Designation: A 764 – 07

# Standard Specification for Metallic Coated Carbon Steel Wire, Coated at Size and Drawn to Size for Mechanical Springs[1]

This standard is issued under the fixed designation A 764; 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 two finishes of round, metallic coated, hard-drawn, carbon steel spring wire having properties and quality for the manufacture of mechanical springs and wire forms that are not subject to high stress or require high fatigue properties.

1.2 The values stated in inch-pound units are to be regarded as the standard. The values stated in SI units are for information purposes only.

## 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 370 Test Methods and Definitions for Mechanical Testing of Steel Products

A 428/A 428M Test Method for Weight [Mass] of Coating on Aluminum-Coated Iron or Steel Articles

A 510 Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel

A 700 Practices for Packaging, Marking, and Loading Methods for Steel Products for Shipment

A 751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products

B 6 Specification for Zinc

B 750 Specification for GALFAN (Zinc-5 % Aluminum-Mischmetal) Alloy in Ingot Form for Hot-Dip Coatings

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

2.2 *U.S. Government Standards:*[3]

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

MIL-STD-129 Marking for Shipment and Storage

2.3 *Automotive Industry Action Group Standard:*[4]

AIAG B-5 02.00 Primary Metals Identification Tag Application Standard

## 3. Terminology

3.1 *Definitions:*

3.1.1 *coating class (regular, 1, or 3)*—specifies the minimum coating weight per unit area of uncoated wire surface. Aluminum coated wire is only specified in one class.

3.1.2 *coating finish (1 or 2)*—specifies whether a coating is applied prior to or after the final cold drawing operation.

3.1.3 *coating type (A, B, or C)*—specifies the required alloy content of the coating.

3.1.4 *tensile class (I or II)*—specifies the tensile range to which the wire is to conform.

## 4. Ordering Information

4.1 Orders for material under this specification should include the following information:

4.1.1 Quantity (weight),

4.1.2 Diameter, finish, class of coating if applicable, type of metallic coating, class of tensile strength, name of material,

4.1.3 ASTM designation and date of issue,

4.1.4 Packaging (Section 15),

4.1.5 Cast or heat analysis report, if desired (Section 6), and

4.1.6 Test report, if desired (Section 14).

NOTE 1—A typical ordering description is as follows: 30 000 lb 0.120 in. Finish 2, Class 1, Type B Metallic Coating, Tensile Class II, Steel Mechanical Spring Wire in 400-lb, 22-in. coils to ASTM A 764, dated.

## 5. Materials and Manufacture

5.1 The base metal of the wire shall be of good commercial quality steel. The steel may be either ingot cast or strand cast.

5.2 A sufficient discard shall be made to ensure freedom from injurious piping and undue segregation.

5.3 The wire shall be cold drawn to produce the desired mechanical properties.

[1] This specification is under the jurisdiction of ASTM Committee A01 on Steel, Stainless Steel and Related Alloys and is under the direct responsibility of Subcommittee A01.03 on Steel Rod and Wire.

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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.

[3] Available from Standardization Documents Order Desk, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, ATTN: NPODS.

[4] Available from Automotive Industry Action Group, 26200 Lahser Rd., Suite 200, Southfield, MI 48034, www.aiag.org.

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

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5.4 Each coil shall be of one continuous length. Only welds made prior to cold drawing are permitted, unless otherwise agreed upon at the time of the purchase or contract.

5.5 The material shall be metallic coated prior to cold drawing, or at an intermediate stage of cold drawing (Finish 1), or shall be metallic coated after the final cold drawing (Finish 2).

5.6 The wire shall be furnished with one of three types of metallic coating, as specified:

5.6.1 *Type A*—Aluminum coated (aluminized),

5.6.2 *Type B*—Zinc coated (galvanized), or

5.6.3 *Type C*—Zinc-5 % aluminum-mischmetal (Zn-5Al-MM) alloy coated.

5.7 Coating Types A and C shall be produced by a hot-dip process. Coating Type B may be produced by either a hot-dip or an electrolytic process at the option of the producer.

5.8 The slab zinc for Coating Type B shall be any grade of zinc conforming to Specification B 6.

5.9 The ingot used for Coating Type C shall conform to Specification B 750.

## 6. *Chemical Requirements* Chemical Requirements

6.1 The steel shall conform to the requirements for chemical composition prescribed in Table 1.

6.2 *Cast or Heat Analysis*—Each cast or heat of steel shall be analyzed by the manufacturer to determine compliance with the percentage of elements prescribed in Table 1. This analysis shall be from a test specimen preferably taken during the pouring of the cast or heat. When required, this shall be reported to the purchaser.

6.3 *Product Analysis*—An analysis may be made by the purchaser from finished wire representing each cast or heat of steel. The chemical composition thus determined, as to elements required or restricted, shall conform to the product analysis requirements specified in Table 10 of Specification A 510.

6.4 For referee purposes, Test Methods, Practices, and Terminology A 751 shall be used.

## 7. Mechanical Requirements

7.1 *Tension Test*:

7.1.1 *Requirements*—The material as represented by tension test specimens shall conform to the requirements prescribed in Table 2 or Table 3 for the various sizes and specified class.

7.1.2 *Test Method*—The tension test shall be made in accordance with Test Methods A 370, Supplement IV.

7.2 *Wrap Test*:

7.2.1 *Requirement*—Finish 1 (drawn to size metallic coated) wire shall withstand wrapping on a mandrel as shown in Table 4 without the steel base fracturing or the metallic coating peeling or flaking to such an extent that coating metal can be removed by rubbing with the bare fingers. Finish 2 (metallic coated at size) wire shall withstand wrapping on a mandrel as shown in Table 5 without the steel base fracturing or the metallic coating peeling or flaking to such an extent that coating metal can be removed by rubbing with the bare fingers. Loosening or detachment, during the wrap test, of superficial, small particles of coating metal formed by mechanical polishing of the metallic coated wire shall not be considered cause for rejection.

7.2.2 *Test Method*—The wrap test shall be made in accordance with Test Methods A 370, Supplement IV.

7.3 *Metallic Coating*.

7.3.1 *Requirement*:

7.3.1.1 For metallic coating Type A, the wire shall conform to the minimum weight of coating prescribed in Table 6.

7.3.1.2 For metallic coating Type B or Type C, the wire shall conform to the minimum weight of coating for Coating Class 1 or 3 prescribed in Table 7. Regular coating has no minimum requirement.

7.3.2 *Test Methods*:

7.3.2.1 The weight of coating test for metallic coating Type A shall be made in accordance with Test Method A 428/A 428M.

7.3.2.2 The weight of coating test for metallic coating Type B or Type C shall be made in accordance with Test Method A 90/A 90M.

**TABLE 1 Chemical Requirements**

| Element | Composition, % |
|---|---|
| Carbon | 0.45–0.85[A] |
| Manganese | 0.30–1.30[B] |
| Phosphorus, max | 0.040 |
| Sulfur, max | 0.050 |
| Silicon | 0.10–0.35 |

[A] Carbon in any one lot shall not vary by more than 0.13 %.
[B] Manganese in any one lot shall not vary by more than 0.30 %.

## 8. Dimensions and Permissible Variations

8.1 The diameter of the wire shall not vary from that specified by more than the tolerances specified in Table 8 or Table 9.

## 9. Workmanship, Finish, and Appearance

9.1 The surface of Finish 1, drawn metallic coated wire, shall be smooth and free from defects such as seams, pits, die marks, and other defects tending to impair the use of the wire for springs.

9.2 The surface of Finish 2, metallic coated at wire size, shall be free of slivers, scale, and other defects tending to impair the use of this wire for springs. The metallic coating shall be smooth and continuous. If a sample does not demonstrate a smooth and continuous coating, one sample shall be cut from each end of the coil and examined.

9.3 The wire shall be packaged so that it can be unwound in a trouble-free manner.

## 10. Sampling

10.1 A lot shall consist of all of the coils of wire of the same size, type of coating, tensile strength class, metallic coating type, finish, and heat or cast offered for inspection at one time. 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 7.1, 7.2, and 7.3.

## 11. Number of Tests and Retests

11.1 The number of test specimens taken from the ends of coils during production to ensure compliance with 7.1, 7.2, and



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**TABLE 2 Tensile Requirements[A]—Finish 1 (Drawn to Size Metallic Coated), Regular or Class 1 Coating (One Class on Coating Type A)**

| Wire Diameter,[B] in. (mm) | Tensile Class I | | Tensile Class II | |
|---|---|---|---|---|
| | Tensile Strength, ksi (MPa) | | Tensile Strength, ksi (MPa) | |
| | min | max | min | max |
| 0.032 (0.81)[C] | 253 (1740) | 306 (2110) | 292 (2010) | 347 (2390) |
| 0.035 (0.89)[C] | 248 (1710) | 301 (2080) | 287 (1980) | 342 (2360) |
| 0.041 (1.04)[C] | 242 (1670) | 293 (2020) | 279 (1920) | 332 (2290) |
| 0.048 (1.22)[C] | 236 (1630) | 286 (1970) | 273 (1880) | 325 (2240) |
| 0.054 (1.37) | 231 (1590) | 279 (1920) | 266 (1830) | 316 (2180) |
| 0.062 (1.57) | 225 (1550) | 272 (1880) | 259 (1790) | 308 (2120) |
| 0.072 (1.83) | 220 (1520) | 266 (1830) | 254 (1750) | 301 (2080) |
| 0.080 (2.03) | 216 (1490) | 261 (1800) | 249 (1720) | 296 (2040) |
| 0.092 (2.34) | 209 (1440) | 253 (1740) | 241 (1660) | 287 (1980) |
| 0.106 (2.69) | 205 (1410) | 248 (1710) | 237 (1630) | 281 (1940) |
| 0.120 (3.05) | 200 (1380) | 241 (1660) | 230 (1590) | 273 (1880) |
| 0.135 (3.43) | 196 (1350) | 237 (1630) | 226 (1560) | 269 (1850) |
| 0.148 (3.76) | 193 (1330) | 234 (1610) | 223 (1540) | 266 (1830) |

[A] Tensile strength values for intermediate diameters may be interpolated.
[B] Decimal size is rounded to three significant places in accordance with Practice E 29.
[C] These sizes are not produced with metallic coating Type A.

**TABLE 3 Tensile Requirements[A]—Finish 2 (Metallic Coated at Size) Regular, Class 1 or Class 3 Coating (One Class on Coating Type A)**

| Wire Diameter,[B] in. (mm) | Class I | | Class II | |
|---|---|---|---|---|
| | Tensile Strength, ksi (MPa) | | Tensile Strength, ksi (MPa) | |
| | min | max | min | max |
| 0.062 (1.57)[C] | 213 (1470) | 272 (1880) | 232 (1600) | 291 (2010) |
| 0.072 (1.83)[C] | 209 (1440) | 266 (1830) | 227 (1570) | 284 (1960) |
| 0.080 (2.03) | 204 (1410) | 261 (1800) | 223 (1540) | 280 (1930) |
| 0.092 (2.34) | 198 (1370) | 253 (1740) | 216 (1490) | 271 (1870) |
| 0.106 (2.69) | 194 (1340) | 248 (1710) | 212 (1460) | 266 (1830) |
| 0.120 (3.05) | 189 (1300) | 241 (1660) | 206 (1420) | 258 (1780) |
| 0.135 (3.43) | 185 (1280) | 237 (1630) | 202 (1390) | 254 (1750) |
| 0.148 (3.76) | 183 (1260) | 234 (1610) | 200 (1380) | 251 (1730) |
| 0.162 (4.11) | 180 (1240) | 230 (1590) | 196 (1350) | 246 (1700) |
| 0.177 (4.50) | 176 (1210) | 225 (1550) | 192 (1320) | 241 (1660) |
| 0.192 (4.88) | 173 (1190) | 221 (1520) | 189 (1300) | 237 (1630) |
| 0.207 (5.26) | 171 (1180) | 218 (1500) | 186 (1280) | 233 (1610) |
| 0.225 (5.72)[C] | 167 (1150) | 214 (1480) | 183 (1260) | 230 (1590) |
| 0.250 (6.35)[C] | 164 (1130) | 210 (1450) | 179 (1230) | 225 (1550) |

[A] Tensile strength values for intermediate diameters may be interpolated.
[B] Decimal size is rounded to three significant places in accordance with Practice E 29.
[C] These sizes are not produced with metallic coating Type A.

**TABLE 4 Mandrel Diameters for Steel Ductility and Adherence of Metallic Coating Test for Finish 1 Wire (Drawn to Size Metallic Coated)**

| Wire Diameter | | Mandrel Diameter | |
|---|---|---|---|
| in. | mm | Class I Tensile | Class II Tensile |
| 0.032 to 0.148 incl | 0.81 to 3.76 incl | 1D[A] | 2D |

[A] D equals nominal wire diameter being tested. For 1D mandrel, wire may be wound on itself.

7.3 varies 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 a fraction thereof, in a lot shall be selected at random, or a total of seven specimens, whichever is less.

11.2 Should 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 tested for the property in which the original sample failed to comply at a frequency of 10 % or more so that the total number of tests is at least double the original. Any lot that exhibits a failure shall be rejected. The manufacturer may test each coil in the failed lot for the property in which failure occurred and reject only the nonconforming coils.

11.3 If any test specimen exhibits obvious imperfections due to cutting a sample from the coil or due to handling damage after the sample has been cut, it may be discarded and another specimen substituted.

## 12. Inspection

12.1 Unless otherwise specified in the contract or purchase order, the manufacturer is responsible for the performance of all inspection and test requirements specified in this specification. Except as otherwise specified in the contract or purchase order, the manufacturer may use his own or any other suitable facilities for the performance of the inspection and test requirements unless disapproved by the purchaser at the time



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**TABLE 5 Mandrel Diameters for Steel Ductility and Adherence of Metallic Coating Test for Finish 2 Wire (Metallic Coated at Size)**

| Wire Diameter | | Mandrel Diameters for Various Coating and Tensile Strength Classes | | | |
|---|---|---|---|---|---|
| | | Regular and Class I Coating | | Class 3 Coating | |
| in. | mm | Class I Tensile | Class I Tensile | Class I Tensile | Class II Tensile |
| 0.062 to under 0.076 | 1.57 to under 1.93 | 1D[A] | 2D | 2D | 3D |
| 0.076 to under 0.148 | 1.93 to under 3.76 | 2D | 3D | 3D | 4D |
| 0.148 to under 0.162 | 3.76 to under 4.11 | 2D | 4D | 4D | 5D |
| 0.162 to 0.250 incl | 4.11 to 6.35 incl | 3D | 5D | 4D | 5D |

[A] D equals nominal wire diameter being tested.

**TABLE 6 Minimum Weight of Aluminum per Unit Area of Uncoated Wire Surface**

| Wire Diameter,[A] in. (mm) | Finish 1 | | Finish 2 | |
|---|---|---|---|---|
| | oz/ft$^2$ | g/m$^2$ | oz/ft$^2$ | g/m$^2$ |
| 0.054 (1.37) | 0.20 | 61 | . . . | . . . |
| 0.062 (1.57) | 0.20 | 61 | . . . | . . . |
| 0.072 (1.83) | 0.20 | 61 | . . . | . . . |
| 0.076 (1.93) | 0.21 | 64 | . . . | . . . |
| 0.080 (2.03) | 0.21 | 64 | 0.30 | 92 |
| 0.092 (2.34) | 0.21 | 64 | 0.32 | 98 |
| 0.099 (2.51) | 0.23 | 70 | 0.32 | 98 |
| 0.106 (2.69) | 0.23 | 70 | 0.35 | 107 |
| 0.120 (3.05) | 0.23 | 70 | 0.35 | 107 |
| 0.135 (3.43) | 0.25 | 70 | 0.35 | 107 |
| 0.148 (3.76) | 0.25 | 70 | 0.40 | 122 |
| 0.162 (4.11) | 0.27 | 82 | 0.40 | 122 |
| 0.177 (4.50) | 0.27 | 82 | 0.40 | 122 |
| 0.192 (4.88) | 0.30 | 92 | 0.40 | 122 |
| 0.207 (5.26) | 0.30 | 92 | 0.40 | 122 |

[A] Diameters, other than those shown above, are produced with aluminum coating equivalent to those of the next smaller size.

**TABLE 7 Minimum Weight of Zinc or Zinc-5 % Aluminum-Mischmetal Alloy per Unit Area of Uncoated Wire Surface**

| Wire Diameter,[A] in. (mm) | Class 1 Coating | | Class 3 Coating | |
|---|---|---|---|---|
| | oz/ft$^2$ | g/m$^2$ | oz/ft$^2$ | g/m$^2$ |
| 0.032 (0.81) | 0.05 | 16 | 0.25 | 76 |
| 0.035 (0.89) | 0.10 | 31 | 0.40 | 122 |
| 0.041 (1.04) | 0.10 | 31 | 0.40 | 122 |
| 0.048 (1.22) | 0.15 | 46 | 0.40 | 122 |
| 0.054 (1.37) | 0.15 | 46 | 0.40 | 122 |
| 0.062 (1.57) | 0.15 | 46 | 0.50 | 153 |
| 0.072 (1.83) | 0.15 | 46 | 0.50 | 153 |
| 0.076 (1.93) | 0.20 | 61 | 0.60 | 183 |
| 0.080 (2.03) | 0.25 | 76 | 0.65 | 198 |
| 0.092 (2.34) | 0.30 | 92 | 0.70 | 214 |
| 0.099 (2.51) | 0.30 | 92 | 0.80 | 244 |
| 0.106 (2.69) | 0.30 | 92 | 0.80 | 244 |
| 0.120 (3.05) | 0.30 | 92 | 0.80 | 244 |
| 0.135 (3.43) | 0.30 | 92 | 0.80 | 244 |
| 0.148 (3.76) | 0.40 | 122 | 0.80 | 244 |
| 0.162 (4.11) | 0.40 | 122 | 0.80 | 244 |
| 0.177 (4.50) | 0.40 | 122 | 0.80 | 244 |
| 0.192 (4.88) | 0.50 | 153 | 0.90 | 275 |
| 0.207 (5.26) | 0.65 | 198 | 0.90 | 275 |
| 0.225 (5.72) | 0.65 | 198 | 0.90 | 275 |
| 0.250 (6.35) | 0.65 | 198 | 0.90 | 275 |

[A] Diameters, other than those shown above, are produced with metallic coating equivalent to those of the next smaller size.

the order is placed. The purchaser shall have the right to perform any of the inspections and tests set forth in this specification when such inspections and tests are deemed necessary to ensure that the material conforms to prescribed requirements.

**TABLE 8 Permissible Variations in Dimensions Finish 1, Drawn to Size Metallic Coated[A]**

| Wire Diameter, in. (mm) | Permissible Variations, Plus and Minus, in. (mm) | Permissible Out-of-Round, in. (mm) |
|---|---|---|
| 0.032 (0.81) to under 0.076 (1.93) | 0.001 (0.03) | 0.001 (0.03) |
| 0.076 (1.93) to 0.148 (3.76) incl | 0.002 (0.05) | 0.002 (0.05) |

[A] For purposes of determining conformance with this specification, all specified limits are absolute as defined in Practice E 29.

**TABLE 9 Permissible Variations in Dimensions Finish 2, Metallic Coated at Size**

| Wire Diameter, in. (mm)[A] | Tolerance,[B] Plus and Minus, in. (mm) | |
|---|---|---|
| | Regular and Class I Coating | Class 3 Coating |
| 0.062 (1.57) to under 0.076 (1.93) | 0.002 (0.05) | 0.002 (0.05) |
| 0.076 (1.93) to 0.250 (6.35) incl | 0.003 (0.08) | 0.004 (0.102) |

[A] For the purpose of determining conformance with this specification, an observed value shall be rounded to the nearest 0.001 in. (0.03 mm) in accordance with the rounding method of Practice E 29.

[B] It is recognized that the surfaces of hot dipped metallic coatings are not perfectly smooth and devoid of irregularities. If the tolerances shown above are rigidly applied to such irregularities that are inherent to the product, unjustified rejections of wire that would actually be satisfactory for use could occur. Therefore, it is intended that these tolerances be used in gaging the uniform areas of the metallic coated wire.

## 13. Rejection and Rehearing

13.1 Unless otherwise specified, any rejection based on tests made in accordance with this specification shall be reported to the manufacturer within a reasonable length of time after receipt of the material.

13.2 The material must be adequately protected and correctly identified in order that the producer may make a proper investigation.

## 14. Certification

14.1 When specified on the purchase order or contract, a manufacturer'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.

14.2 The certification shall include the specification number, year date of issue, and revision letter, if any.

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## 15. Packaging, Marking, and Loading

15.1 The coil weight, dimensions, and method of packaging shall be agreed upon between the manufacturer and the purchaser.

15.2 The size of wire, ASTM specification, finish, coating class, coating type, tensile class, and name or mark of the manufacturer shall be shown on a tag securely attached to each package of wire.

15.3 Unless otherwise specified in the purchaser's order, packaging, marking, and loading for shipments shall be in accordance with those procedures outlined in Practices A 700.

15.4 When specified in the contract or order, and for direct procurement by or direct shipment to the U.S. Government, marking for shipment, in addition to requirements specified in the contract or order, shall be in accordance with MIL-STD-129 for U.S. Military Agencies and in accordance with Fed. Std. No. 123 for U.S. Government Civil Agencies.

15.5 *Bar Coding*—In addition to the previously stated identification requirements, bar coding is acceptable as a supplementary identification method. Bar coding should be consistent with AIAG Standard 02.00. The bar code may be applied to a substantially affixed tag.

## 16. Keywords

16.1 aluminized; galvanized; mechanical springs; springs; steel wire; wire; wire forms; zinc-5 % aluminum-mischmetal alloy coated

## SUMMARY OF CHANGES

Committee A01 has identified the location of selected changes to this standard since the last issue (A 764 – 95(2001)) that may impact the use of this standard. (Approved 03/01/2007.)

(*1*) Removed references to MIL-STD-163.

(*2*) Completed 5-year review.

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