Designation: A 752 – 93 (Reapproved 1998)

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:*

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

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

A 919 Terminology Relating to Heat Treatment of Metals[4]

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

E 30 Test Methods for Chemical Analysis of Steel, Cast Iron, Open-Hearth Iron, and Wrought Iron[6]

E 112 Test Methods for Determining Average Grain Size[7]

2.2 *AIAG Standard:*

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

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 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 03.05.

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

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

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 Orders for hot-rolled wire rods under this specification should include the following information:

4.1.1 Quantity (pounds or kilograms),
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 Orders for coarse round wire under this specification shall include the following information:

4.2.1 Quantity (pounds or kilograms),
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
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

TABLE 2 *Continued*

UNS Designation	Grade No.	Chemical Composition, Ranges and Limits, %							
		Carbon	Manganese	Phosphorus, max	Sulfur, max	Silicon	Nickel	Chromium	Molybdenum
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]									
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	. . .

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 0.30	. . .	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	