



Designation: **A228/A228M—07 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 reappraisal. A superscript epsilon ( $\epsilon$ ) 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 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 (~~metric~~) units or inch-pound units are to be regarded separately as standard. The values stated in each system ~~are~~ may not be exact equivalents; therefore, each system ~~must~~ 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~~ [A510M 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~~A510M Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel (Metric) (Withdrawn 2011)~~<sup>3</sup>

[A700 Practices for Packaging, Marking, and Loading Methods for Steel Products for Shipment \(Withdrawn 2014\)](#)<sup>3</sup>

[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](#)

#### 2.2 ~~Military Standard:~~

~~MIL-STD-163 Steel Mill Products, Preparation for Shipment and Storage~~<sup>4</sup>

#### 2.2 Federal Standard:

~~Fed. Std. No. 123, Marking for Shipment (Civil Agencies)~~<sup>4</sup> [4-4b15-4382-914b-45b9974668fa/astm-a228-a228m-14](#)

#### 2.3 American National Standard:<sup>5</sup>

[B32.4 Preferred Metric Sizes for Round, Square, Rectangle, and Hexagon Metal Products](#)

#### 2.4 AIAG Standard:<sup>6</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](#).

<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](#), 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.

<sup>3</sup> The last approved version of this historical standard is referenced on [www.astm.org](#).

<sup>4</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>5</sup> Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, [http://www.ansi.org](#).

<sup>6</sup> Available from Automotive Industry Action Group (AIAG), 26200 Lahser Rd., Suite 200, Southfield, MI 48033, [http://www.aiag.org](#).

#### 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, Orders for steel wire under this specification shall contain the following information:~~

- 4.1.1 Quantity ~~(mass), (weight in lbs, or mass in kg),~~
- 4.1.2 Name of material (music steel spring wire),
- 4.1.3 ~~Dimensions~~Diameter (Table 1 and Section 9),
- 4.1.4 Finish (see 10.2),
- 4.1.5 Packaging (Section 15), and
- 4.1.6 Heat analysis report, if requested (see 6.2),
- 4.1.7 Certification or test report, or both, if specified (Section 14), and
- 4.1.6 ASTM designation and year of issue.

NOTE 1—A typical metric ordering description is as follows: 2500 kg Music Spring Wire, 1.40 mm diameter, phosphate coated in 25 kg coils to ASTM A288M dated \_\_\_\_\_, or for inch-pound units, 5000 lb Music Spring Wire, 0.055 in. diameter, phosphate coated in 50 lb coils to ASTM A288 dated \_\_\_\_\_.

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 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 steel ~~may be either ingot cast or strand cast. The rod~~ to be used in the manufacture of wire furnished to this specification shall be in accordance with Specification ~~A510A510/A510M or 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 ~~A510A510/A510M or 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 ~~each end of every coil or from the top or outside end of each reel or spool.~~ 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 ~~6.0 mm [0.250 in.], 0.283 in. [7.2 mm],~~ mechanical properties ~~and chemical composition~~ 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 ~~wrap test shall be applied only to sizes smaller than 0.70 mm [0.028 in.] in diameter. 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.

7.2.3 *Test Method*—Each test specimen shall be closed wound on an arbor of its own diameter as prescribed in Table 3 for a minimum of four full wraps. Wire so tested shall not show any splits or fractures.



TABLE 1 Tensile Requirements

SI Units					
Inch-Pound Units					
Diameter, mm <sup>A</sup> E	Tensile Strength, MPa		Diameter, mm <sup>A,B</sup> max	Tensile Strength, MPa	
	Diameter, in. <sup>A</sup>	Diameter, in. <sup>A</sup>		Tensile Strength, ksi	
min	Tensile Strength, ksi	Diameter, in. <sup>A</sup>	max	min	max
0.10	3000	3300	0.90	2200	2450
0.004	439	485	0.059	296	327
0.11	2950	3250	1.00	2150	2400
0.005	426	471	0.063	293	324
0.12	2900	3200	1.1	2120	2380
0.006	415	459	0.067	290	321
0.14	2850	3150	1.2	2100	2350
0.007	407	449	0.072	287	317
0.16	2800	3100	1.4	2050	2300
0.008	399	441	0.076	284	314
0.18	2750	3050	1.6	2000	2250
0.009	393	434	0.080	282	312
0.20	2700	3000	1.8	1980	2220
0.010	387	428	0.085	279	308
0.22	2680	2980	2.0	1950	2200
0.011	382	422	0.090	276	305
0.25	2650	2950	2.2	1900	2150
0.012	377	417	0.095	274	303
0.28	2620	2920	2.5	1850	2100
0.013	373	412	0.100	271	300
0.30	2600	2900	2.8	1820	2050
0.014	369	408	0.102	270	299
0.35	2550	2820	3.0	1800	2000
0.015	365	404	0.107	268	296
0.40	2500	2750	3.2	1780	1980
0.016	362	400	0.110	267	295
0.45	2450	2700	3.5	1750	1950
0.018	356	393	0.112	266	294
0.50	2400	2650	3.8	1720	1920
0.020	350	387	0.121	263	290
0.55	2380	2620	4.0	1700	1900
0.022	345	382	0.125	261	288
0.60	2350	2600	4.5	1680	1880
0.024	341	377	0.130	259	286
0.65	2320	2580	5.0	1650	1850
0.026	337	373	0.135	258	285
0.70	2300	2550	5.5	1620	1820
0.028	333	368	0.140	256	283
0.80	2250	2500	6.0	1600	1800
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

Inch-Pound Units

SI Units

Diameter, in. <sup>A</sup>	Tensile Strength, ksi		Diameter, in. <sup>A</sup> max	Tensile Strength, ksi	
	Diameter, mm <sup>A</sup>	Diameter, mm <sup>A</sup>		Tensile Strength, MPa	
min	Tensile Strength, MPa	Diameter, mm <sup>A</sup>	max	min	max
0.004	439	485	0.055	300	331



0.10	3000	3300	1.1	2120	2380
0.005	426	474	0.059	296	327
0.11	2950	3250	1.2	2100	2350
0.006	415	459	0.063	293	324
0.12	2900	3200	1.4	2050	2300
0.007	407	449	0.067	290	321
0.14	2850	3150	1.6	2000	2250
0.008	399	441	0.072	287	317
0.16	2800	3100	1.8	1980	2220
0.009	393	434	0.076	284	314
0.18	2750	3050	2.0	1950	2200
0.010	387	428	0.080	282	312
0.20	2700	3000	2.2	1900	2150
0.011	382	422	0.085	279	308
0.22	2680	2980	2.5	1850	2100
0.012	377	417	0.090	276	305
0.25	2650	2950	2.8	1820	2050
0.013	373	412	0.095	274	303
0.28	2620	2920	3.0	1800	2000
0.014	369	408	0.100	271	300
0.30	2600	2900	3.2	1780	1980
0.015	365	404	0.102	270	299
0.35	2550	2820	3.5	1750	1950
0.016	362	400	0.107	268	296
0.40	2500	2750	3.8	1720	1920
0.018	356	393	0.110	267	295
0.45	2450	2700	4.0	1700	1900
0.020	350	387	0.112	266	294
0.50	2400	2650	4.5	1680	1880
0.022	345	382	0.121	263	290
0.55	2380	2620	5.0	1650	1850
0.024	341	377	0.125	261	288
0.60	2350	2600	5.5	1620	1820
0.026	337	373	0.130	259	286
0.65	2320	2580	6.0	1600	1800
0.028	333	368	0.135	258	285
0.70	2300	2550	6.5	1580	1780
0.030	330	365	0.140	256	283
0.80	2250	2500	7.0	1550	1750
0.032	327	361	0.145	254	281
0.90	2200	2450	7.2	1540	1740
0.034	324	358	0.150	253	279
1.00	2150	2400			
0.036	321	355	0.156	251	277
0.038	318	352	0.162	249	275
0.040	315	349	0.177	245	270
0.042	313	346	0.192	241	267
0.045	309	342	0.207	238	264
0.048	306	339	0.225	235	260
0.051	303	335	0.250	230	255

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

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

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

### 7.3 Torsion Test:

7.3.1 *Requirements*—The torsion test shall be applied to wire sizes 0.70 mm [0.028 in.] and larger in diameter. For wire sizes smaller in diameter than 0.70 mm [0.028 in.], the torsion test may be substituted for the wrap test (7.2). In this case, the minimum number of torsions to failure will be equivalent to 25 in a test length of 100d.

7.3.2 *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.

7.3.3 *Test Method*—Test specimens shall be prepared and tested as shown in A938 with the following exception. The minimum number of torsions (twists) to failure in a test length of 100d (where d = the wire diameter being tested) are shown in Table 34.