Designation: A 1000 – 99

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

This standard is issued under the fixed designation A 1000; 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 a quality 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 A 401, A 231 and A 229 and the valve spring quality grades such Specifications as A 230, A 232, A 877 and A 878. 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 oil-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. Within the text, the inch-pound units are shown in parentheses. The values stated in each system are not exact equivalents; therefore, each system must be used independent of the other.

2. Referenced Documents

2.1 *ASTM Standards:*

A 229 Specification for Steel Wire, Oil-Tempered for Mechanical Springs[2]

A 230 Specification for Steel Wire, Oil-Tempered Carbon Valve Spring Quality[2]

A 231 Specification for Chrome-Vanadium Alloy Steel Spring Quality Wire[2]

A 232 Specification for Chrome-Vanadium Alloy Steel Valve Spring Quality[2]

A 370 Test Methods and Definitions for Mechanical Testing of Steel Products[2]

A 401 Specification for Steel Wire, Chrome-Silicon Alloy[2]

A 700 Practices for Packaging, Marking, and Loading Methods for Steel Products for Domestic Shipment[3]

A 751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products[2]

A 877 Specification for Steel Wire, Chrome-Silicon Alloy Valve Spring Quality[2]

A 878 Specification for Steel Wire, Modified Chrome-Vanadium Valve Spring Quality[2]

A 941 Terminology Relating to Steel, Stainless Steel, Related Alloys, and Ferroalloys[4]

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications[5]

E 45 Practice for Determining the Inclusion Content of Steel[6]

2.2 *Federal Standard:*

Fed. Std. No. 123 Marking for Shipment (Civil Agencies)[7]

2.3 *Military Standard:*

MIL-STD-163 Steel Mill Products, Preparation for Shipment and Storage[7]

2.4 *AIAG Standard:*

AIAG B-5 02.00 Primary Metals Identification Tag Application Standard[8]

2.5 *European Standard:*

EN 10270-2 Steel Wire for Mechanical Springs Part 2: Oil-Hardened and Tempered Springsteel Wire of Unalloyed and Alloyed Steels[9]

3. Terminology

3.1 *Definitions:*

3.1.1 For definition of terms used in this practice, see Terminology A 941.

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 may include, but are not limited to the following,

4.1.1 Quantity (mass),

[1] This specification is under the jurisdiction of ASTM Committee A-1 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] *Annual Book of ASTM Standards*, Vol 01.03.

[3] *Annual Book of ASTM Standards*, Vol 01.05.

[4] *Annual Book of ASTM Standards*, Vol 01.01.

[5] *Annual Book of ASTM Standards*, Vol 14.02.

[6] *Annual Book of ASTM Standards*, Vol 03.01.

[7] Available from Standardization Documents Order Desk, Bldg 4 Section D. 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS

[8] Available from the Automotive Industry Action Group, 26200 Lasher, Suite 200, Southfield, MI 48034.

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

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),
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: 20 000-kg oil-tempered chromium-silicon alloy steel specialty spring quality wire, size 6.00 mm in 1500-kg coils to ASTM ___ dated ___, or for inch-pound units, 40 000-lb. oil-tempered chromium-silicon alloy steel specialty spring quality wire, size 0.250 in. in 3000-lb coils to ASTM___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.

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 E 29.

6.4 For referee purposes, Test Methods, Practices, and Terminology A 751 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 *Oil Tempered*:

7.2.1 *Tensile Strength and %RA, Round Wire*—When purchased in the oil-tempered condition, the tensile strength and minimum percent reduction in area of round wire, sizes 2.50 mm (0.105 in.) 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.

7.2.3 *Tensile Strength Variation*—In addition, the maximum tensile variation in a coil shall be 70 Mpa (10 KSI).

NOTE 2—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.

7.2.5 *Location of Tests*—Test specimens shall be taken for each five coils, or fraction thereof, in a lot. Each heat in a given lot shall be tested.

7.2.6 *Test Method*—The tension test shall be made in accordance with Test Methods and Definitions A 370.

7.3 *Wrap Test*:

7.3.1 Round oil tempered wire 4.00 mm (0.156 in.) or smaller in diameter shall wrap on itself as an arbor without breakage. Larger diameter wire up to and including 8.00 mm (0.312 in.) shall wrap without breakage on a mandrel twice the wire diameter. The wrap test is not applicable to wire over 8.00 mm (0.312 in.) in diameter or to shaped and flat rolled wires.

7.3.2 The special high tensile chrome silicon vanadium grade of round oil tempered wire 4.00 mm (0.156 in.) or smaller in diameter shall wrap on a mandrel twice the diameter without breakage. Larger diameter wire up to and including 8.00 mm (0.312 in.) shall wrap without breakage on a mandrel three times the wire diameter. The wrap test is not applicable to wire over 8.00 mm (0.312 in.) in diameter or to shaped and flat rolled wires.

7.3.3 *Test Method*—The wrap test shall be made in accordance with Test Methods and Definitions A 370.

8. Metallurgical Requirements

8.1 *Surface Condition*:

8.1.1 The surface of the wire as received shall be free of imperfections such as seams, pits, die marks, scratches, and other surface defects that are deeper than 1 % of the wire