Designation: A 752 – 04

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

This standard is issued under the fixed designation A 752; 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.

1.3 The values stated in inch-pound units are to be regarded as the standard.

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 919 Terminology Relating to Heat Treatment of Metals[3]

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

E 30 Test Methods for Chemical Analysis of Steel, Cast Iron, Open-Hearth Iron, and Wrought Iron[3]

E 112 Test Methods for Determining Average Grain Size

2.2 *AIAG Standard:*

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

3. Terminology

3.1 *Description 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: aluminum, 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. Note that aluminum, columbium, and vanadium may also be used for grain refinement purposes.

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 0.035 to 0.999 in. (0.89 to 25.4 mm) in diameter, inclusive*, wire produced from hot-rolled wire rods or hot-rolled coiled bars 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.

3.1.2.1 Coarse round wire is designated by common fractions or decimal parts of an inch, or millimetres.

3.1.3 *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.

3.1.3.1 Rod sizes from 7⁄32 to 47⁄64 in. (5.6 to 18.7 mm) in diameter, inclusive, are designated by fractions or decimal parts of an inch as shown in Table 1.

[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] Withdrawn.

[4] Available from Automotive Industry Action Group (AIAG), 26200 Lahser Rd., Suite 200, Southfield, MI 48034.

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

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TABLE 1 Sizes of Alloy Steel Wire Rods

Inch Fraction	Decimal Equivalent, in.	Metric Equivalent, mm	Inch Fraction	Decimal Equivalent, in.	Metric Equivalent, mm
7/32	0.219	5.6	31/64	0.484	12.3
15/64	0.234	6.0	1/2	0.500	12.7
1/4	0.250	6.4	33/64	0.516	13.1
17/64	0.266	6.7	17/32	0.531	13.5
9/32	0.281	7.1	35/64	0.547	13.9
19/64	0.297	7.5	9/16	0.562	14.3
5/16	0.312	7.9	37/64	0.578	14.7
21/64	0.328	8.3	19/32	0.594	15.1
11/32	0.344	8.7	39/64	0.609	15.5
23/64	0.359	9.1	5/8	0.625	15.9
3/8	0.375	9.5	41/64	0.641	16.3
25/64	0.391	9.9	21/32	0.656	16.7
13/32	0.406	10.3	43/64	0.672	17.1
27/64	0.422	10.7	11/16	0.688	17.5
7/16	0.438	11.1	45/64	0.703	17.9
29/64	0.453	11.5	23/32	0.719	18.3
15/32	0.469	11.9	47/64	0.734	18.7

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 (pounds),

4.1.2 Name of material (wire rods),

4.1.3 Diameter (Table 1),

4.1.4 Chemical composition grade number (Table 2),

4.1.5 Thermal treatment, if required,

4.1.6 Packaging, and

4.1.7 ASTM designation and date of issue.

NOTE 1—A typical ordering description is as follows: 80 000 lb Hot-Rolled Alloy Steel Wire Rods, ¼ in., Grade 4135 in 2 000-lb maximum coils to ASTM A 752-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 (pounds),

4.2.2 Name of material (alloy steel wire),

4.2.3 Diameter (see 3.1.3.1),

4.2.4 Chemical composition (Table 2 or Table 3),

4.2.5 Thermal treatment, if required,

4.2.6 Packaging,

4.2.7 ASTM designation A 752 and date of issue, and

4.2.8 Special requirements, if any.

NOTE 2—A typical ordering description is as follows: 40 000 lb, Alloy Steel Wire, 0.312 in. diameter, Grade 8620, annealed at finish size, in 500-lb Catch Weight Coils on Tubular Carriers to ASTM A 752-XX.

TABLE 2 Chemical Composition Ranges and Limits for Cast or 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 2 are produced to check, product, or verification analysis tolerances shown in Table 4.

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 0.30	. . .	. . .	. . .
G13350	1335	0.33 to 0.38	1.60 to 1.90	0.035	0.040	0.15 to 0.30	. . .	. . .	. . .
G13400	1340	0.38 to 0.43	1.60 to 1.90	0.035	0.040	0.15 to 0.30	. . .	. . .	. . .
G13450	1345	0.43 to 0.48	1.60 to 1.90	0.035	0.040	0.15 to 0.30	. . .	. . .	. . .
G40120	4012	0.09 to 0.14	0.75 to 1.00	0.035	0.040	0.15 to 0.30	. . .	. . .	0.15 to 0.25
G40230	4023	0.20 to 0.25	0.70 to 0.90	0.035	0.040	0.15 to 0.30	. . .	. . .	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 0.30	. . .	. . .	0.20 to 0.30

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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
G40270	4027	0.25 to 0.30	0.70 to 0.90	0.035	0.040	0.15 to 0.30	. . .	. . .	0.20 to 0.30
G40280	4028	0.25 to 0.30	0.70 to 0.90	0.035	0.035 to 0.050	0.15 to 0.30	. . .	. . .	0.20 to 0.30
G40370	4037	0.35 to 0.40	0.70 to 0.90	0.035	0.040	0.15 to 0.30	. . .	. . .	0.20 to 0.30
G40470	4047	0.45 to 0.50	0.70 to 0.90	0.035	0.040	0.15 to 0.30	. . .	. . .	0.20 to 0.30
G41180	4118	0.18 to 0.23	0.70 to 0.90	0.035	0.040	0.15 to 0.30	. . .	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 0.30	. . .	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 0.30	. . .	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 0.30	. . .	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 0.30	. . .	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 0.30	. . .	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 0.30	. . .	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 0.30	. . .	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 0.30	. . .	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 0.30	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 0.30	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 0.30	1.65 to 2.00	0.70 to 0.90	0.20 to 0.30
G44190	4419	0.18 to 0.23	0.45 to 0.65	0.035	0.040	0.15 to 0.30	. . .	. . .	0.45 to 0.60
G46150	4615	0.13 to 0.18	0.45 to 0.65	0.035	0.040	0.15 to 0.30	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 0.30	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 0.30	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 0.30	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 0.30	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 0.30	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 0.30	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 0.30	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 0.30	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 0.30	. . .	0.30 to 0.50	. . .
G51200	5120	0.17 to 0.22	0.70 to 0.90	0.035	0.040	0.15 to 0.30	. . .	0.70 to 0.90	. . .
G51300	5130	0.28 to 0.33	0.70 to 0.90	0.035	0.040	0.15 to 0.30	. . .	0.80 to 1.10	. . .
G51320	5132	0.30 to 0.35	0.60 to 0.80	0.035	0.040	0.15 to 0.30	. . .	0.75 to 1.00	. . .
G51350	5135	0.33 to 0.38	0.60 to 0.80	0.035	0.040	0.15 to 0.30	. . .	0.80 to 1.05	. . .
G51400	5140	0.38 to 0.43	0.70 to 0.90	0.035	0.040	0.15 to 0.30	. . .	0.70 to 0.90	. . .
G51450	5145	0.43 to 0.48	0.70 to 0.90	0.035	0.040	0.15 to 0.30	. . .	0.70 to 0.90	. . .
G51470	5147	0.46 to 0.51	0.70 to 0.95	0.035	0.040	0.15 to 0.30	. . .	0.85 to 1.15	. . .
G51500	5150	0.48 to 0.53	0.70 to 0.90	0.035	0.040	0.15 to 0.30	. . .	0.70 to 0.90	. . .
G51550	5155	0.51 to 0.59	0.70 to 0.90	0.035	0.040	0.15 to 0.30	. . .	0.70 to 0.90	. . .
G51600	5160	0.56 to 0.64	0.75 to 1.00	0.035	0.040	0.15 to 0.30	. . .	0.70 to 0.90	. . .
. . .	E51100	0.98 to 1.10	0.25 to 0.45	0.025	0.025	0.15 to 0.30	. . .	0.90 to 1.15	. . .
. . .	E52100	0.98 to 1.10	0.25 to 0.45	0.025	0.025	0.15 to 0.30	. . .	1.30 to 1.60	. . .

UNS Designation	Grade No.	Chemical Composition, Ranges and Limits, %							
		Carbon	Manganese	Phosphorus, max	Sulfur, max	Silicon	Nickel	Chromium	Other Elements
									Vanadium
G61180	6118	0.16 to 0.21	0.50 to 0.70	0.035	0.040	0.15 to 0.30	. . .	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 0.30	. . .	0.80 to 1.10	0.15 min
									Molybdenum
STANDARD ALLOY STEELS									
G86150	8615	0.13 to 0.18	0.70 to 0.90	0.035	0.040	0.15 to 0.30	0.40 to 0.70	0.40 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 0.30	0.40 to 0.70	0.40 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 0.30	0.40 to 0.70	0.40 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 0.30	0.40 to 0.70	0.40 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 0.30	0.40 to 0.70	0.40 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 0.30	0.40 to 0.70	0.40 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 0.30	0.40 to 0.70	0.40 to 0.60	0.15 to 0.25
G86370	8637	0.35 to 0.40	0.75 to 1.00	0.035	0.040	0.15 to 0.30	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 0.30	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 0.30	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 0.30	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 0.30	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 0.30	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 0.30	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 0.30	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]									

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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
G50441	50B44	0.43 to 0.48	0.75 to 1.00	0.035	0.040	0.15 to 0.30	. . .	0.40 to 0.60	. . .
G50461	50B46	0.44 to 0.49	0.75 to 1.00	0.035	0.040	0.15 to 0.30	. . .	0.20 to 0.35	. . .
G50501	50B50	0.48 to 0.53	0.75 to 1.00	0.035	0.040	0.15 to 0.30	. . .	0.40 to 0.60	. . .
G50601	50B60	0.56 to 0.64	0.75 to 1.00	0.035	0.040	0.15 to 0.30	. . .	0.40 to 0.60	. . .
G51601	51B60	0.56 to 0.64	0.75 to 1.00	0.035	0.040	0.15 to 0.30	. . .	0.70 to 0.90	. . .
G81451	81B45	0.43 to 0.48	0.75 to 1.00	0.035	0.040	0.15 to 0.30	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 0.30	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 0.30	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 %.

5. Manufacture

5.1 The product of the steel making processes is either cast into ingots that are hot rolled to blooms or billets, or strand cast directly into blooms or billets for subsequent processing into rods.

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 2. For specified compositions not contained in Table 2 the ranges and limits expressed in Table 3 shall apply unless other such ranges and limits shall have been agreed upon between the purchaser and the manufacturer.

6.2 *Cast or Heat Analysis*—An analysis of each cast or 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 cast or 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 4 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.

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 E 30 shall be used.

TABLE 3 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 4.

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	

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TABLE 3 *Continued*

Element	When Maximum of Specified Element is, %	Range, %		Maximum Limit, %[A]
		Open-Hearth or Basic Oxygen Steel	Electric Furnace Steel	
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	0.040
	Basic open hearth or basic oxygen steel			0.025
	Basic electric furnace steel			
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	
	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.

TABLE 4 Product or Verification Analysis Tolerances—Alloy Steels

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

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TABLE 4 *Continued*

Element	Limit or Maximum of Specified Range, %	Tolerance Over Maximum Limit or Under Minimum Limit, %
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
	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 check, product, or verification analysis.

[B] Tolerance is over *and* under.

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, spheroidize annealed or patented wire rod or bars; also as annealed, spheroidize annealed, patented, or oil tempered at finish size. 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 (non-spheroidized) are shown in Table 5.

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 6.

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 7.

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 of 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.

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TABLE 5 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, ksi (MPa)	UNS Designation	Grade No.	Tensile Strength, ksi (MPa)
G13300	1330	88 (610)	G50501	50B50	97 (670)
G13350	1335	90 (620)	G50601	50B60	103 (710)
G13400	1340	92 (630)	G51200	5120	82 (570)
G13450	1345	97 (670)	G51300	5130	84 (580)
G40120	4012	71 (490)	G51320	5132	84 (580)
G40230	4023	73 (500)	G51350	5135	86 (590)
G40240	4024	73 (500)	G51400	5140	90 (620)
G40270	4027	82 (570)	G51450	5145	94 (650)
G40280	4028	82 (570)	G51470	5147	99 (680)
G40370	4037	89 (610)	G51500	5150	97 (670)
G40470	4047	97 (670)	G51550	5155	103 (710)
G41180	4118	82 (570)	G51600	5160	104 (720)
G41300	4130	86 (590)	G51601	51B60	109 (750)
G41370	4137	92 (630)	G61180	6118	80 (550)
G41400	4140	94 (650)	G61500	6150	97 (670)
G41420	4142	97 (670)	G81451	81B45	92 (630)
G41450	4145	99 (680)	G86150	8615	80 (550)
G41470	4147	100 (690)	G86170	8617	80 (550)
G41500	4150	100 (690)	G86200	8620	82 (570)
G41610	4161	111 (770)	G86220	8622	84 (580)
G43200	4320	94 (650)	G86250	8625	84 (580)
G43400	4340	104 (720)	G86270	8627	84 (580)
G44190	4419	82 (570)	G86300	8630	88 (610)
G46150	4615	80 (550)	G86370	8637	92 (630)
G46200	4620	82 (570)	G86400	8640	94 (650)
G46210	4621	82 (570)	G86420	8642	97 (670)
G46260	4626	84 (580)	G86450	8645	99 (680)
G47180	4718	84 (580)	G86550	8655	104 (720)
G47200	4720	82 (570)	G87200	8720	82 (570)
G48150	4815	92 (630)	G87400	8740	97 (670)
G48170	4817	94 (650)	G88220	8822	88 (610)
G48200	4820	94 (650)	G92540	9254	111 (770)
G50150	5015	73 (500)	G92550	9255	111 (770)
G50441	50B44	94 (650)	G92600	9260	111 (770)
G50461	50B46	92 (630)	G94171	94B17	73 (500)
			G94301	94B30	84 (580)

11. Retests

11.1 The difficulties in obtaining truly representative samples of wire rod and coarse round wire without destroying the usefulness of the coil account for the generally accepted practice of allowing retests for mechanical tests and surface examination. An additional test piece is cut from each end of the coil from which the original sample was taken. A portion of the coil may be discarded prior to cutting the sample for retest. If any of the retests fail to comply with the requirements, the coil of rod or wire may be rejected. Before final rejection, however, it is frequently advisable to base the final decision on an actual trial of the material to determine whether or not it will perform the function for which it is intended.

TABLE 6 Permissible Variation in Diameter of Alloy Wire Rod in Coils

NOTE 1— For purposes of determining conformance with this specification, all specified limits in Table 6 are absolute limits as defined in Practice E 29.

Diameter of Rod		Permissible Variation, Plus and Minus, in. (mm)	Permissible Out-of-Round in. (mm)
Fractions, in.	Decimal, in. (mm)		
7/32 to 47/64, incl	0.219 to 0.734 (5.6 to 18.7), incl	0.016 (0.41)	0.025 (0.64)

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TABLE 7 Permissible Variation in Diameter for Alloy Coarse Round Wire

NOTE 1—For purposes of determining conformance with this specification, all specified limits in Table 7 are absolute limits as defined in Practice E 29.

Diameter of Wire, in. (mm)	Permissible Variation, Plus and Minus, in. (mm)	Permissible Out-of-Round, in. (mm)
0.035 to 0.075 (0.89 to 1.90), incl	0.001 (0.03)	0.001 (0.03)
Over 0.075 to 0.148 (1.90 to 3.76), incl	0.0015 (0.04)	0.0015 (0.04)
Over 0.148 to 0.500 (3.76 to 12.70), incl	0.002 (0.05)	0.002 (0.05)
Over 0.500 to 0.625 (12.70 to 15.87), incl	0.0025 (0.06)	0.0025 (0.06)
Over 0.625 (15.87)	0.003 (0.08)	0.003 (0.08)

12. Inspection

12.1 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.

13. Rejection and Rehearing

13.1 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.

14. Certification

14.1 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.

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

15. Packaging, Marking, and Loading

15.1 A tag shall be securely attached to each coil and shall be marked with the size, heat number, grade number, ASTM specification number, and name or mark of the manufacturer.

15.2 When specified in the purchase order, packaging, marking, and loading for shipment shall be in accordance with those procedures recommended by Practices A 700.

15.3 *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.

16. Keywords

16.1 alloy; coarse round wire; general; wire rods

SUMMARY OF CHANGES

Committee A01 has identified the location of selected changes to this standard since the last issue, A 752–93 (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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