549	610	824
4.10	275	366	549	610	824
4.50	275	366	549	610	824
4.90	305	366	610	610	915
5.30 and larger	305	366	610	610	915

[A] Coating weights [mass] for diameters other than those shown in this table are the coating weights [mass] for the next smaller diameter.

TABLE 4 Tensile Strength for Temper Designation (Inch-Pound Units)

Wire Diameter, in.	Soft, Ksi[A]	Medium, Ksi[A]	Hard, Ksi[A]
0.035 to under 0.080	75 max	70 to 100	90 to 120
0.080 to under 0.106	75 max	70 to 95	85 to 115
0.106 to 0.176[A] , incl	70 max	65 to 90	80 to 110
Over 0.176	70 max	60 to 85	75 to 105

[A] For the purpose of determining conformance with this specification, an observed value shall be rounded to the nearest 1 Ksi in accordance with the rounding method of Practice E29.

TABLE 5 Tensile Strength for Temper Designation (SI Units)

Wire Diameter, mm	MPa		
	Soft[A]	Medium[A]	Hard[A]
0.20 to under 2.00	515 max	485 to 690	620 to 825
2.00 to under 2.50	515 max	485 to 655	585 to 795
2.50 to under 4.70	485 max	450 to 620	550 to 760
4.70 and over	485 max	415 to 585	515 to 715

[A] For the purpose of determining conformance with this specification, an observed value shall be rounded to the nearest 1 MPa in accordance with the rounding method of Practice E29.

TABLE 6 Diameter Tolerance for Zinc-Coated Wire in Coils (Inch-Pound Units)[A]

Wire Diameter, in.	Tolerance[B] Plus and Minus, in.	
	Regular and Class 1 Coating	Class 3, 4, 5 or B and C Coating
0.035 to under 0.076	0.002	0.002
0.076 to under 0.148	0.003	0.004
0.148 to 0.250, incl.	0.003	0.004
Over 0.250 to 0.500, incl.	0.003	0.005

[A] For the purpose of determining conformance with this specification, an observed value shall be rounded to the nearest 0.001 in. in accordance with the rounding method of Practice E29.

[B] It is recognized that the surfaces of heavy zinc coating, particularly those produced by hot galvanizing, are not perfectly smooth and devoid of irregularities. The tolerances shown in Table 6 shall not be rigidly applied to such irregularities that are inherent to the product, so that unjustified rejections of wire that are actually satisfactory for use do not occur. Therefore, it is intended that these tolerances be used in gauging the uniform areas of the zinc-coated wire.

TABLE 7 Diameter Tolerance for Zinc-Coated Wire in Coils (SI Units)[A]

Wire Diameter, mm	Tolerance[B] , Plus and Minus, mm	
	Regular and Class 1 Coating	Class 3, 4, 5 or A, B, and C Coating
0.20 to under 1.90	0.05	0.05
1.90 to under 3.70	0.08	0.10
3.70 to under 5.90	0.08	0.10
5.90 and over	0.08	0.13

[A] For the purpose of determining conformance with this specification, an observed value shall be rounded to the nearest 0.01 mm in accordance with the rounding method of Practice E29.

[B] It is recognized that the surfaces of heavy zinc coating, particularly those produced by hot galvanizing, are not perfectly smooth and devoid of irregularities. The tolerances shown in Table 7 shall not be rigidly applied to such irregularities that are inherent to the product, so that unjustified rejections of wire that is actually satisfactory for use do not occur. Therefore, it is intended that these tolerances be used in gauging the uniform areas of the zinc-coated wire.

rate not exceeding 15 turns/min around a cylindrical steel mandrel having a diameter as prescribed in Table 8 or Table 9 without cracking or flaking the zinc coating to such an extent that any zinc can be removed by rubbing with the bare fingers. Loosening or detachment during the adhesion test of superficial, small particles of zinc formed by mechanical polishing of the surface of the zinc-coated wire shall not be considered cause for rejection.

11. Workmanship, Finish, and Appearance

11.1 The zinc-coated wire shall be free of slivers, scale, and other imperfections not consistent with good commercial practice. The coating shall be continuous and reasonably uniform. To ensure large continuous length coils, welds are permitted in the finished wire.

12. Number of Tests and Retests

12.1 The number of test specimens taken from the ends of coils during production to ensure compliance with Sections 7, 8, 9, and 10 vary with the quality control procedures and the manufacturing facilities of each manufacturer but is generally not less than 10 % of the coils produced. For the purpose of

TABLE 8 Mandrel Diameters for Test for Adherence of Zinc Coating (Inch-Pound Units)

Wire Diameter, in.	Mandrel Diameters for Coating Classes	
	Regular and 1	Class 3, 3S, 4, 5 or A, B, and C
0.035 to under 0.076	1*D*[A]	2*D*[A]
0.076 to under 0.148	1*D*	3*D*
0.148 to 0.500, incl	2*D*	4*D*

[A] *D* = nominal wire diameter being tested.

TABLE 9 Mandrel Diameters for Test for Adherence of Zinc Coating (SI Units)

Wire Diameter, mm	Mandrel Diameters for Coating Classes	
	Regular and 1	Class 3, 3S, 4, 5 or A, B, and C
0.20 to under 1.90	1*D*[A]	2*D*[A]
1.90 to under 3.70	1*D*	3*D*
3.70 and over	2*D*	4*D*

[A] *D* = nominal wire diameter being tested.

final product testing, one specimen from every ten coils or fraction thereof in a lot shall be selected at random or a total of seven specimens, whichever is less.

12.2 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 Sections 7, 8, 9, and 10.

12.3 If one or more of the wire specimens fail any requirement, the lot shall be subjected to retest. For retest purposes, the original lot shall be regrouped into 50 coil lots or fractions thereof. Each lot shall be 10 % tested for the property in which the original sample failed to comply. The number of samples thus selected shall be at least twice the number of the original sampling. Any lot that exhibits a failure shall be rejected.

12.3.1 The manufacturer has the option of testing each coil in the failed lot for the property in which the failure occurred, rejecting the nonconforming coils. The coils which conform for the property tested shall be deemed to conform to the specification requirements.

13. Inspection

13.1 Unless otherwise specified in the purchase order or contract, the manufacturer is responsible for the performance of all inspection and test requirements specified in this specification. Except as otherwise specified in the purchase order or contract, the manufacturer shall use his own or other suitable facilities for the performance of the inspection and test requirements, at his option, unless disapproved by the purchaser at the time the order is placed. The purchaser shall have the right to perform any of the inspection and tests prescribed in this specification when such inspections and tests are deemed necessary to ensure that the material conforms to prescribed requirements.

14. Rejection and Rehearing

14.1 Material that fails to conform to the requirements of this specification is subject to rejection. Rejection shall be reported to the producer or supplier promptly and in writing. In case of dissatisfaction with the results of the test, the producer or supplier shall make claim for a rehearing.

15. Certification

15.1 When specified in the purchase order or contract, a producer's or supplier's certification shall be furnished to the purchaser that the material was manufactured, sampled, tested, and inspected in accordance with this specification and has been found to meet the requirements. When specified in the purchase order or contract, a report of the test results shall be furnished.

16. Package and Package Marking

16.1 Unless otherwise specified, packaging, marking, and loading for shipment shall be in accordance with Guide A700.

17. Keywords

17.1 galvanized wire; steel wire; wire; zinc-coated carbon steel wire

SUPPLEMENTARY REQUIREMENTS

The following supplementary requirements shall apply only when specified by the purchaser in the contract or order.

S1. Zinc Coating on Wire for Nails and Staples

S1.1 These requirements apply only to nails and staples, and coated wire from which nails and staples are cut and formed, which are specified to have a Class 1, Class 2, or Class 3S zinc coating.

S1.2 Referenced diameters for staple legs, nail shanks, or wire in Table S1.1 are for nominal, uncoated (bright) wire. See Specification F1667 for allowable diameter tolerances.

S1.3 *Coating Weight [Mass]*—The zinc coating weight [mass] on the nails or staples, or on the wire used in the manufacture of nails and staples, as represented by test specimens tested in accordance with Section 12 of this specification and Test Method A90/A90M, shall conform to the requirements of Table S1.1 for the class specified.

S1.4 *Class 2 Coating Requirements*—The test for coating adherence on nails, staples, or wire specified to have Class 2 coating shall be conducted using the mandrel diameter as shown for Class 1 coating in Table 8 or Table 9.

S1.5 *Class 3S Coating Requirements*:

S1.5.1 Class 3S coating shall be hot-dip galvanized.

TABLE S1.1 Minimum Weight [Mass] of Zinc per Unit Area of Uncoated Nail, Staple, or Wire Surface

Diameter of Staple Leg, Nail Shank, or Wire, in. [mm][A]	Class 1 Zinc Coating, oz/ft^2 [g/m^2]	Class 2 Zinc Coating, oz/ft^2 [g/m^2]	Class 3S Zinc Coating, oz/ft^2 [g/m^2]
0.035 [0.89]	0.15 [45]	0.30 [90]	. . .
0.048 [1.22]	0.15 [45]	0.30 [90]	. . .
0.062 [1.57]	0.15 [45]	0.35 [105]	. . .
0.076 [1.93]	0.20 [60]	0.40 [120]	. . .
0.080 [2.03]	0.25 [75]	0.45 [135]	. . .
0.092 [2.34]	0.28 [85]	0.50 [150]	. . .
0.099 [2.51]	0.28 [85]	0.50 [150]	1.00 [305]
0.113 [2.87]	0.30 [92]	0.50 [150]	1.00 [305]
0.120 [3.05]	0.30 [92]	0.50 [150]	1.00 [305]
0.128 [3.25]	0.30 [92]	0.50 [150]	1.00 [305]
0.131 [3.32]	0.30 [92]	0.50 [150]	1.00 [305]
0.135 [3.43]	0.30 [92]	0.50 [150]	1.00 [305]
0.148 [3.76]	0.35 [105]	0.60 [180]	1.00 [305]
0.162 [4.11]	0.35 [105]	0.70 [215]	1.00 [305]
0.192 [4.88]	0.50 [150]	0.70 [215]	1.00 [305]
0.207 [5.26] and larger	0.53 [160]	0.75 [230]	1.00 [305]

[A] Coating weights [mass] for diameters other than those shown in Table S1.1 are the coating weights [mass] for the next smaller diameter.

S1.5.2 The test for coating adherence on nails, staples, or wire specified to have Class 3S coating shall be conducted using the mandrel diameter as shown for Class 3S coating in Table 8 or Table 9.

SUMMARY OF CHANGES

Committee A05 has identified the location of selected changes to this standard since the last issue (A641/A641M – 09a(2014)) that may impact the use of this standard. (Approved Sept. 1, 2019.)

(1) Changes made to Table 8, Table 9, Table S1.1, and the Supplementary Requirements section.