



Designation: **A401/A401M – 15 A401/A401M – 18**

## Standard Specification for Steel Wire, Chromium-Silicon Alloy<sup>1</sup>

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 ( $\epsilon$ ) 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/A1000M](#)) or high cycle fatigue applications (see Specification [A877/A877M](#)). 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.

1.3 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

### 2. Referenced Documents

2.1 *ASTM Standards:*<sup>2</sup>

[A370 Test Methods and Definitions for Mechanical Testing of Steel Products](#)

[A510/A510M Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel, and Alloy Steel](#)

[A700 Guide 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 Alloys, Chrome-Silicon-Vanadium Alloy Valve Spring Quality](#)

[A941 Terminology Relating to Steel, Stainless Steel, Related Alloys, and Ferroalloys](#)

[A1000/A1000M Specification for Steel Wire, Carbon and Alloy Specialty Spring Quality](#)

[E8/E8M Test Methods for Tension Testing of Metallic Materials](#)

[E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications](#)

### 3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of terms used in this specification, see Terminology [A941](#).

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *equivalent round diameter, n*—diameter of a round wire having equivalent cross sectional area to a given shaped wire.

3.2.2 *round wire, n*—wire having a circular cross section.

3.2.3 *shape factor, n*—this value is used to obtain cross sectional area for shaped wires when multiplied by measured width and thickness.

3.2.4 *shaped wire, n*—wire having a non-circular cross section.

<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.

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

#### 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),
- 4.1.2 Name of material (chromium-silicon alloy steel wire),
- 4.1.3 Dimensions (Table 1 and Section 9),
- 4.1.4 Condition (Section 7), and
- 4.1.5 ASTM designation and year of issue.

4.2 ~~It~~ The purchaser 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: have the option to specify additional requirements, including but not limited to:

- 3.1.1 Quantity (mass);
- 3.1.2 Name of material (chromium-silicon alloy steel wire);
- 4.2.1 Dimensions—Requirements for certifications, heat analysis or test reports (Table 16.2 and Section 814),
- 3.1.4 Condition (Section 6);
- 3.1.5 Packaging (Section 14);
- 3.1.6 Heat analysis report, if requested (5.2);
- 4.2.2 Certification or test report, or both, if specified—Special packing, marking, and loading requirements (Section 1315), and
- 4.2.3 ASTM designation and year of issue. Other special requirements, if any.

NOTE 1—A typical ordering description is as follows: 20 000-kg, quench and tempered chromium-silicon alloy steel wire, size 6.00 mm in 150 kg coils to ASTM A401/A401M dated \_\_\_\_, or for inch-pound units, 40 000-lb quench and tempered chromium-silicon alloy steel spring wire, size 0.250 in. in 350-lb coils to ASTM A401/A401M 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 of Grade 9254 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 chemical composition thus determined, as to elements required or restricted, shall conform to the product analysis requirements in Table 4 of Specification A510/A510M.

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

7.2 *Quench and Tempered*—When purchased in the quench and tempered condition, the tensile strength and minimum percent reduction of area, sizes 2.50 mm [0.098 in.] and coarser, of the wire area 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.

7.2.1 *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.

7.2.2 *Location of Tests*—Test specimens—It shall be taken permissible to take test specimens from either end of the coil.

7.2.3 *Test Method*—The tension test shall be made in accordance with Test Methods and Definitions A370. For shaped wires, cross sectional area shall be calculated either by using the procedure in Test Methods E8/E8M for uniform but nonsymmetrical cross-sections, or by measuring width and thickness and multiplying by a shape factor. Reduction of area for shaped wires shall be calculated by using this shape factor. Measure the maximum and minimum dimension on the necked down section and multiply by the shape factor to estimate the cross sectional area for use in the standard reduction of area calculation.



TABLE 1 Tensile Requirements<sup>A</sup>

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