Designation: A1000/A1000M – 11

Standard Specification for Steel Wire, Carbon and Alloy Specialty Spring Quality[1]

This standard is issued under the fixed designation A1000/A1000M; 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.

1. Scope*

1.1 This specification covers four different grades of round and shaped plain carbon and alloy steel spring wire, uniform in quality and temper, intended for the manufacture of mechanical springs that can withstand moderate fatigue stresses over some relatively low number of cycles. The quality level is between the commercial quality grades of wire such as Specifications A401/A401M, A231/A231M, and A229/A229M and the valve spring quality grades such Specifications as A230/A230M, A232/A232M, and A877/A877M. It is similar to the grade TD (referenced in EN 10270-2) intended for medium fatigue levels, such as required for clutch springs. This wire shall be either in the annealed and cold-drawn or quenched and tempered condition as specified by purchaser.

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:*[2]

A229/A229M Specification for Steel Wire, Quenched and Tempered for Mechanical Springs

A230/A230M Specification for Steel Wire, Oil-Tempered Carbon Valve Spring Quality

A231/A231M Specification for Chromium-Vanadium Alloy Steel Spring Wire

A232/A232M Specification for Chromium-Vanadium Alloy Steel Valve Spring Quality Wire

A370 Test Methods and Definitions for Mechanical Testing of Steel Products

A401/A401M Specification for Steel Wire, Chromium-Silicon Alloy

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

A877/A877M Specification for Steel Wire, Chromium-Silicon Alloy, Chrome-Silicon-Vanadium Alloy Valve Spring Quality

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

E45 Test Methods for Determining the Inclusion Content of Steel

2.2 *European Standard:*

EN 10270-2 Steel Wire for Mechanical Springs Part 2: Oil-Hardened and Tempered Springsteel Wire of Unalloyed and Alloyed Steels[3]

3. Terminology

3.1 *Definitions:*

3.1.1 For definition of terms used in this specification, see Terminology A941.

3.2 *Definitions of Terms Specific to This Standard:*

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

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 are permitted to include, but are not limited to the following,

4.1.1 Quantity (mass),

4.1.2 Name of material (chromium-silicon alloy steel specialty spring quality wire),

4.1.3 Dimensions (Table 1 and Section 9),

4.1.4 Condition (Section 7),

4.1.5 Packaging (Section 15),

4.1.6 Heat analysis report, if requested (6.2),

[1] This specification is under the jurisdiction of ASTM Committee A01 on Steel, Stainless Steel and Related Alloysand 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.

[3] Available from European Committee for Standardization, rue de Stassart 36,B-1050 Brussels

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

TABLE 1 Permissible Variations in Wire Dimensions (Round and Shapes)[A]

SI Units		
Dimension, mm	Permissible Variations, ± mm	Permissible Out-Of-Round, mm
0.5 to 2.0, incl	0.02	0.02
Over 2.0 to 4.0, incl	0.03	0.03
Over 4.0 to 9.5, incl	0.04	0.04
Over 9.5	0.05	0.05
Inch-Pound Units		
Dimension, in.	Permissible Variations, ± in.	Permissible Out-Of-Round, in.
0.020 to 0.075, incl	0.0008	0.0008
Over 0.075 to 0.148, incl	0.001	0.001
Over 0.148 to 0.375, incl	0.0015	0.0015
Over 0.375	0.002	0.002
Permissible Variations in Wire Dimensions (Flat Rolled)[A]		
SI Units		
Dimension, mm	Thickness Permissible Variations, ± mm	Width Permissible Variations, mm
All	0.05	0.120
Inch-Pound Units		
Dimension, in.	Thickness Permissible Variations, ± in.	Width Permissible Variations, in.
All	0.002	0.005

[A] For purposes of determining conformance with this specification, all specified limits are absolute as defined in Practice E29.

4.1.7 Certification or test report, or both, if specified (Section 14), and

4.1.8 ASTM designation and year of issue.

NOTE 1—A typical ordering description is as follows: 40 000-lb. quenched and tempered chromium-silicon alloy steel specialty spring quality wire, size 0.250 in. in 3000-lb coils to Specification A1000/A1000M dated _______, or for SI units, 20 000-kg quenched and tempered chromium-silicon alloy steel specialty spring quality wire, size 6.00 mm in 1500-kg coils to Specification A1000/A1000M 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.

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

6. Chemical Composition

6.1 The steel shall conform to the requirements for chemical composition specified 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, this shall be reported to the purchaser and shall conform to the requirements of Table 2.

6.3 *Product Analysis*—An analysis may be made by the purchaser from finished wire representing each heat of steel. The average of all the separate determinations made shall be within the limits specified in the analysis column.

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

7. Mechanical Properties

7.1 *Annealed and Cold Drawn*—When purchased in the annealed and cold-drawn condition, the wire shall have been given a sufficient amount of cold working to meet the purchaser's coiling requirements and shall be in a suitable condition to respond properly to heat treatment. In special cases the hardness, if desired, shall be stated in the purchase order.

7.2 *Quenched and Tempered:*

7.2.1 *Tensile Strength and %RA, Round Wire*—When purchased in the quenched and tempered condition, the tensile strength and minimum percent reduction in area of round wire, sizes 0.105 in. [2.50 mm] and larger shall conform to the requirements prescribed in Tables 3-6.

7.2.2 *Tensile Strength, Shaped and Flat Wire*—Tensile strength of shaped and flat rolled wires shall conform to these tables based on the conversion to equivalent round dimensions. Percent reduction of area is not applicable to shaped and flat rolled wires.

NOTE 2—Equivalent round definition: The cross sectional area of non-round wires converted to the round wire diameter.

7.2.3 *Tensile Strength Variation*—In addition, the maximum tensile variation in a coil shall be 10 ksi [70 MPa].

NOTE 3—Any specimen breaking in the tensile grips shall be discarded and a new specimen tested if the specified mechanical properties are not achieved. If breakage in the tensile grips prevents conformance to percent reduction in area requirements, conformance to the wrap test (see 7.3) shall suffice.

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

TABLE 2 Chemical Requirements

	Analysis, %			
	Grade A Chromium-Silicon	Grade B Carbon	Grade C Chromium-Vanadium	Grade D Chromium-Silicon-Vanadium
Carbon	0.51 to 0.59	0.55 to 0.75	0.60 to 0.70	0.55 to 0.68
Manganese	0.50 to 0.80	0.60 to 0.90	0.50 to 0.90	0.50 to 0.90
Phosphorus	0.025 max	0.025 max	0.025 max	0.025 max
Sulfur	0.025 max	0.025 max	0.025 max	0.025 max
Silicon	1.20 to 1.60	0.15 to 0.30	0.15 to 0.30	1.20 to 1.65
Chromium	0.60 to 0.80	[A]	0.35 to 0.60	0.50 to 0.80
Vanadium	[A]	[A]	0.10 to 0.25	0.08 to 0.25

[A] Not required.