



Designation: **A229/A229M – 12** **A229/A229M – 17**

Standard Specification for Steel Wire, Quenched and Tempered for Mechanical Springs¹

This standard is issued under the fixed designation A229/A229M; 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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

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 commercial quality round and shaped quenched and tempered steel spring wire intended especially for the manufacture of mechanical springs and wire forms. The quality level is lower than specialty spring quality (Specification A1000/A1000M) or valve spring quality (Specification A230/A230M).

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 are not necessarily exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems can result in non-conformance with the standard.

1.3 *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

[A230/A230M Specification for Steel Wire, Oil-Tempered Carbon Valve Spring Quality](#)

[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](#)~~

~~[A510M Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel \(Metric\) \(Withdrawn 2011\)](#)~~³

[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](#)

[A1000/A1000M Specification for Steel Wire, Carbon and Alloy Specialty Spring Quality](#)

[E8/E8M Test Methods for Tension Testing of Metallic Materials](#)

[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](#)

3. Terminology

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

3.2 *Definitions of Terms Specific to This Standard:*

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

3.2.1 commercial quality wire, n—a grade of wire that is fairly common quality and intended for applications that are primarily static in nature, or not involving significant fatigue loading.

3.2.2 equivalent round diameter, n—diameter of a round wire having equivalent cross sectional area to a given shaped wire.

¹ 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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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

3.2.3 shape factor, n —a value used to obtain cross sectional area for shaped wires when multiplied by measured width and measured thickness.

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 requirements may include, but are not limited to, the following:

- 4.1.1 Quantity (mass or weight),
- 4.1.2 Name of material (quenched and tempered steel mechanical spring wire) and class ([Table 1](#) or [Table 2](#)),
- 4.1.3 Dimensions (Section [10](#)),
- 4.1.4 ~~Chemical composition (Restrictions to the allowed chemical composition range beyond those specified in [Table 3](#)),~~² if required,
- 4.1.5 Packaging (Section [16](#)),
- 4.1.6 ~~Cast or heat analysis report, if desired (see [7.2](#));~~
- 4.1.7 ~~Certification or test report, or both, if specified (Section [15](#)), and~~
- 4.1.6 ASTM designation and date of issue.

NOTE 1—A typical metric ordering description is as follows: 10 000 kg quenched and tempered steel mechanical spring wire, Class I, 8.00 mm diameter, in 250-kg coils to ASTM A229 M – xx, or for inch-pound units, 20 000 lb quenched and tempered steel mechanical Spring Wire, Class I 0.315 in. diameter, in 500-lb coils to ASTM A 229 – xx.

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

- 4.2.1 Requirements for certifications, reporting of heat analysis or test reports (see Sections [15](#) and [7](#)),
- 4.2.2 Special packing, marking, and loading requirements, and
- 4.2.3 Other special requirements, if any.

5. General Requirements

5.1 Material furnished to this specification shall conform to the applicable requirements of either ~~Specification [A510](#)~~[A510](#)/[A510M](#) or ~~Specification [A510](#)~~.

TABLE 1 Tensile Requirements, SI Units^A

| Diameter, mm | Class I | | Class II | |
|-----------------|-----------------------|-----------------|-----------------------|-----------------|
| | Tensile Strength, MPa | | Tensile Strength, MPa | |
| | min | max | min | max |
| 0.50 | 2050 | 2250 | 2230 | 2450 |
| 0.55 | 2020 | 2220 | 2220 | 2440 |
| 0.60 | 2000 | 2200 | 2210 | 2430 |
| 0.65 | 1950 | 2150 | 2190 | 2410 |
| 0.70 | 1950 | 2150 | 2170 | 2190 |
| <u>0.70</u> | <u>1950</u> | <u>2150</u> | <u>2170</u> | <u>2390</u> |
| 0.80 | 1900 | 2100 | 2140 | 2360 |
| 0.90 | 1850 | 2050 | 2100 | 2320 |
| 1.00 | 1800 | 2000 | 2060 | 2280 |
| 1.10 | 1780 | 1980 | 2030 | 2240 |
| 1.20 | 1750 | 1950 | 2000 | 2210 |
| 1.40 | 1700 | 1900 | 1950 | 2150 |
| 1.60 | 1650 | 1850 | 1900 | 2100 |
| 1.80 | 1620 | 1820 | 1860 | 2060 |
| 2.00 | 1600 | 1800 | 1820 | 2020 |
| 2.20 | 1580 | 1780 | 1790 | 1990 |
| 2.50 | 1550 | 1750 | 1750 | 1950 |
| 2.80 | 1520 | 1720 | 1710 | 1900 |
| 3.00 | 1500 | 1700 | 1690 | 1880 |
| 3.50 | 1450 | 1620 | 1640 | 1830 |
| 4.00 | 1400 | 1580 | 1600 | 1780 |
| 4.50 | 1380 | 1550 | 1560 | 1740 |
| 5.00 | 1350 | 1520 | 1520 | 1700 |
| 5.50 | 1320 | 1500 | 1500 | 1680 |
| 6.00 | 1300 | 1480 | 1480 | 1660 |
| 7.00 | 1280 | 1450 | 1450 | 1630 |
| 8.00 | 1250 | 1430 | 1430 | 1610 |
| 9.00 | 1220 | 1400 | 1410 | 1590 |
| 10.00 | 1200 | 1380 | 1400 | 1580 |
| 11.00 | 1180 | 1350 | 1380 | 1560 |
| 12.00 | 1150 | 1320 | 1360 | 1540 |
| 14.00 | 1120 | 1300 | 1340 | 1520 |
| 16.00 | 1120 | 1300 | 1320 | 1500 |

^A Tensile strength values for intermediate diameters shall be interpolated.



TABLE 2 Tensile Requirements, Inch-Pound Units

| Diameter, ^A in. | Class I | | Class II | |
|----------------------------|-----------------------|-----|-----------------------|-----|
| | Tensile Strength, ksi | | Tensile Strength, ksi | |
| | min | max | min | max |
| 0.020 | 293 | 323 | 324 | 354 |
| 0.023 | 289 | 319 | 320 | 350 |
| 0.026 | 286 | 316 | 317 | 347 |
| 0.029 | 283 | 313 | 314 | 344 |
| 0.032 | 280 | 310 | 311 | 341 |
| 0.035 | 274 | 304 | 305 | 335 |
| 0.041 | 266 | 296 | 297 | 327 |
| 0.048 | 259 | 289 | 290 | 320 |
| 0.054 | 253 | 283 | 284 | 314 |
| 0.062 | 247 | 277 | 278 | 308 |
| 0.072 | 241 | 271 | 272 | 302 |
| 0.080 | 235 | 265 | 266 | 296 |
| 0.092 | 230 | 260 | 261 | 291 |
| 0.106 | 225 | 255 | 256 | 286 |
| 0.120 | 220 | 250 | 251 | 281 |
| 0.135 | 215 | 240 | 241 | 266 |
| 0.148 | 210 | 235 | 236 | 261 |
| 0.162 | 205 | 230 | 231 | 256 |
| 0.177 | 200 | 225 | 226 | 251 |
| 0.192 | 195 | 220 | 221 | 246 |
| 0.207 | 190 | 215 | 216 | 241 |
| 0.225 | 188 | 213 | 214 | 239 |
| 0.244 | 187 | 212 | 213 | 238 |
| 0.250 | 185 | 210 | 211 | 236 |
| 0.312 | 183 | 208 | 209 | 234 |
| 0.375 | 180 | 205 | 206 | 231 |
| 0.438 | 175 | 200 | 201 | 226 |
| 0.500 | 170 | 195 | 196 | 221 |
| 0.562 | 165 | 190 | 191 | 216 |
| 0.625 | 165 | 190 | 191 | 216 |

^A Tensile strength values for intermediate diameters shall be interpolated.

TABLE 3 Chemical Requirements

| Element | Composition, % |
|-----------------|----------------|
| Carbon | 0.55–0.85 |
| Manganese | 0.30–1.20 |
| Phosphorus, max | 0.040 |
| Sulfur, max | 0.050 |
| Silicon | 0.15–0.35 |

6. Materials and Manufacture

- 6.1 The steel may be made by any commercially accepted steel-making process. The steel shall be fully killed.
- 6.2 The finished wire shall be free of detrimental pipe and undue segregation.
- 6.3 The wire shall be quenched and tempered to produce the desired mechanical properties.

7. Chemical Composition

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

7.2 *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.

7.3 *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 7 of Specification ~~A510/A510M~~ or ~~A510M~~.

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

8. Mechanical Properties

8.1 *Tension Test*: