Designation: A 920/A 920M – 07

Standard Specification for Steel Bars, Microalloy, Hot-Wrought, Special Quality, Mechanical Properties[1]

This standard is issued under the fixed designation A 920/A 920M; 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 hot-wrought, special quality microalloyed carbon steel bars intended for use in applications where as-rolled mechanical properties are desired. A typical end use is hydraulic cylinder shafts.

1.2 The bars shall be furnished to chemical composition and mechanical properties as provided herein. Chemical composition is based on standard carbon steel grades modified to include microalloying elements such as columbium (niobium), vanadium, or molybdenum. Three strength classes are available, designated 75 [520], 80 [550], and 100 [690], corresponding to the minimum yield strength in ksi.

1.3 Sections and sizes of bar steels available are covered in Specification A 29/A 29M.

1.4 Supplementary Requirements S1 to S5 are provided for use when additional controls or requirements are desired. These shall apply only when specified on the purchase order.

1.5 The values stated in either inch-pound units or SI units are to be regarded separately as standard. Within the text and tables, SI units are shown in brackets. The values stated in each system are not exact equivalents; therefore, each system must be used independently of the other. Combining values from the two systems may result in nonconformance with the specification.

1.6 Unless the order specifies the applicable "M" specification designation, the material shall be furnished to the inch-pound units.

2. Referenced Documents

2.1 *ASTM Standards:* [2]

A 29/A 29M Specification for Steel Bars, Carbon and Alloy, Hot-Wrought, General Requirements for

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

A 576 Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality

E 45 Test Methods for Determining the Inclusion Content of Steel

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *microalloyed steels*, *n*—carbon steels to which small quantities of certain elements are added in order to enhance mechanical properties.

3.1.1.1 *Discussion*—This enhancement of mechanical properties results from control of the temperature and cooling rate during the hot-rolling process.

4. Ordering Information

4.1 Orders for material supplied to this specification should include the following, as required, to describe adequately the desired material:

4.1.1 Quantity (weight or number of bars),

4.1.2 Name of material (hot-rolled microalloyed steel bars),

4.1.3 Dimensions,

4.1.4 ASTM specification number and date of issue,

4.1.5 Grade designation or chemical composition limits (see Section 8),

4.1.6 Class,

4.1.7 Type (see 7.1) to designate grain refiner,

4.1.8 Additions to the specification and Supplementary Requirements, if required, and,

4.1.9 End use.

5. General Requirements

5.1 Material furnished under this specification shall conform to the applicable requirements of the current edition of Specification A 29/A 29M, unless otherwise provided herein.

6. Materials and Manufacture

6.1 *Melting Practice*—The steel shall be produced in accordance with the applicable methods for primary and secondary melting outlined in Specification A 576.

6.2 The steel shall be killed. Supplementary Requirements S1 through S5 may be invoked upon agreement between producer and purchaser.

6.3 The bars shall be special quality.

[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 A01.15 on Bars.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

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

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6.4 The bars shall be hot-wrought, as wrought, unless otherwise specified.

7. Metallurgical Requirements

7.1 *Grain Size*—The steel shall conform to the fine grain size requirement of Specification A 29/A 29M. The grain refining element may be specified according to one of the following types:

7.1.1 *Type A, Aluminum*—The total aluminum analysis shall be 0.020 % or greater, and shall be reported.

7.1.2 *Type B*—The grain refining element shall be specified in accordance with 5.1.2.3 of Specification A 29/A 29M.

7.2 *Microstructure*—The microstructure shall consist of a minimum of 90 % ferrite-pearlite or 90 % bainite as agreed upon between the purchaser and producer.

8. Chemical Composition

8.1 Typical examples of chemical compositions are shown in Table 1. Other compositions may be specified using one of the following methods:

8.1.1 Base compositions selected from Table 1 of Specification A 576, with the addition of microalloying elements as provided in 8.3 to 8.5, or

8.1.2 Base compositions using the ranges and limits shown in Table 2 of Specification A 576, with the addition of microalloying elements as provided in 8.3 to 8.5.

NOTE 1—For improved machinability, alternative sulfur ranges may be specified upon agreement between the purchaser and the producer. Additional machinability-enhancing elements such as lead, bismuth, selenium, or tellurium may also be specified by agreement.

8.2 Silicon analysis shall be 0.15/0.35 %. Silicon content up to 0.80 % maximum may be furnished upon agreement between purchaser and producer.

8.3 Vanadium, columbium (niobium), or molybdenum may be specified singly or in combination, subject to the limits shown in Table 2. The elements and ranges specified shall be upon agreement between the purchaser and the producer.

8.4 Titanium shall be added when specified for refinement of the ferritic-pearlitic (or bainitic) or austenitic grain size. When titanium is specified, the titanium limits shall be as agreed upon between producer and purchaser. The titanium content shall be reported.

8.5 Nitrogen may be specified as a supplement to vanadium, columbium, or titanium. If specified, the nitrogen content shall not exceed 0.030 % and shall be reported.

TABLE 2 Chemical Requirements—(Microalloy Elements)

Element	Chemical Ranges and Limits, %	
	Heat Analysis	Product Analysis
Vanadium	0.02–0.20	0.01–0.21
Columbium (Niobium)	0.005–0.07	0.004–0.08
Molybdenum	0.01–0.30	0.31 max

8.6 Sampling for heat and product analysis shall be in accordance with the requirements of Specification A 29/A 29M.

9. Mechanical Properties

9.1 The material as represented by the test specimens shall conform to the requirements of Table 3 for the class specified.

9.2 Test specimens shall be prepared from the material in the as-rolled condition, unless otherwise specified.

9.3 Test specimens shall be taken longitudinally and may be tested in full thickness or they may be machined to the dimensions shown in Figs. 4 or 5 of Test Methods and Definitions A 370. If the test specimens are selected conforming to the dimensions of Fig. 5, they shall be machined from a position midway between the center and surface of the bar.

9.4 Two tension tests shall be made from each heat, unless the finished material from a heat is less than 50 tons (45 mg), when one tension test will be sufficient.

10. Workmanship and Appearance

10.1 The bars shall be free of visible pipe and conditioned as necessary to remove any injurious surface imperfections.

11. Certification and Test Reports

11.1 When specified by the purchaser, a manufacturer's certification that the material was manufactured and tested in accordance with this specification together with a report of the heat analysis for the specified elements and for copper, chromium, nickel, molybdenum, vanadium, and columbium shall be furnished. When the amount of an element present is less than 0.02 %, the heat analysis may be reported as <0.02 %, except for aluminum, titanium, and nitrogen. When specified, these elements shall be reported to three decimal places.

11.2 The report shall include the results of any mechanical tests performed in accordance with this specification, including supplementary requirements, if any.

TABLE 1 Typical Chemical Compositions of Microalloyed Carbon Steels

NOTE—These compositions are identical to those in Specification A 576, with the exception of the addition of vanadium.

Base Grade Designation	Chemical Composition Limits, %				
	C	Mn	P	S	V
10V40	0.37–0.44	0.60–0.90	0.040 max	0.050 max	0.02–0.20
10V45	0.43–0.50	0.60–0.90	0.040 max	0.050 max	0.02–0.20
11V37	0.32–0.39	1.35–1.65	0.040 max	0.08–0.13	0.02–0.20
11V41	0.37–0.45	1.35–1.65	0.040 max	0.08–0.13	0.02–0.20
15V24	0.19–0.25	1.35–1.65	0.040 max	0.050 max	0.02–0.20
15V41	0.36–0.44	1.35–1.65	0.040 max	0.050 max	0.02–0.20

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TABLE 3 Mechanical Property Requirements

Class	Yield Strength, min		Tensile Strength, min		Elongation, %, min	
	ksi	MPa	ksi	MPa	in 8 in. (200 mm)	in 2 in. (50 mm)
75	75	[520]	100	[690]	7	10
80	80	[550]	100	[690]	6	9
100	100	[690]	115	[790]	5	7

12. Keywords

12.1 carbon steel bars; microalloyed steel; steel bars

SUPPLEMENTARY REQUIREMENTS

One or more of the following supplementary requirements shall apply only when specified by the purchaser.

S1. Restricted Chemical Composition

S1.1 Restricted heat analysis limits or ranges or restricted product analysis tolerances on one or more elements may be specified by the purchaser if the manufacturer agrees to meet the requested restriction.

S2. Restricted Incidental Elements

S2.1 The steel shall not exceed the limits for copper, nickel, chromium, molybdenum, or other elements as shown on the purchase order.

S3. Nonmetallic Inclusion Requirement

S3.1 A microscopical examination of longitudinal sections to determine the nature and frequency of nonmetallic inclusions shall be made as prescribed in Test Methods E 45. The acceptance limits shall be specified by the purchaser.

NOTE S1.1—In resulfurized steels, much of the sulfur is present as sulfide inclusions. For this reason, maximum sulfide inclusion level should not be specified.

S4. Calcium Treatment

S4.1 The steel shall be calcium treated.

S5. Cleaning

S5.1 The surface of the bars shall be descaled by pickling or shotblasting, or other suitable means.

S6. Restricted Mechanical Property Requirements

S6.1 Restricted mechanical property requirements to be agreed upon between purchaser and producer.

SUMMARY OF CHANGES

Committee A01 has identified the location of selected changes to this standard since the last issue (A 920/A 920M – 02a) that may impact the use of this standard. (Approved Nov. 1, 2007.)

(*1*) Changed Nitrogen percentage to 0.030 % in 8.5.

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