



Designation: A228/A228M – 14

# Standard Specification for Steel Wire, Music Spring Quality<sup>1</sup>

This standard is issued under the fixed designation A228/A228M; 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 a high quality, round, cold-drawn steel music spring quality wire, uniform in mechanical properties, intended especially for the manufacture of springs subject to high stresses or requiring good fatigue properties.

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

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

A938 Test Method for Torsion Testing of Wire

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

E1077 Test Methods for Estimating the Depth of Decarburization of Steel Specimens

<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.

2.2 *Federal Standard:*

Fed. Std. No. 123, Marking for Shipment (Civil Agencies)<sup>3</sup>

2.3 *American National Standard:*<sup>4</sup>

B32.4 Preferred Metric Sizes for Round, Square, Rectangle, and Hexagon Metal Products

2.4 *AIAG Standard:*<sup>5</sup>

AIAG B-5 02.00 Primary Metals Identification Tag Application Standard

## 3. Terminology

3.1 *Definitions*—For definitions of terms used in this specification, refer to Terminology A941.

## 4. Ordering Information

4.1 Orders for steel wire under this specification shall contain the following information:

4.1.1 Quantity (weight in lbs, or mass in kg),

4.1.2 Name of material (music steel spring wire),

4.1.3 Diameter (Table 1 and Section 9),

4.1.4 Finish (see 10.2),

4.1.5 Packaging (Section 15), and

4.1.6 ASTM designation and year of issue.

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

4.2.1 Requirements for certifications, heat, or test reports, (see Section 14),

4.2.2 Special packing, marking, and loading requirements (see Section 15), and

4.2.3 Other special requirements, if any,

NOTE 1—A typical inch-pound units ordering description is as follows: 10 000 lb Music Steel Spring Wire, 0.055 in. diameter, phosphate coated in 1000 lb coils to ASTM A288M\_A228M dated \_\_\_\_\_, or for metric

<sup>3</sup> Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111–5098, <http://www.dodssp.daps.mil>.

<sup>4</sup> Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

<sup>5</sup> Available from Automotive Industry Action Group (AIAG), 26200 Lahser Rd., Suite 200, Southfield, MI 48033, <http://www.aiag.org>.

**TABLE 1 Tensile Requirements**

| Inch-Pound Units              |                          |     |                               |                          |     |
|-------------------------------|--------------------------|-----|-------------------------------|--------------------------|-----|
| Diameter,<br>in. <sup>4</sup> | Tensile Strength,<br>ksi |     | Diameter,<br>in. <sup>4</sup> | Tensile Strength,<br>ksi |     |
|                               | min                      | max |                               | min                      | max |
| 0.004                         | 439                      | 485 | 0.059                         | 296                      | 327 |
| 0.005                         | 426                      | 471 | 0.063                         | 293                      | 324 |
| 0.006                         | 415                      | 459 | 0.067                         | 290                      | 321 |
| 0.007                         | 407                      | 449 | 0.072                         | 287                      | 317 |
| 0.008                         | 399                      | 441 | 0.076                         | 284                      | 314 |
| 0.009                         | 393                      | 434 | 0.080                         | 282                      | 312 |
| 0.010                         | 387                      | 428 | 0.085                         | 279                      | 308 |
| 0.011                         | 382                      | 422 | 0.090                         | 276                      | 305 |
| 0.012                         | 377                      | 417 | 0.095                         | 274                      | 303 |
| 0.013                         | 373                      | 412 | 0.100                         | 271                      | 300 |
| 0.014                         | 369                      | 408 | 0.102                         | 270                      | 299 |
| 0.015                         | 365                      | 404 | 0.107                         | 268                      | 296 |
| 0.016                         | 362                      | 400 | 0.110                         | 267                      | 295 |
| 0.018                         | 356                      | 393 | 0.112                         | 266                      | 294 |
| 0.020                         | 350                      | 387 | 0.121                         | 263                      | 290 |
| 0.022                         | 345                      | 382 | 0.125                         | 261                      | 288 |
| 0.024                         | 341                      | 377 | 0.130                         | 259                      | 286 |
| 0.026                         | 337                      | 373 | 0.135                         | 258                      | 285 |
| 0.028                         | 333                      | 368 | 0.140                         | 256                      | 283 |
| 0.030                         | 330                      | 365 | 0.145                         | 254                      | 281 |
| 0.032                         | 327                      | 361 | 0.150                         | 253                      | 279 |
| 0.034                         | 324                      | 358 | 0.156                         | 251                      | 277 |
| 0.036                         | 321                      | 355 | 0.162                         | 249                      | 275 |
| 0.038                         | 318                      | 352 | 0.177                         | 245                      | 270 |
| 0.040                         | 315                      | 349 | 0.192                         | 241                      | 267 |
| 0.042                         | 313                      | 346 | 0.207                         | 238                      | 264 |
| 0.045                         | 309                      | 342 | 0.225                         | 235                      | 260 |
| 0.048                         | 306                      | 339 | 0.250                         | 230                      | 255 |
| 0.051                         | 303                      | 335 | 0.262                         | 228                      | 253 |
| 0.055                         | 300                      | 331 | 0.283                         | 223                      | 248 |

  

| SI Units                     |                       |      |                              |                       |      |
|------------------------------|-----------------------|------|------------------------------|-----------------------|------|
| Diameter,<br>mm <sup>4</sup> | Tensile Strength, MPa |      | Diameter,<br>mm <sup>4</sup> | Tensile Strength, MPa |      |
|                              | min                   | max  |                              | min                   | max  |
| 0.10                         | 3000                  | 3300 | 1.1                          | 2120                  | 2380 |
| 0.11                         | 2950                  | 3250 | 1.2                          | 2100                  | 2350 |
| 0.12                         | 2900                  | 3200 | 1.4                          | 2050                  | 2300 |
| 0.14                         | 2850                  | 3150 | 1.6                          | 2000                  | 2250 |
| 0.16                         | 2800                  | 3100 | 1.8                          | 1980                  | 2220 |
| 0.18                         | 2750                  | 3050 | 2.0                          | 1950                  | 2200 |
| 0.20                         | 2700                  | 3000 | 2.2                          | 1900                  | 2150 |
| 0.22                         | 2680                  | 2980 | 2.5                          | 1850                  | 2100 |
| 0.25                         | 2650                  | 2950 | 2.8                          | 1820                  | 2050 |
| 0.28                         | 2620                  | 2920 | 3.0                          | 1800                  | 2000 |
| 0.30                         | 2600                  | 2900 | 3.2                          | 1780                  | 1980 |
| 0.35                         | 2550                  | 2820 | 3.5                          | 1750                  | 1950 |
| 0.40                         | 2500                  | 2750 | 3.8                          | 1720                  | 1920 |
| 0.45                         | 2450                  | 2700 | 4.0                          | 1700                  | 1900 |
| 0.50                         | 2400                  | 2650 | 4.5                          | 1680                  | 1880 |
| 0.55                         | 2380                  | 2620 | 5.0                          | 1650                  | 1850 |
| 0.60                         | 2350                  | 2600 | 5.5                          | 1620                  | 1820 |
| 0.65                         | 2320                  | 2580 | 6.0                          | 1600                  | 1800 |
| 0.70                         | 2300                  | 2550 | 6.5                          | 1580                  | 1780 |
| 0.80                         | 2250                  | 2500 | 7.0                          | 1550                  | 1750 |
| 0.90                         | 2200                  | 2450 | 7.2                          | 1540                  | 1740 |
| 1.00                         | 2150                  | 2400 |                              |                       |      |

<sup>4</sup> Tensile strength values for intermediate diameters may be interpolated.

units, 5000 kg Music Steel Spring Wire, 1.40 mm diameter, phosphate coated in 500 kg coils to ASTM A288 dated \_\_\_\_\_.

## 5. Materials and Manufacture

5.1 The steel may be made by any commercially accepted steel-making process. The rod to be used in the manufacture of

wire furnished to this specification shall be in accordance with Specification **A510/A510M**.

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

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 2**.

6.2 *Heat Analysis*—Each heat of steel shall be analyzed by the manufacturer to determine the percentage of elements prescribed in **Table 2**. This analysis shall be made from a test specimen preferably taken during the pouring of the heat. When requested in the purchase order, the heat analysis shall be reported to the purchaser.

6.3 *Product Analysis*—An analysis may be made by the purchaser from finished wire representing each heat of steel. The chemical composition thus determined, as to elements required or restricted, shall conform to the product analysis requirements specified in **Table 7** 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**.

7.1.2 *Number of Tests*—One test specimen shall be taken from the top or outside end of each coil, reel, or spool, and shall be tested for conformance.

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

7.1.4 For wire diameters over 0.283 in. [7.2 mm], mechanical properties shall be negotiated between purchaser and supplier and shall be included on the order information.

### 7.2 Wrap Test:

7.2.1 *Requirements*—The material shall conform to the requirements prescribed in **Table 3**. The requirement for conformance to wrap test on wires above 0.283 in. [7.2 mm] in diameter shall be agreed upon between purchaser and producer.

7.2.2 *Number of Tests*—One test specimen shall be taken from the top or outside end of each coil, reel or spool and shall be tested for conformance.

**TABLE 2 Chemical Requirements**

| Element         | Composition, % |
|-----------------|----------------|
| Carbon          | 0.70–1.00      |
| Manganese       | 0.20–0.70      |
| Phosphorus, max | 0.025          |
| Sulfur, max     | 0.030          |
| Silicon         | 0.10–0.30      |