Designation: A 752M – 04

METRIC

Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Alloy Steel [Metric][1]

This standard is issued under the fixed designation A 752M; 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 general requirements for alloy steel rods and uncoated coarse round alloy wire in coils that are not required to meet hardenability band limits.

1.2 In case of conflict, the requirements in the purchase order, on the drawing, in the individual specification, and in this general specification shall prevail in the sequence named.

NOTE 1—This specification is the metric counterpart of Specification A 752.

2. Referenced Documents

2.1 *ASTM Standards:* [2]

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

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

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

A 919 Terminology Relating to Heat Treatment of Metals

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

E 112 Test Methods for Determining Average Grain Size

2.2 *Military Standard:*

MIL-STD-163 Steel Mill Products, Preparation for Shipment and Storage[3]

2.3 *Federal Standard:*

Fed. Std. No. 123 Marking for Shipment (Civil Agencies)[3]

2.4 *AIAG Standard:*

AIAGB-5 02.00 Primary Metals Identification Tag Application Standard[4]

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *alloy steel*—steel is considered to be alloy steel when the maximum of the range given for the content of alloying elements exceeds one or more of the following limits: manganese 1.65 %, silicon 0.60 %, copper 0.60 %; or in which a definite range or a definite minimum quantity of any of the following elements is specified or required within the limits of the recognized field of constructional alloy steels: chromium up to 3.99 %, cobalt, columbium, molybdenum, nickel, titanium, tungsten, vanadium, zirconium, or any other alloying elements added to obtain a desired alloying effect.

3.1.1.1 Boron treatment of alloy steels, which are fine grain, may be specified to improve hardenability.

3.1.1.2 Other elements, such as lead, selenium, tellurium, or bismuth, may be specified to improve machinability.

3.1.2 *coarse round wire—from 0.90 to 25 mm in diameter, inclusive*, wire produced from hot-rolled wire rods or hot-rolled coiled rounds by one or more cold reductions primarily for the purpose of obtaining a desired size with dimensional accuracy, surface finish, and mechanical properties. By varying the amount of cold reduction and other wire mill practices, including thermal treatment, a wide diversity of mechanical properties and finishes are made available. Suggested wire diameters are shown in Table 1.

3.1.3 *straightened and cut wire*—wire produced from coils of wire by means of special machinery that straightens the wire and cuts it to a specified length.

3.1.3.1 The straightening operation may alter the mechanical properties of the wire, especially the tensile strength. The straightening operation may also induce changes in the diameter of the wire. The extent of the changes in the properties of the wire after cold straightening depends upon the kind of wire

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

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

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

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TABLE 1 Suggested Diameters for Alloy Steel Wire, mm

0.90	6.0
1.00	6.5
1.10	7.0
1.20	7.5
1.30	8.0
1.40	8.5
1.60	9.0
1.80	9.5
2.0	10.0
2.1	11.0
2.2	12.0
2.4	13.0
2.5	14.0
2.6	15.0
2.8	16.0
3.0	17.0
3.2	18.0
3.5	19.0
3.8	20.0
4.0	21.0
4.2	22.0
4.5	23.0
4.8	24.0
5.0	25.0
5.5	. . .

and also on the normal variation in the adjustments of the straightening equipment. It is therefore not possible to forecast the properties of straightened and cutwire. Each kind of wire needs individual consideration. In most cases, the application of straightened and cut wire is not seriously influenced by these changes.

3.1.4 *wire rods*—rods that are hot rolled from billets into an approximate round cross section and into coils of one continuous length. Rods are not comparable to hot-rolled bars in accuracy of cross section or surface finish and as a semi-finished product are primarily for the manufacture of wire.

3.1.4.1 Table 2 shows the nominal diameter for hot-rolled wire rods. Sizes are shown in 0.5-mm increments from 5.5 to 19 mm.

4. Ordering Information

4.1 It shall be the responsibility of the purchaser to specify all requirements that are necessary for hot-rolled wire rods under this specification. Such requirements include, but are not limited to, the following:

4.1.1 Quantity (kilograms),

4.1.2 Name of material (wire rods),

4.1.3 Diameter (Table 1),

4.1.4 Chemical composition grade number (Table 3),

4.1.5 Packaging (Section 14),

4.1.6 Heat analysis report, if requested (Section 6),

4.1.7 Certification or test report, or both, if specified (Section 13),

4.1.8 ASTM designation and date of issue, and

4.1.9 Special requirements, if any.

TABLE 2 Sizes of Alloy Steel Wire Rods, mm

5.5	12.5
6	13
6.5	13.5
7	14
7.5	14.5
8	15
8.5	15.5
9	16
9.5	16.5
10	17
10.5	17.5
11	18
11.5	18.5
12	19

TABLE 3 Alloy Steels—Chemical Composition Ranges and Limits for Heat Analysis

NOTE 1— Grades shown in this table with prefix letter E are normally only made by the basic electric furnace process. All others are normally manufactured by the basic open hearth or basic oxygen processes but may be manufactured by a basic electric furnace process. If the electric furnace process is specified or required for grades other than those designated above, the limits for phosphorus and sulfur are respectively 0.025 % max.

NOTE 2— Small quantities of certain elements, which are not specified or required, are present in alloy steels. These elements are considered as incidental and may be present to the following maximum amounts: copper, 0.35 %, nickel, 0.25 %, chromium, 0.20 %, molybdenum, 0.06 %.

NOTE 3—Where minimum and maximum sulfur content is shown it is indicative of resulfurized steel.

NOTE 4—The chemical ranges and limits shown in Table 4 are produced to product analysis tolerances shown in Table 5.

NOTE 5—Standard alloy steels can be produced with a lead range of 0.15 to 0.35 %. Such steels are identified by inserting the letter "L" between the second and third numerals of the Grade number, for example, 41L40. Lead is reported only as a range of 0.15 to 0.35 % since it is added to the mold as the steel is poured.

UNS Designation	Grade No.	Chemical Composition, Ranges and Limits, %							
		Carbon	Manganese	Phosphorus, max	Sulfur, max	Silicon	Nickel	Chromium	Molybdenum
		STANDARD ALLOY STEELS							
G13300	1330	0.28 to 0.33	1.60 to 1.90	0.035	0.040	0.15 to 0.35	. . .	. . .	. . .
G13350	1335	0.33 to 0.38	1.60 to 1.90	0.035	0.040	0.15 to 0.35	. . .	. . .	. . .
G13400	1340	0.38 to 0.43	1.60 to 1.90	0.035	0.040	0.15 to 0.35	. . .	. . .	. . .
G13450	1345	0.43 to 0.48	1.60 to 1.90	0.035	0.040	0.15 to 0.35	. . .	. . .	. . .
G40120	4012	0.09 to 0.14	0.75 to 1.00	0.035	0.040	0.15 to 0.35	. . .	. . .	0.15 to 0.25
G40230	4023	0.20 to 0.25	0.70 to 0.90	0.035	0.040	0.15 to 0.35	. . .	. . .	0.20 to 0.30
G40240	4024	0.20 to 0.25	0.70 to 0.90	0.035	0.035 to 0.050	0.15 to 0.35	. . .	. . .	0.20 to 0.30
					0.040				0.20 to 0.30
G40270	4027	0.25 to 0.30	0.70 to 0.90	0.035		0.15 to 0.35	. . .	. . .	

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TABLE 2 *Continued*

UNS Designation	Grade No.	Chemical Composition, Ranges and Limits, %							
		Carbon	Manganese	Phosphorus, max	Sulfur, max	Silicon	Nickel	Chromium	Molybdenum
G40280	4028	0.25 to 0.30	0.70 to 0.90	0.035	0.035 to 0.050	0.15 to 0.35	. . .	. . .	0.20 to 0.30
					0.040				0.20 to 0.30
G40370	4037	0.35 to 0.40	0.70 to 0.90	0.035		0.15 to 0.35	. . .	. . .	
G40470	4047	0.45 to 0.50	0.70 to 0.90	0.035	0.040	0.15 to 0.35	. . .	. . .	0.20 to 0.30
G41180	4118	0.18 to 0.23	0.70 to 0.90	0.035	0.040	0.15 to 0.35	. . .	0.40 to 0.60	0.08 to 0.15
G41300	4130	0.28 to 0.33	0.40 to 0.60	0.035	0.040	0.15 to 0.35	. . .	0.80 to 1.10	0.15 to 0.25
G41370	4137	0.35 to 0.40	0.70 to 0.90	0.035	0.040	0.15 to 0.35	. . .	0.80 to 1.10	0.15 to 0.25
G41400	4140	0.38 to 0.43	0.75 to 1.00	0.035	0.040	0.15 to 0.35	. . .	0.80 to 1.10	0.15 to 0.25
G41420	4142	0.40 to 0.45	0.75 to 1.00	0.035	0.040	0.15 to 0.35	. . .	0.80 to 1.10	0.15 to 0.25
G41450	4145	0.43 to 0.48	0.75 to 1.00	0.035	0.040	0.15 to 0.35	. . .	0.80 to 1.10	0.15 to 0.25
G41470	4147	0.45 to 0.50	0.75 to 1.00	0.035	0.040	0.15 to 0.35	. . .	0.80 to 1.10	0.15 to 0.25
G41500	4150	0.48 to 0.53	0.75 to 1.00	0.035	0.040	0.15 to 0.35	. . .	0.80 to 1.10	0.15 to 0.25
G41610	4161	0.56 to 0.64	0.75 to 1.00	0.035	0.040	0.15 to 0.35	. . .	0.70 to 0.90	0.25 to 0.35
G43200	4320	0.17 to 0.22	0.45 to 0.65	0.035	0.040	0.15 to 0.35	1.65 to 2.00	0.40 to 0.60	0.20 to 0.30
G43400	4340	0.38 to 0.43	0.60 to 0.80	0.035	0.040	0.15 to 0.35	1.65 to 2.00	0.70 to 0.90	0.20 to 0.30
G43406	E4340	0.38 to 0.43	0.65 to 0.85	0.025	0.025	0.15 to 0.35	1.65 to 2.00	0.70 to 0.90	0.20 to 0.30
G44190	4419	0.18 to 0.33	0.45 to 0.65	0.035	0.040	0.15 to 0.35	. . .	. . .	0.45 to 0.60
		STANDARD ALLOY STEELS							
G46150	4615	0.13 to 0.18	0.45 to 0.65	0.035	0.040	0.15 to 0.35	1.65 to 2.00	. . .	0.20 to 0.30
G46200	4620	0.17 to 0.22	0.45 to 0.65	0.035	0.040	0.15 to 0.35	1.65 to 2.00	. . .	0.20 to 0.30
G46210	4621	0.18 to 0.23	0.70 to 0.90	0.035	0.040	0.15 to 0.35	1.65 to 2.00	. . .	0.20 to 0.30
G46260	4626	0.24 to 0.29	0.45 to 0.65	0.035	0.040	0.15 to 0.35	0.70 to 1.00	. . .	0.15 to 0.25
G47180	4718	0.16 to 0.21	0.70 to 0.90	0.035	0.040	0.15 to 0.35	0.90 to 1.20	0.35 to 0.55	0.30 to 0.40
G47200	4720	0.17 to 0.22	0.50 to 0.70	0.035	0.040	0.15 to 0.35	0.90 to 1.20	0.35 to 0.55	0.15 to 0.25
G48150	4815	0.13 to 0.18	0.40 to 0.60	0.035	0.040	0.15 to 0.35	3.25 to 3.75	. . .	0.20 to 0.30
G48170	4817	0.15 to 0.20	0.40 to 0.60	0.035	0.040	0.15 to 0.35	3.25 to 3.75	. . .	0.20 to 0.30
G48200	4820	0.18 to 0.23	0.50 to 0.70	0.035	0.040	0.15 to 0.35	3.25 to 3.75	. . .	0.20 to 0.30
G50150	5015	0.12 to 0.17	0.30 to 0.50	0.035	0.040	0.15 to 0.35	. . .	0.30 to 0.50	. . .
G51200	5120	0.17 to 0.22	0.70 to 0.90	0.035	0.040	0.15 to 0.35	. . .	0.70 to 0.90	. . .
G51300	5130	0.28 to 0.33	0.70 to 0.90	0.035	0.040	0.15 to 0.35	. . .	0.80 to 1.10	. . .
G51320	5132	0.30 to 0.35	0.60 to 0.80	0.035	0.040	0.15 to 0.35	. . .	0.75 to 1.00	. . .
G51350	5135	0.33 to 0.38	0.60 to 0.80	0.035	0.040	0.15 to 0.35	. . .	0.80 to 1.05	. . .
G51400	5140	0.38 to 0.43	0.70 to 0.90	0.035	0.040	0.15 to 0.35	. . .	0.70 to 0.90	. . .
G51450	5145	0.43 to 0.48	0.70 to 0.90	0.035	0.040	0.15 to 0.35	. . .	0.70 to 0.90	. . .
G51470	5147	0.46 to 0.51	0.70 to 0.95	0.035	0.040	0.15 to 0.35	. . .	0.85 to 1.15	. . .
G51500	5150	0.48 to 0.53	0.70 to 0.90	0.035	0.040	0.15 to 0.35	. . .	0.70 to 0.90	. . .
G51550	5155	0.51 to 0.59	0.70 to 0.90	0.035	0.040	0.15 to 0.35	. . .	0.70 to 0.90	. . .
G51600	5160	0.56 to 0.64	0.75 to 1.00	0.035	0.040	0.15 to 0.35	. . .	0.70 to 0.90	. . .
. . .	E51100	0.98 to 1.10	0.25 to 0.45	0.025	0.025	0.15 to 0.35	. . .	0.90 to 1.15	. . .
. . .	E52100	0.98 to 1.10	0.25 to 0.45	0.025	0.025	0.15 to 0.35	. . .	1.30 to 1.60	. . .
									Vanadium
G61180	6118	0.16 to 0.21	0.50 to 0.70	0.035	0.040	0.15 to 0.35	. . .	0.50 to 0.70	0.10 to 0.15
G61500	6150	0.48 to 0.53	0.70 to 0.90	0.035	0.040	0.15 to 0.35	. . .	0.80 to 1.10	0.15 min
									Molybdenum
G86150	8615	0.13 to 0.18	0.70 to 0.90	0.035	0.040	0.15 to 0.35	0.040 to 0.70	0.040 to 0.60	0.15 to 0.25
G86170	8617	0.15 to 0.20	0.70 to 0.90	0.035	0.040	0.15 to 0.35	0.040 to 0.70	0.040 to 0.60	0.15 to 0.25
G86200	8620	0.18 to 0.23	0.70 to 0.90	0.035	0.040	0.15 to 0.35	0.040 to 0.70	0.040 to 0.60	0.15 to 0.25
G86220	8622	0.20 to 0.25	0.70 to 0.90	0.035	0.040	0.15 to 0.35	0.040 to 0.70	0.040 to 0.60	0.15 to 0.25
G86250	8625	0.23 to 0.28	0.70 to 0.90	0.035	0.040	0.15 to 0.35	0.040 to 0.70	0.040 to 0.60	0.15 to 0.25
G86270	8627	0.25 to 0.30	0.70 to 0.90	0.035	0.040	0.15 to 0.35	0.040 to 0.70	0.040 to 0.60	0.15 to 0.25
G86300	8630	0.28 to 0.33	0.70 to 0.90	0.035	0.040	0.15 to 0.35	0.040 to 0.70	0.040 to 0.60	0.15 to 0.25
		STANDARD ALLOY STEELS							
G86370	8637	0.35 to 0.40	0.75 to 1.00	0.035	0.040	0.15 to 0.35	0.40 to 0.70	0.40 to 0.60	0.15 to 0.25
G86400	8640	0.38 to 0.43	0.75 to 1.00	0.035	0.040	0.15 to 0.35	0.40 to 0.70	0.40 to 0.60	0.15 to 0.25
G86420	8642	0.40 to 0.45	0.75 to 1.00	0.035	0.040	0.15 to 0.35	0.40 to 0.70	0.40 to 0.60	0.15 to 0.25
G86450	8645	0.43 to 0.48	0.75 to 1.00	0.035	0.040	0.15 to 0.35	0.40 to 0.70	0.40 to 0.60	0.15 to 0.25
G86550	8655	0.51 to 0.59	0.75 to 1.00	0.035	0.040	0.15 to 0.35	0.40 to 0.70	0.40 to 0.60	0.15 to 0.25
G87200	8720	0.18 to 0.23	0.70 to 0.90	0.035	0.040	0.15 to 0.35	0.40 to 0.70	0.40 to 0.60	0.20 to 0.30
G87400	8740	0.38 to 0.43	0.75 to 1.00	0.035	0.040	0.15 to 0.35	0.40 to 0.70	0.40 to 0.60	0.20 to 0.30
G88220	8822	0.20 to 0.25	0.75 to 1.00	0.035	0.040	0.15 to 0.35	0.40 to 0.70	0.40 to 0.60	0.30 to 0.40
G92540	9254	0.51 to 0.59	0.60 to 0.80	0.035	0.040	1.20 to 1.60	. . .	0.60 to 0.80	. . .
G92550	9255	0.51 to 0.59	0.70 to 0.95	0.035	0.040	1.80 to 2.20	. . .	. . .	. . .
G92600	9260	0.56 to 0.64	0.75 to 1.00	0.035	0.040	1.80 to 2.20	. . .	. . .	. . .
		STANDARD BORON ALLOY STEELS[A]							
G50441	50B44	0.43 to 0.48	0.75 to 1.00	0.035	0.040	0.15 to 0.35	. . .	0.40 to 0.60	. . .
G50461	50B46	0.44 to 0.49	0.75 to 1.00	0.035	0.040	0.15 to 0.35	. . .	0.20 to 0.35	. . .

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TABLE 2 *Continued*

UNS Designation	Grade No.	Chemical Composition, Ranges and Limits, %							
		Carbon	Manganese	Phosphorus, max	Sulfur, max	Silicon	Nickel	Chromium	Molybdenum
G50501	50B50	0.48 to 0.53	0.75 to 1.00	0.035	0.040	0.15 to 0.35	. . .	0.40 to 0.60	. . .
G50601	50B60	0.56 to 0.64	0.75 to 1.00	0.035	0.040	0.15 to 0.35	. . .	0.40 to 0.60	. . .
G51601	51B60	0.56 to 0.64	0.75 to 1.00	0.035	0.040	0.15 to 0.35	. . .	0.70 to 0.90	. . .
G81451	81B45	0.43 to 0.48	0.75 to 1.00	0.035	0.040	0.15 to 0.35	0.20 to 0.40	0.35 to 0.55	0.08 to 0.15
G94171	94B17	0.15 to 0.20	0.75 to 1.00	0.035	0.040	0.15 to 0.35	0.30 to 0.60	0.30 to 0.50	0.08 to 0.15
G94301	94B30	0.28 to 0.33	0.75 to 1.00	0.035	0.040	0.15 to 0.35	0.30 to 0.60	0.30 to 0.50	0.08 to 0.15

[A] These steels can be expected to a minimum boron content of 0.0005 %.

NOTE 2—A typical ordering description is as follows: 50 000 kg Steel Wire Rods, 5.5 mm, Grade G 41400 W approximately 600 kg coils to ASTM A 752M dated-XX.

4.2 It shall be the responsibility of the purchaser to specify all requirements that are necessary for coarse round wire under this specification. Such requirements include, but are not limited to, the following:

4.2.1 Quantity (kilograms),

4.2.2 Name of material (alloy steel wire),

4.2.3 Diameter (Table 2),

4.2.4 Length (straightened and cut only),

4.2.5 Chemical composition (Table 3),

4.2.6 Packaging (Section 14),

4.2.7 Heat analysis report, if requested (Section 6),

4.2.8 Certification or test report, or both, if specified (Section 13),

4.2.9 ASTM designation and date of issue, and

4.2.10 Special requirements, if any.

NOTE 3—A typical ordering description is as follows: 15 000 kg Alloy Steel Wire, 3.8 mm diameter, Grade 4135 in 1000-kg Coils on Tubular Carriers, to ASTM A 752M-XX, or 2500 Pieces, Alloy Steel Wire, 9.5 mm diameter, Straightened and Cut, 0.76 m, Grade G 41400 in 25-Piece Bundles on Pallets to ASTM A 752M-XX.

5. Manufacture

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

6. Chemical Composition

6.1 The chemical composition for alloy steel under this specification shall conform to the requirements set forth in the purchase order. The grades commonly specified for alloy steel wire rods and alloy steel wire are shown in Table 3. For specified compositions not contained in Table 3 the ranges and limits expressed in Table 4 shall apply unless other such ranges and limits shall have been agreed upon between the purchaser and the manufacturer.

TABLE 4 Alloy Steels—Chemical Composition Ranges and Limits for Cast or Heat Analysis

NOTE 1— Boron steels can be expected to have a 0.0005 % minimum boron content.

NOTE 2—Alloy steels can be produced with a lead range of 0.15 to 0.35 %. Lead is reported only as a range of 0.15 to 0.35 % since it is added to the mold as the steel is poured.

NOTE 3—The chemical ranges and limits of alloy steels are produced to the check, product, or verification analysis tolerances shown in Table 5.

Element	When Maximum of Specified Element is, %	Range, %		Maximum Limit, %[A]
		Open-Hearth or Basic Oxygen Steel	Electric Furnace Steel	
Carbon	To 0.55, incl	0.05	0.05	
	Over 0.55 to 0.70, incl	0.08	0.07	
	Over 0.70 to 0.80, incl	0.10	0.09	
	Over 0.80 to 0.95, incl	0.12	0.11	
	Over 0.95 to 1.35, incl	0.13	0.12	
Manganese	To 0.60, incl	0.20	0.15	
	Over 0.60 to 0.90, incl	0.20	0.20	
	Over 0.90 to 1.05, incl	0.25	0.25	
	Over 1.05 to 1.90, incl	0.30	0.30	
	Over 1.90 to 2.10, incl	0.40	0.35	
Phosphorus	Basic open-hearth or basic oxygen steel			0.035
	Basic electric furnace steel			0.025
Sulfur	To 0.050, incl	0.015	0.015	
	Over 0.050 to 0.07, incl	0.02	0.02	
	Over 0.07 to 0.10, incl	0.04	0.04	
	Over 0.10 to 0.14, incl	0.05	0.05	
	Basic open hearth or basic oxygen steel			0.040
	Basic electric furnace			0.025
Silicon	To 0.15, incl	0.08	0.08	
	Over 0.15 to 0.20, incl	0.10	0.10	
	Over 0.20 to 0.40, incl	0.15	0.15	

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TABLE 4 *Continued*

Element	When Maximum of Specified Element is, %	Range, %		Maximum Limit, %[A]
		Open-Hearth or Basic Oxygen Steel	Electric Furnace Steel	
	Over 0.40 to 0.60, incl	0.20	0.20	
	Over 0.60 to 1.00, incl	0.30	0.30	
	Over 1.00 to 2.20, incl	0.40	0.35	
Nickel	To 0.50, incl	0.20	0.20	
	Over 0.50 to 1.50, incl	0.30	0.30	
	Over 1.50 to 2.00, incl	0.35	0.35	
	Over 2.00 to 3.00, incl	0.40	0.40	
	Over 3.00 to 5.30, incl	0.50	0.50	
	Over 5.30 to 10.00, incl	1.00	1.00	
Chromium	To 0.40, incl	0.15	0.15	
	Over 0.40 to 0.90, incl	0.20	0.20	
	Over 0.90 to 1.05, incl	0.25	0.25	
	Over 1.05 to 1.60, incl	0.30	0.30	
	Over 1.60 to 1.75, incl	[B]	0.35	
	Over 1.75 to 2.10, incl	[B]	0.40	
	Over 2.10 to 3.99, incl	[B]	0.50	
Molybdenum	To 0.10, incl	0.05	0.05	
	Over 0.10 to 0.20, incl	0.07	0.07	
	Over 0.20 to 0.50, incl	0.10	0.10	
	Over 0.50 to 0.80, incl	0.15	0.15	
	Over 0.80 to 1.15, incl	0.20	0.20	
Tungsten	To 0.50, incl	0.20	0.20	
	Over 0.50 to 1.00, incl	0.30	0.30	
	Over 1.00 to 2.00, incl	0.50	0.50	
	Over 2.00 to 4.00, incl	0.60	0.60	
Vanadium	To 0.25, incl	0.05	0.05	
	Over 0.25 to 0.50, incl	0.10	0.10	
Aluminum	Up to 0.10, incl	0.05	0.05	
	Over 0.10 to 0.20, incl	0.10	0.10	
	Over 0.20 to 0.30, incl	0.15	0.15	
	Over 0.30 to 0.80, incl	0.25	0.25	
	Over 0.80 to 1.30, incl	0.35	0.35	
	Over 1.30 to 1.80, incl	0.45	0.45	
Copper	To 0.60, incl	0.20	0.20	
	Over 0.60 to 1.50, incl	0.30	0.30	
	Over 1.50 to 2.00, incl	0.35	0.35	

[A] Applies to only nonrephosphorized and nonresulfurized steels.

[B] Not normally produced in open hearth.

6.2 *Heat Analysis*—An analysis of each heat shall be made by the producer to determine the percentage of the elements specified. The analysis shall be made from a test sample preferably taken during the pouring of the heat. The chemical composition thus determined shall be reported, if required, to the purchaser or his representative.

6.3 *Product Analysis*—A product analysis may be made by the purchaser. The analysis is not used for a duplicate analysis to confirm a previous result. The purpose of the product analysis is to verify that the chemical composition is within specified limits for each element, including applicable permissible variations in product analysis. The results of analyses taken from different pieces of a heat may differ within permissible limits from each other and from the heat analysis. Table 5 shows the permissible variations for product analysis of alloy steel. The results of the product analysis, except lead, shall not vary both above and below the specified ranges.

TABLE 5 Alloy Steels—Product or Verification Analysis Tolerances

Element	Limit or Maximum of Specified Range, %	Tolerance Over Maximum Limit or Under Minimum Limit, %
Carbon	To 0.30, incl	0.01
	Over 0.30 to 0.75, incl	0.02
	Over 0.75	0.03
Manganese	To 0.90, incl	0.03
	Over 0.90 to 2.10, incl	0.04
Phosphorus	Over max only	0.005
Sulfur	To 0.060, incl[A]	0.005
Silicon	To 0.40, incl	0.02
	Over 0.40 to 2.20, incl	0.05
Nickel	To 1.00, incl	0.03
	Over 1.00 to 2.00, incl	0.05

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TABLE 5 *Continued*

Element	Limit or Maximum of Specified Range, %	Tolerance Over Maximum Limit or Under Minimum Limit, %
	Over 2.00 to 5.30, incl	0.07
	Over 5.30 to 10.00, incl	0.10
Chromium	To 0.90, incl	0.03
	Over 0.90 to 2.10, incl	0.05
	Over 2.10 to 3.99, incl	0.10
Molybdenum	To 0.20, incl	0.01
	Over 0.20 to 0.40, incl	0.02
	Over 0.40 to 1.15, incl	0.03
Vanadium	To 0.10, incl	0.01
	Over 0.10 to 0.25, incl	0.02
	Over 0.25 to 0.50, incl	0.03
	Min value specified, check under min limit	0.01
Tungsten	To 1.00, incl	0.04
	Over 1.00 to 4.00, incl	0.08
Aluminum	Up to 0.10, incl	0.03
	Over 0.10 to 0.20, incl	0.04
	Over 0.20 to 0.30, incl	0.05
	Over 0.30 to 0.80, incl	0.07
	Over 0.80 to 1.80, incl	0.10
Lead	0.15 to 0.35, incl	0.03[B]
Copper	To 1.00, incl	0.03
	Over 1.00 to 2.00, incl	0.05

[A] Sulfur over 0.060 % is not subject to product analysis.
[B] Tolerance is over *and* under.

6.3.1 The location from which chips for product analysis are obtained is important because of normal segregation. For rods and wire, chips must be taken by milling or machining the full cross section of the sample.

6.3.1.1 Steel subjected to certain thermal treatments by the purchaser may not give chemical analysis results that properly represent its original composition. Therefore, purchasers should analyze chips taken from the steel in the condition in which it is received from the producer.

6.3.1.2 When samples are returned to the producer for product analysis, the samples should consist of pieces of the full cross section.

6.3.2 For referee purposes, Test Methods, Practices and Terminology A 751 shall be used.

7. Metallurgical Structure

7.1 Grain size when specified shall be determined in accordance with the requirements of Test Methods E 112.

7.2 Alloy steel wire rods may be specified as annealed, spheroidize annealed, or patented. Refer to Terminology A 919 for definitions.

7.3 Alloy steel wire may be specified as drawn from annealed or spheroidize annealed wire, rod, or bars, spheroidize annealed at finish size, patented, or oil tempered. Refer to Terminology A 919 for definitions.

8. Mechanical Properties

8.1 The properties enumerated in individual specifications shall be determined in accordance with Test Methods and Definitions A 370.

8.2 The maximum expected tensile strengths for the more common grades of alloy rods with regular mill annealing (nonspheroidized) are shown in Table 6.

TABLE 6 Maximum Expected Tensile Strengths for Annealed Alloy Steel Rods

NOTE 1—Specific microstructures such as spheroidize anneal or lamellar pearlite anneal may require modification of these tensile strength values.

UNS Designation	Grade no.	Tensile Strength, MPa	UNS Designation	Grade No.	Tensile Strength, MPa
G13300	1330	610	G50601	50B60	710
G13350	1335	620	G51200	5120	570
G13400	1340	630	G51300	5130	580
G13450	1345	670	G51320	5132	580
G40120	4012	490	G51350	5135	590
G40230	4023	500	G51400	5140	620
G40240	4024	500	G51450	5145	650
G40270	4027	570	G51470	5147	680
G40280	4028	570	G51500	5150	670
G40370	4037	610	G51550	5155	710
G40470	4047	670	G51600	5160	720
G41180	4118	570	G51601	51B60	750

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TABLE 6 *Continued*

UNS Designation	Grade no.	Tensile Strength, MPa	UNS Designation	Grade No.	Tensile Strength, MPa
G41300	4130	590	G61180	6118	550
G41370	4137	630	G61500	6150	670
G41400	4140	650	G81451	81B45	630
G41420	4142	670	G86150	8615	550
G41450	4145	680	G86170	8617	550
G41470	4147	690	G86200	8620	570
G41500	4150	690	G86220	8622	580
G41610	4161	770	G86250	8625	580
G43200	4320	650	G86270	8627	580
G43400	4340	720	G86300	8630	610
G44190	4419	570	G86370	8637	630
G46150	4615	550	G86400	8640	650
G46200	4620	570	G86420	8642	670
G46210	4621	570	G86450	8645	680
G46260	4626	580	G86550	8655	720
G47180	4718	580	G87200	8720	570
G47200	4720	570	G87400	8740	670
G48150	4815	630	G88220	8822	610
G48170	4817	650	G92540	9254	770
G48200	4820	650	G92550	9255	770
G50150	5015	500	G92600	9260	770
G50441	50B44	650	G94171	94B17	500
G50461	50B46	630	G94301	94B30	580
G50501	50B50	670			

8.3 Because of the great variety in the kinds and grades of rods and wire and the extensive diversity of application, a number of formal mechanical test procedures have been developed. These tests are used as control tests by producers during intermediate stages of wire processing, as well as for final testing of the finished product, and apply particularly to rods and wire for specific applications. A number of these tests are further described in Supplement IV, Round Wire Products, of Test Methods and Definitions A 370.

8.4 Since the general utility of rods and wire require continuity of length, in the case of rods, tests are commonly made on samples taken from the ends of coils after removing two to three rings; in the case of wire, tests are commonly taken from the ends of the coils, thereby not impairing the usefulness of the whole coil.

9. Dimensions and Permissible Variation

9.1 The diameter and out-of-roundness of the alloy wire rod shall not vary from that specified by more than that prescribed in Table 7.

9.2 The diameter and out-of-roundness of the alloy coarse round wire shall not vary from that specified by more than that prescribed in Table 8.

TABLE 7 Permissible Variation in Diameter for Alloy Steel Wire Rod in Coils

NOTE 1— For purposes of determining conformance with this specification, all specified limits in this table are absolute limits as defined in Practice E 29.

Diameter of Rod, mm	Permissible Variation, Plus and Minus, mm	Permissible Out-of-Round, mm
3.5 to 19	0.40	0.60

TABLE 8 Permissible Variation in Diameter for Alloy Steel Coarse Round Wire

NOTE 1—For purposes of determining conformance with this specification, all specified limits in this table are absolute limits as defined in Practice E 29.

Diameter of Wire, mm	Permissible Variation, Plus and Minus, mm	Permissible Out-of-Round, mm
In Coils		
0.90 to under 1.90	0.03	0.03
1.90 to under 12.5	0.05	0.05
12.5 and over	0.08	0.08
Straightened and Cut		
0.90 to under 1.90	0.03	0.03
1.90 to under 3.80	0.05	0.05
3.80 to under 12.5	0.08	0.08

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TABLE 8 *Continued*

In Coils		
Diameter of Wire, mm	Permissible Variation, Plus and Minus, mm	Permissible Out-of-Round, mm
12.5 and over	0.10	0.10

9.3 The length of straightened and cut wire shall not vary from that specified by more than that prescribed in Table 9.

TABLE 9 Permissible Variation in Length for Straightened and Cut Alloy Steel Wire

NOTE 1—For purposes of determining conformance with this specification, all specified limits in this table are absolute limits as defined in Practice E 29.

Cut Length, m	Permissible Variations, Plus and Minus, mm
Under 1.0	1.6
1.0 to 4.0	2.4
Over 4.0	3.0

9.4 The burrs formed in cutting straightened and cut wire shall not exceed the diameter specified by more than that prescribed in Table 10.

TABLE 10 Permissible Variation for Burrs for Straightened and Cut Alloy Steel Wire

NOTE 1— For purposes of determining conformance with this specification, all specified limits in this table are absolute limits as defined in Practice E 29.

Diameter of Wire, mm	Permissible Variations, over Measured Diameter, mm
Up to 3.0, incl	0.10
Over 3.0 to 6.5, incl	0.15
Over 6.5 to 12.5, incl	0.20
Over 12.5	0.25

10. Workmanship, Finish, and Appearance

10.1 The alloy wire rod shall be free from detrimental surface imperfections, tangles, and sharp kinks.

10.1.1 Two or more rod coils may be welded together to produce a larger coil. The weld zone may not be as sound as the original material. The mechanical properties existing in the weld zone may differ from those in the unaffected base metal. The weld may exceed the permissible variations for diameter and out-of-roundness on the minus side of the permissible variation but not on the plus side.

10.2 The wire as received shall be smooth and substantially free from rust, shall not be kinked or improperly cast. No detrimental die marks or scratches may be present. Each coil shall be one continuous length of wire. Welds made during cold drawing are permitted.

10.3 The straightened and cut wire shall be substantially straight and not be kinked or show excessive spiral marking.

11. Inspection

11.1 The manufacturer shall afford the purchaser's inspector all reasonable facilities necessary to satisfy him that the material is being produced and furnished in accordance with this specification. Mill inspection by the purchaser shall not interfere unnecessarily with the manufacturer's operations. All tests and inspections shall be made at the place of manufacture, unless otherwise agreed to.

12. Rejection

12.1 Any rejection based on tests made in accordance with this specification shall be reported to the manufacturer within a reasonable length of time. The material must be adequately protected and correctly identified in order that the manufacturer may make a proper investigation.

13. Certification

13.1 Upon request of the purchaser in the contract or order, a manufacturer's certification that the material was manufactured and tested in accordance with this specification, together with a report of the test results, shall be furnished at the time of shipment.

13.2 The certification shall include the specification number, year date of issue, and revision letter, if any.

14. Packaging, Marking, and Loading for Shipment

14.1 The coil mass, dimensions, and the method of packaging shall be agreed upon between the manufacturer and purchaser.

14.2 The size of the wire, purchaser's order number, ASTM specification number, heat number, and name or mark of the manufacturer shall be marked on a tag securely attached to each coil of wire.

14.3 Unless otherwise specified in the purchaser's order, packaging, marking, and loading for shipments shall be in accordance with those procedures recommended by Practice A 700.

14.4 *For Government Procurement*—Packaging, packing, and marking of material for military procurement shall be in accordance with the requirements of MIL-STD-163, Level A, Level C, or commercial as specified in the contract or purchase order. Marking for shipment of material for civil agencies shall be in accordance with Fed. Std. No. 123.

14.5 *Bar Coding*—In addition to the previously-stated identification requirements, bar coding is acceptable as a supplementary identification method. Bar coding should be consistent with AIAG Standard 02.00, Primary Metals Identification Tag Application. The bar code may be applied to a substantially affixed tag.

15. Keywords

15.1 alloy; general; rods; wire

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SUMMARY OF CHANGES

Committee A01 has identified the location of selected changes to this standard since the last issue, A 752M–93 (2003), that may impact the use of this standard. (Approved March 1, 2004.)

(*1*) Revised Sections 4.1 and 4.2 to eliminate non-mandatory language.

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