



Designation: A227/A227M – 06 (Reapproved 2011)

## Standard Specification for Steel Wire, Cold-Drawn for Mechanical Springs<sup>1</sup>

This standard is issued under the fixed designation A227/A227M; 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.

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

### 1. Scope\*

1.1 This specification covers two classes of round cold-drawn steel spring wire having properties and quality for the manufacture of mechanical springs that are not subject to high stress or requiring high fatigue properties and wire forms.

1.2 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.

### 2. Referenced Documents

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

[A370 Test Methods and Definitions for Mechanical Testing of Steel Products](#)

[A510/A510M Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel, and Alloy Steel](#)

[A700 Guide for Packaging, Marking, and Loading Methods for Steel Products for Shipment](#)

[A751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products](#)

[A941 Terminology Relating to Steel, Stainless Steel, Related Alloys, and Ferroalloys](#)

[E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications](#)

#### 2.2 American National Standard:

[B 32.4M Preferred Metric Sizes for Round, Square, Rectangle, and Hexagon Metal Products<sup>3</sup>](#)

#### 2.3 Federal Standard:

[Fed. Std. No. 123 Marking for Shipment \(Civil Agencies\)<sup>4</sup>](#)

#### 2.4 AIAG Standard:

[AIAG B-5 02.00 Primary Metals Identification Tag Application Standard<sup>5</sup>](#)

### 3. Terminology

#### 3.1 Definitions of Terms Specific to This Standard:

3.1.1 For definition of terms used in this specification, refer to Terminology [A941](#).

### 4. Ordering Information

4.1 It shall be the responsibility of the purchaser to specify all requirements that are necessary for material under this specification. Such requirement may include, but are not limited to, the following:

4.1.1 Quantity (mass),

4.1.2 Name of material (cold-drawn steel mechanical spring wire) and class ([Table 1](#) or [Table 2](#)),

4.1.3 Wire diameter ([Table 1](#) or [Table 2](#)),

4.1.4 Packaging ([Section 15](#)),

4.1.5 Cast or heat analysis report, if requested ([Section 6](#)),

4.1.6 Certification or test report, or both, if specified ([Section 14](#)), and

4.1.7 ASTM designation and date of issue.

NOTE 1—A typical ordering description is as follows: 15 000 kg Cold-Drawn Mechanical Spring Wire, Class I, Size 5.00 mm in 700-kg coils to ASTM A227M dated\_\_\_\_\_, or for non-SI units, 30 000 lb Cold-Drawn Mechanical Spring Wire, Class I, Size 0.207 in. diameter in 500-lb coils to ASTM A227 dated\_\_\_\_\_.

### 5. Manufacture

5.1 The steel may be made by any commercially accepted steel-making process. The steel may be either ingot cast or strand cast.

5.2 The finished wire shall be free of detrimental pipe and undue segregation.

<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 A01.03 on Steel Rod and Wire.

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<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 American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.

<sup>4</sup> Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

<sup>5</sup> Available from Automotive Industry Action Group (AIAG), 26200 Lahser Rd., Suite 200, Southfield, MI 48034.

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

**TABLE 1 Tensile Requirements, SI Units<sup>A</sup>**

| Diameter, <sup>B</sup><br>mm | Class I               |      | Class II             |      |
|------------------------------|-----------------------|------|----------------------|------|
|                              | Tensile Strength, MPa |      | Tensile Strength MPa |      |
|                              | min                   | max  | min                  | max  |
| 0.50                         | 1960                  | 2240 | 2240                 | 2520 |
| 0.55                         | 1940                  | 2220 | 2220                 | 2500 |
| 0.60                         | 1920                  | 2200 | 2200                 | 2480 |
| 0.65                         | 1900                  | 2180 | 2180                 | 2460 |
| 0.70                         | 1870                  | 2140 | 2140                 | 2410 |
| 0.80                         | 1830                  | 2100 | 2100                 | 2370 |
| 0.90                         | 1800                  | 2070 | 2070                 | 2340 |
| 1.00                         | 1770                  | 2040 | 2040                 | 2310 |
| 1.10                         | 1740                  | 2000 | 2000                 | 2260 |
| 1.20                         | 1720                  | 1980 | 1980                 | 2240 |
| 1.40                         | 1670                  | 1930 | 1930                 | 2180 |
| 1.60                         | 1640                  | 1880 | 1880                 | 2120 |
| 1.80                         | 1600                  | 1840 | 1840                 | 2080 |
| 2.00                         | 1580                  | 1810 | 1810                 | 2040 |
| 2.20                         | 1550                  | 1780 | 1780                 | 2010 |
| 2.50                         | 1510                  | 1730 | 1730                 | 1960 |
| 2.80                         | 1480                  | 1700 | 1700                 | 1920 |
| 3.00                         | 1460                  | 1680 | 1680                 | 1900 |
| 3.50                         | 1420                  | 1630 | 1630                 | 1840 |
| 4.00                         | 1380                  | 1590 | 1590                 | 1800 |
| 4.50                         | 1350                  | 1550 | 1550                 | 1750 |
| 5.00                         | 1320                  | 1510 | 1510                 | 1700 |
| 5.50                         | 1300                  | 1490 | 1490                 | 1670 |
| 6.00                         | 1280                  | 1470 | 1470                 | 1650 |
| 6.50                         | 1250                  | 1440 | 1440                 | 1630 |
| 7.00                         | 1220                  | 1410 | 1410                 | 1600 |
| 7.50                         | 1200                  | 1390 | 1390                 | 1580 |
| 8.00                         | 1190                  | 1370 | 1370                 | 1550 |
| 9.00                         | 1160                  | 1340 | ...                  | ...  |
| 10.00                        | 1130                  | 1310 | ...                  | ...  |
| 11.00                        | 1110                  | 1280 | ...                  | ...  |
| 12.00                        | 1090                  | 1260 | ...                  | ...  |
| 14.00                        | 1050                  | 1210 | ...                  | ...  |
| 16.00                        | 1010                  | 1170 | ...                  | ...  |

<sup>A</sup> Tensile strength values for intermediate diameters may be interpolated.

<sup>B</sup> Preferred sizes. For a complete list, refer to ANSI B32.4M, Preferred Metric Sizes for Round, Square, Rectangle, and Hexagon Metal Products.

**TABLE 2 Tensile Requirements, Inch-Pound Units<sup>A</sup>**

| Diameter, in. | Class I               |     | Class II              |     |
|---------------|-----------------------|-----|-----------------------|-----|
|               | Tensile Strength, ksi |     | Tensile Strength, ksi |     |
|               | min                   | max | min                   | max |
| 0.020         | 283                   | 323 | 324                   | 364 |
| 0.023         | 279                   | 319 | 320                   | 360 |
| 0.026         | 275                   | 315 | 316                   | 356 |
| 0.029         | 271                   | 311 | 312                   | 352 |
| 0.032         | 266                   | 306 | 307                   | 347 |
| 0.035         | 261                   | 301 | 302                   | 342 |
| 0.041         | 255                   | 293 | 294                   | 332 |
| 0.048         | 248                   | 286 | 287                   | 325 |
| 0.054         | 243                   | 279 | 280                   | 316 |
| 0.062         | 237                   | 272 | 273                   | 308 |
| 0.072         | 232                   | 266 | 267                   | 301 |
| 0.080         | 227                   | 261 | 262                   | 296 |
| 0.092         | 220                   | 253 | 254                   | 287 |
| 0.106         | 216                   | 248 | 249                   | 281 |
| 0.120         | 210                   | 241 | 242                   | 273 |
| 0.135         | 206                   | 237 | 238                   | 269 |
| 0.148         | 203                   | 234 | 235                   | 266 |
| 0.162         | 200                   | 230 | 231                   | 261 |
| 0.177         | 195                   | 225 | 226                   | 256 |
| 0.192         | 192                   | 221 | 222                   | 251 |
| 0.207         | 190                   | 218 | 219                   | 247 |
| 0.225         | 186                   | 214 | 215                   | 243 |
| 0.250         | 182                   | 210 | 211                   | 239 |
| 0.312         | 174                   | 200 | 201                   | 227 |
| 0.375         | 167                   | 193 | 194                   | 220 |
| 0.438         | 165                   | 190 | 191                   | 216 |
| 0.500         | 156                   | 180 | 181                   | 205 |
| 0.562         | 152                   | 176 | 177                   | 201 |
| 0.625         | 147                   | 170 | 171                   | 294 |

<sup>A</sup> Tensile strength values for intermediate diameters shall be interpolated.

**TABLE 3 Chemical Requirements**

| Element         | Composition, %         |
|-----------------|------------------------|
| Carbon          | 0.45–0.85 <sup>A</sup> |
| Manganese       | 0.30–1.30 <sup>B</sup> |
| Phosphorus, max | 0.040                  |
| Sulfur, max     | 0.050                  |
| Silicon         | 0.15–0.35              |

<sup>A</sup> Carbon in any one lot shall not vary more than 0.13 %.

<sup>B</sup> Manganese in any one lot shall not vary more than 0.30 %.

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

## 6. Chemical Composition

6.1 The steel shall conform to the requirements for chemical composition prescribed in **Table 3**.

6.2 *Cast or Heat Analysis*—Each cast or heat of steel shall be analyzed by the manufacturer to determine the percentage of elements prescribed in **Table 3**. This analysis shall be made from a test specimen preferably taken during the pouring of the cast or heat. When requested, this shall be reported to the purchaser and shall conform to the requirements of **Table 3**.

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 3** of Specification **A510/A510M**.

6.4 For referee purposes, Test Methods, Practices, and Terminology **A751** shall be used.

## 7. Mechanical Properties

### 7.1 Tension Test:

7.1.1 *Requirements*—The material as represented by tension test specimens shall conform to the requirements prescribed in **Table 1** or **Table 2**.

7.1.2 *Number of Tests*—One test specimen shall be taken for each ten coils, or fraction thereof, in a lot. Each cast or heat in a given lot shall be tested.

7.1.3 *Location of Tests*—Test specimens shall be taken from either end of the coil.

7.1.4 *Test Method*—The tension test shall be made in accordance with Test Methods and Definitions **A370**.

### 7.2 Wrap Test:

7.2.1 *Requirements*—The material as represented by the wrap test specimens shall conform to the requirements specified in **Table 4** or **Table 5**. Wrap test on wires over 8.5 mm or 0.312 in. in diameter is not applicable. Since the conventional methods will not accommodate over 8.5 mm or 0.312 in., an alternative test procedure shall be agreed upon between purchaser and producer.