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Standard Specification for Steel Wire, Chromium-Silicon Alloy¹

This standard is issued under the fixed designation A401/A401M; 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 round and shaped chromium-silicon alloy steel spring wire having properties and quality intended for the manufacture of springs resistant to set when used at moderately elevated temperatures. This product is not meant to be used for non-static applications involving moderate fatigue stresses (see Specification A1000) or high cycle fatigue applications (see Specification A877/A877M). ~~This wire shall be provided either in the annealed and cold-drawn or oil-tempered condition as specified by the 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 brackets. The values stated in each system are not exact equivalents; therefore, each system must be used independent of the other. This wire shall be provided either in the annealed and cold-drawn or quench and tempered condition as specified by the 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.

1.2.1 Within the text, the inch-pound units are shown in brackets.

2. Referenced Documents

2.1 ASTM Standards:²

- A370 [Test Methods and Definitions for Mechanical Testing of Steel Products](#)
- 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](#)
- A752 [Specification for General Requirements for Wire Rods and Coarse Round Wire, Alloy Steel](#)
- A877/A877M [Specification for Steel Wire, Chromium-Silicon Alloy Valve Spring Quality](#)
- A1000 [Specification for Steel Wire, Carbon and Alloy Specialty Spring Quality](#)
- E29 [Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications](#)

2.2 ANSI Standard:

- B 32.4 [Preferred Metric Sizes for Round, Square, Rectangle and Hexagon Metal Products](#)

2.3 Federal Standards:

- Fed. Std. No. 123 [Marking for Shipment \(Civil Agencies\)](#)

2.4 Military Standard:

- MIL-STD-163 [Steel Mill Products, Preparation for Shipment and Storage](#)⁴

2.5 AIAG Standard:

- AIAG B-502.00 [Primary Metals Identification Tag Application Standard](#)

3. Ordering Information

3.1 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:

- 3.1.1 Quantity (mass),
- 3.1.2 Name of material (chromium-silicon alloy steel 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.

- 3.1.3 Dimensions (Table 1 and Section 8),
- 3.1.4 Condition (Section 6),
- 3.1.5 Packaging (Section 14),
- 3.1.6 Heat analysis report, if requested (5.2),
- 3.1.7 Certification or test report, or both, if specified (Section 13), and
- 3.1.8 ASTM designation and year of issue.

NOTE 1—A typical ordering description is as follows: 20 000-kg, oil-tempered-quench and tempered chromium-silicon alloy steel wire, size 6.00 mm

TABLE 1 Tensile Requirements^A

SI Units			
Diameter, ^B mm	MPa, min	MPa, max	Reduction of Area, min, %
0.80	2080	2260	C
0.90	2070	2250	C
1.00	2060	2240	C
1.10	2040	2220	C
1.20	2020	2200	C
1.40	2000	2180	C
1.60	1980	2160	C
1.80	1960	2140	C
2.00	1940	2120	C
2.20	1920	2100	C
2.50	1900	2080	45
2.80	1880	2060	45
3.00	1860	2040	45
3.50	1840	2020	40
4.00	1820	2000	40
4.50	1800	1980	40
5.00	1780	1960	40
5.50	1760	1940	40
6.00	1740	1920	40
6.50	1720	1900	40
7.00	1700	1880	40
8.00	1680	1860	40
9.00	1660	1840	40
10.00	1640	1820	40
11.00	1620	1800	35
12.0	1600	1780	35
13.0	1580	1760	30
14.0	1570	1750	30
15.0	1560	1740	30
16.0	1550	1730	30
17.0	1540	1720	30
18.0	1530	1710	30

Inch-Pound Units			
Diameter, in.	ksi, min	ksi, max	Reduction of Area, min, %
0.032	300	325	C
0.041	298	323	C
0.054	292	317	C
0.062	290	315	C
0.080	285	310	C
0.092	280	305	45
0.120	275	300	45
0.135	270	295	40
0.162	265	290	40
0.177	260	285	40
0.192	260	283	40
0.219	255	278	40
0.250	250	275	40
0.312	245	270	40
0.375	240	265	40
0.438	235	260	35
0.500	230	255	35
0.562	228	253	30
0.625	226	251	30
0.687	224	249	30

^ATensile strength values for intermediate diameters may be interpolated.

^BPreferred sizes. For a complete list, refer to ANSI B32.4.

^CThe reduction of area test is not applicable to wire under 2.34 mm [0.092 in.] in diameter.

in 150 kg coils to ASTM A401/A401M dated ____, or for inch-pound units, 40 000-lb oil-tempered quench and tempered chromium-silicon alloy steel spring wire, size 0.250 in. in 350-lb coils to ASTM A401/A401M dated ____.

4. Materials and Manufacture

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

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

5. Chemical Composition

5.1 The steel shall conform to the requirements of Grade 9254 for chemical composition specified in Table 2.

5.2 *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.

5.3 *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 in Table 4 of Specification A752.

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

6. Mechanical Properties

6.1 *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 or tensile strength, if desired, shall be stated in the purchase order.

6.2 ~~*Oil-Quench and Tempered*~~—When purchased in the ~~oil-tempered~~ quench and tempered condition, the tensile strength and minimum percent reduction of area, sizes 2.50 mm {0.105[0.098 in.]} and coarser, of the wire shall conform to the requirements prescribed in Table 1—Tensile strength of shaped and flat rolled wires shall conform to this table based on the conversion to equivalent round dimensions. Percent reduction of area is not applicable to shaped and flat rolled wires.

NOTE 2—Any specimen breaking in the grips shall be discarded and a new specimen tested if the specified mechanical properties are not achieved.

NOTE 3—Equivalent round definition: The cross sectional area of non-round wires converted to the round wire diameter.

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

6.2.2 *Location of Tests*—Test specimens shall be taken from either end of the coil.

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

6.3 *Wrap Test:*

~~6.3.1 Oil-tempered~~ 6.3.1 *Quench and tempered* or cold drawn wire 4.00 mm {0.162[0.157 in.]} and smaller in diameter shall wind on itself as an arbor without breakage. Larger diameter wire up to and including 8.00 mm {0.312[0.315 in.]} in diameter 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[0.315 in.]} in diameter or to shaped and flat rolled wires.

6.3.2 *Number of Tests*—One test specimen shall be taken for each 10 coils, or fraction thereof, in a lot. Each heat in a given lot shall be tested.

6.3.3 *Location of Test*—Test specimens shall be taken from either end of the coil.

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

~~7. Metallurgical Requirements~~ Metallurgical Requirements

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7.1 *Surface Condition:*

~~7.1.1~~ 7.1.1 *On the whole, the surface of the wire as received shall be free of rust and excessive scale. No* Based upon examination of end specimens, no serious die marks, scratches, or other continuous surface imperfections shall be present. Based upon examination of etched-end specimen, seams shall not exceed 3.5 % of the wire diameter, or 0.25 mm [0.010 in.], whichever is the smaller as measured on a transverse section.

TABLE 2 Chemical Requirements

UNS Designation G9254		Grade No. 9254			
Ranges and Limits, %					
Carbon	Manganese	Phosphorus, max	Sulfur, max	Silicon	Chromium
0.51–0.59	0.60–0.80	0.035	0.040	1.20–1.60	0.60–0.80