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Standard Specification for Steel Wire, Oil-Tempered for Mechanical Springs 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 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 classes of ~~oil-tempered round and shaped quenched and tempered~~ steel spring wire intended especially for the manufacture of mechanical springs 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~~ are not ~~be~~ necessarily exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems ~~may~~ can result in non-conformance with the standard.

2. Referenced Documents

2.1 ASTM Standards:²

A370 Test Methods and Definitions for Mechanical Testing of Steel Products

A510 Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel

A510M Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel (Metric)

A700 Practices 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

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

2.2 American National Standard:

B 32.4M Preferred Metric Sizes for Round, Square, Rectangle, and Hexagon Metal Products

2.3 Military Standard:

MIL-STD-163 Steel Mill Products, Preparation for Shipment and Storage

2.4 Federal Standard:

Fed. Std. No. 123 Marking for Shipment (Civil Agencies)⁴ - 710b-457e-993a-b7a968611875/astm-a229-a229m-12

2.5 AIAG Standard:

AIAGB-502.00 Primary Metals Identification Tag Application Standard

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

4.1.1 Quantity (mass or weight),

4.1.2 Name of material (~~oil-tempered~~(quenched and tempered steel mechanical spring wire) and class (Table 1 or Table 2),

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.

TABLE 1 Tensile Requirements, SI Units^A

Diameter, B 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
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.

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

- 4.1.3 Dimensions (Section 10),
- 4.1.4 Chemical composition (Table 3), 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
- 4.1.8 ASTM designation and date of issue.

NOTE 1—A typical metric ordering description is as follows: 10 000 kg oil-tempered 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 oil-tempered quenched and tempered steel mechanical Spring Wire, Class I 0.315 in. diameter, in 500-lb coils to ASTM A 229 – xx.

5. General Requirements

5.1 Material furnished to this specification shall conform to the applicable requirements of either Specification A510M or Specification A510.

6. Materials and Manufacture

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

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 ^A
Manganese	0.30–1.20
Phosphorus, max	0.040
Sulfur, max	0.050
Silicon	0.15–0.35

^AGenerally 0.80/1.20% manganese for diameter 5.00 mm or 0.192 in. and larger; 0.30/0.90% for diameters less than 5.00 mm or 0.192 in. The choice of composition shall be optional with the manufacturer unless the purchaser definitely specifies otherwise.

requirements specified in Table 7 of Specification A510 or A510M.

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

8. Mechanical Properties

8.1 Tension Test:

8.1.1 *Requirements*—The material as represented by tension test specimens shall conform to the requirements prescribed in Table 1 or Table 2. Tensile strength of shaped and flat rolled wires shall conform to either table based on the conversion to equivalent round dimensions.

8.1.2 *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.

8.1.3 *Location of Tests*—Representative test specimens shall be taken from either end of the coil.

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

8.2 Wrap Test:

8.2.1 *Requirements*—Wire 4.00 mm or 0.162 in. and smaller in diameter shall wind on itself as an arbor without breakage. Larger diameter wire, up to and including 8.00 mm or 0.312 in. shall wind, without breakage, on a mandrel twice the wire diameter. Wrap test on wires over 8.00 mm or 0.312 in. diameter is not applicable. Wire 0.157 in. [4.00 mm] and smaller in diameter shall wind on itself as an arbor without breakage. Larger diameter wire, up to and including 0.315 in. [8.00 mm] shall wind, without