



Designation: A 641/A 641M - 09

Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire¹

This standard is issued under the fixed designation A 641/A 641M; 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 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 A 641) or SI units (as A 641M). 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.

2. Referenced Documents

2.1 ASTM Standards.²

- A 90/A 90M Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings
- A 700 Practices for Packaging, Marking, and Loading Methods for Steel Products for Shipment
- A 902 Terminology Relating to Metallic Coated Steel Products
- B 6 Specification for Zinc
- E 8 Test Methods for Tension Testing of Metallic Materials

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.

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

3. Terminology

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

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 into a number of classes (Class 1, 2, 3, or A, 4, B, 5. Class 1, 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 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]),
- 5.1.2 Coated wire diameter,
- 5.1.3 Intended use, when the wire is to be used for staples (see Supplementary Requirement S1),
- 5.1.4 Class of coating (see Table 1, Table 2, or Table S1.1 when applicable),
- 5.1.5 Temper (soft, medium, or hard) (Table 4 or Table S1.1),
- 5.1.6 ASTM designation and year of issue as A 641-____ for inch-pound units, or A 641M-____ for SI units,
- 5.1.7 Supplementary Requirements (if required).

NOTE 2—A typical ordering description (inch-pound units) is: 50 000 lb, 0.120 in., zinc-coated wire, Class 1 coating, in 1500-lb coils on tubular carriers to ASTM A 641-____.

NOTE 3—A typical ordering description (SI units) is as follows: 3.00 mm., zinc-coated wire, Class 1 coating, soft temper, in coils on tubular carriers to ASTM A 641M-____.

6. Materials and Manufacture

6.1 The steel from which the wire is produced shall conform to any commercially accepted steel making process.

*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)

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
0.15	0.45	n/a	0.90	n/a	1.35
0.15	0.50	n/a	1.00	n/a	1.50
0.15	0.55	n/a	1.10	n/a	1.65
0.20	0.60	n/a	1.20	n/a	1.80
0.20	0.65	n/a	1.20	n/a	1.80
0.20	0.65	n/a	1.20	n/a	1.80
0.25	0.70	1.20	1.40	2.00	2.10
0.25	0.70	1.20	1.40	2.00	2.10
0.28	0.75	1.20	1.50	2.00	2.25
0.28	0.80	1.20	1.60	2.00	2.40
0.30	0.80	1.20	1.60	2.00	2.40
0.30	0.85	1.20	1.70	2.00	2.55
0.30	0.85	1.20	1.70	2.00	2.55
0.35	0.90	1.20	1.80	2.00	2.70
0.35	0.90	1.20	1.80	2.00	2.70
0.44	0.90	1.20	1.80	2.00	2.70
0.50	1.00	1.20	2.00	2.00	3.00
0.53	1.00	1.20	2.00	2.00	3.00

[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
under 0.25	20
under 0.40	25
under 0.50	30
under 0.60	35
under 0.80	40
under 1.10	45
under 1.50	55
under 1.90	65
under 2.30	75
under 3.20	85
under 4.00	100
under 4.90	115
under 5.90	150
and over	190

zinc when used shall be any grade of zinc Specification B 6.

Properties

zinc-coated wire, as represented by the test specimens found to contain a weld or obvious shall be discarded and another test specimen conformance to the tensile strength require-

Variations

missible variation in diameter of the zinc-coated by the test specimens shall meet the in Table 6 or Table 7.

of Coating

zinc-coated wire, as represented by the test specimens in accordance with Section 12 and Test Method A shall conform to the requirements of Table 1, Table 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 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 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.



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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	n/a
1.00	153	n/a	305	n/a	n/a
1.20	168	n/a	336	n/a	n/a
1.40	183	n/a	366	n/a	n/a
1.60	198	n/a	366	n/a	n/a
1.80	198	n/a	366	n/a	n/a
1.90	214	366	427	610	n/a
2.00	214	366	427	610	n/a
2.30	229	366	458	610	n/a
2.50	244	366	488	610	n/a
2.70	244	366	488	610	n/a
3.00	259	366	519	610	n/a
3.40	259	366	519	610	n/a
3.80	275	366	549	610	n/a
4.10	275	366	549	610	n/a
4.50	275	366	549	610	n/a
4.90	305	366	610	610	n/a
5.30 and larger	305	366	610	610	n/a

^ACoating 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

^AFor the purpose of determining conformance with this specification, and observed value shall be rounded to the nearest 1 Ksi in accordance with the rounding method of Practice E 29.

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

^AFor 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 E 29.

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

^AFor 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 E 29.

^BIt 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 gaging the uniform areas of the zinc-coated wire.

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

TABLE 7 Diameter Tolerance for Zinc-Coated Wire (SI Units)^A

Wire Diameter, mm	Tolerance ^B , Plus and Minus, mm	
	Regular and Class 1 Coating	Class 2 Coating
0.20 to under 1.90	0.05	0.05
1.90 to under 3.70	0.08	0.08
3.70 to under 5.90	0.08	0.08
5.90 and over	0.08	0.08

^AFor 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 E 29.

^BIt 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 are actually satisfactory for use do not occur. Therefore, it is intended that these tolerances be used in gaging the uniform areas of the zinc-coated wire.

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

Wire Diameter, in.	Mandrel Diameters for Test for Adherence of Zinc Coating, in.	
	Regular and 1	Class 2
0.035 to under 0.076	1D ^A	1D ^A
0.076 to under 0.148	1D	1D
0.148 to 0.500, incl	2D	2D

^AD = nominal wire diameter being tested.

thereof. Each lot shall be 10 % tested for the property in which the original sample failed to comply. The number of specimens thus selected shall be at least twice the number of specimens in the original lot for the property in which the failure occurred.

12.3.1 The manufacturer has the option of testing specimens in the failed lot for the property in which the failure occurred, rejecting the nonconforming coils. The coils which are rejected 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

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

Mandrel Diameters for Coating Classes	
Mandrel Diameter, mm	Class 3, 4, 5 or A, B, and C
	Regular and 1
	1D ^A 2D ^A
	1D 3D
	2D 4D

^A diameter being tested.

and test requirements specified in this specification and otherwise specified in the purchase order or contract shall use his own or other suitable equipment for the performance of the inspection and test at his option, unless disapproved by the purchaser in 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 necessary to ensure that the material conforms to the requirements.

Reheating

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 reheating.

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 Practices A 700.

17. Keywords

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

SUPPLEMENTARY REQUIREMENTS

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	Class 2
	Coating, oz/ft ² [g/m ²]	Coating, oz/ft ² [g/m ²]
0.035 [0.89]	0.10 [30]	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]
0.090 [2.03]	0.25 [75]	0.45 [135]
0.092 [2.34]	0.28 [85]	0.50 [150]
0.148 [3.76]	0.35 [105]	0.60 [180]
0.192 [4.88]	0.50 [150]	0.70 [215]
0.25 [6.25] and larger	0.53 [160]	0.75 [230]

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

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

S1.2 Coating on Wire for Nails and Staples

These requirements apply only to nails and staples, and wire which nails and staples are cut and formed, and wire which has a Class 1 or Class 2 zinc coating. **Weight [Mass]**—The zinc coating weight on nails or staples, or on the wire to be used in the manufacture of nails and staples, as represented by test specimens in accordance with Section 12 of this specification and Test Method A 90/A 90M, shall conform to the requirements of Table S1.1 for the class specified.

S1.3 Class 2 Coating Requirements—The permissible variation in diameter of nails, staples, or wire specified to have Class 2 coating shall be the same as shown for Class 1 coating in Table 6 or Table 7. 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.



SUMMARY OF CHANGES

Committee A05 has identified the location of selected changes to this standard since the last (A 641/A 641M - 03) that may impact the use of this standard. (January 1, 2009)

(I) Revised 9.1.

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

Table with 3 columns: Wire Diameter (Inches), Tensile Strength (ksi), and Tensile Strength (MPa). Rows include ranges like 0.035 to under 0.063, 0.063 to under 0.106, 0.106 to 0.178, and Over 0.178.

For the purpose of section 9.1, the tensile strength of a wire shall be determined in accordance with the requirements of section 9.1.1 and the test method of Practice 8.2.2.

TABLE 5 Minimum Weight (Mass) of Zinc per Unit Area of Uncoated Nail, Staple, or Wire Surface

Table with 3 columns: Wire Diameter (Inches), Minimum Weight (mg/cm²), and Minimum Weight (mg/in²). Rows include ranges like 0.03 to under 0.06, 0.06 to under 0.10, 0.10 to under 0.15, 0.15 to under 0.20, 0.20 to under 0.25, and 0.25 to under 0.30.

For the purpose of section 9.1, the minimum weight of zinc per unit area of uncoated nail, staple, or wire surface shall be determined in accordance with the requirements of section 9.1.1 and the test method of Practice 8.2.2.

TABLE 6 Diameter Tolerance for Zinc-Coated Wire (Coils) (Inch-Pound Units)

Table with 2 columns: Wire Diameter (Inches) and Diameter Tolerance (Inches). Rows include ranges like 0.03 to under 0.06, 0.06 to under 0.10, 0.10 to under 0.15, 0.15 to under 0.20, 0.20 to under 0.25, and 0.25 to under 0.30.

9.1.3.2.1.1. The diameter tolerance for zinc-coated wire (coils) shall apply only when specified by the purchaser in the contract or order. The diameter tolerance for zinc-coated wire (coils) shall be determined in accordance with the requirements of section 9.1.1 and the test method of Practice 8.2.2.

13.1.1. Unless otherwise specified in the contract, the manufacturer is responsible for the inspection of the zinc-coated wire.

TABLE 7 Diameter Tolerance for Zinc-Coated Wire (Nails and Staples) (Inch-Pound Units)

Table with 2 columns: Wire Diameter (Inches) and Diameter Tolerance (Inches). Rows include ranges like 0.03 to under 0.06, 0.06 to under 0.10, 0.10 to under 0.15, 0.15 to under 0.20, 0.20 to under 0.25, and 0.25 to under 0.30.

For the purpose of section 9.1, the diameter tolerance for zinc-coated wire (nails and staples) shall be determined in accordance with the requirements of section 9.1.1 and the test method of Practice 8.2.2.

TABLE 8 Minimum Diameters for Temper Designation (Inch-Pound Units)

Table with 2 columns: Wire Diameter (Inches) and Minimum Diameter (Inches). Rows include ranges like 0.03 to under 0.06, 0.06 to under 0.10, 0.10 to under 0.15, 0.15 to under 0.20, 0.20 to under 0.25, and 0.25 to under 0.30.

For the purpose of section 9.1, the minimum diameter for zinc-coated wire shall be determined in accordance with the requirements of section 9.1.1 and the test method of Practice 8.2.2.

13.1.1. Unless otherwise specified in the contract, the manufacturer is responsible for the inspection of the zinc-coated wire.