



Designation: A320/A320M – 22a

Standard Specification for Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service¹

This standard is issued under the fixed designation A320/A320M; 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope*

1.1 This specification² covers alloy and stainless steel bolting materials and bolting components for pressure vessels, valves, flanges, and fittings for low-temperature service. See Specification [A962/A962M](#) for the definition of bolting. The bars shall be hot-wrought and may be further processed by centerless grinding or by cold drawing. Austenitic stainless steel may be solution annealed or annealed and strain-hardened. When strain hardened austenitic stainless steel is ordered, the purchaser should take special care to ensure that [Appendix X1](#) is thoroughly understood.

1.2 Several grades are covered, including both ferritic and austenitic steels designated L7, B8, etc. Selection will depend on design, service conditions, mechanical properties, and low-temperature characteristics. The mechanical requirements of [Table 1](#) indicate the diameters for which the minimum mechanical properties apply to the various grades and classes, and [Table 2](#) stipulates the requirements for Charpy impact energy absorption. The manufacturer should determine that the material can conform to these requirements before parts are manufactured. For example, when Grade L43 is specified to meet the [Table 2](#) impact energy values at $-150\text{ }^{\circ}\text{F}$ [$-101\text{ }^{\circ}\text{C}$], additional restrictions (such as procuring a steel with lower P and S contents than might normally be supplied) in the chemical composition for AISI 4340 are likely to be required.

NOTE 1—The committee formulating this specification has included several grades of material that have been rather extensively used for the present purpose. Other compositions will be considered for inclusion by the committee from time to time as the need becomes apparent. Users should note that hardenability of some of the grades mentioned may restrict the maximum size at which the required mechanical properties are obtainable.

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 A01.22 on Steel Forgings and Wrought Fittings for Piping Applications and Bolting Materials for Piping and Special Purpose Applications.

Current edition approved Nov. 1, 2022. Published November 2022. Originally approved in 1948. Last previous edition approved in 2022 as A320/A320M – 22. DOI: 10.1520/A0320_A0320M-22A.

² For ASME Boiler and Pressure Vessel Code applications, see related Specification SA-320 in Section II of that Code.

1.3 The following referenced general requirements are indispensable for application of this specification: Specification [A962/A962M](#).

1.4 Nuts for use with bolting are covered in Section 10 and the nut material shall be impact tested.

1.5 Supplementary Requirements are provided for use at the option of the purchaser. The supplementary requirements shall apply only when specified in the purchase order or contract.

1.6 This specification is expressed in both inch-pound units and SI units; however, unless the purchase order or contract specifies the applicable *M* specification designation (SI) units, the inch-pound units shall apply.

1.7 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

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

2. Referenced Documents

2.1 ASTM Standards:³

[A194/A194M](#) Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both

[A962/A962M](#) Specification for Common Requirements for Bolting Intended for Use at Any Temperature from Cryogenic to the Creep Range

[E566](#) Practice for Electromagnetic (Eddy Current/Magnetic Induction) Sorting of Ferrous Metals

³ 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



TABLE 1 Mechanical Requirements

Class and Grade, Diameter, in. [mm]	Heat Treatment	Minimum Tempering Temperature, °F [°C]	Tensile Strength, min, ksi [MPa]	Yield Strength, min, ksi [MPa] (0.2 % offset)	Elongation in 2 in. or 50 mm, min, %	Reduction of Area, min, %	Hardness, max
Ferritic Steels							
L7, L7A, L7B, L7C, L70, L71, L72, L73			125 [860]	105 [725]	16	50	321 HBW or 35 HRC
2½ [65] and under ^A	quenched and tempered	1100 [593]					
L43			125 [860]	105 [725]	16	50	321 HBW or 35 HRC
4 [100] and under ^A	quenched and tempered	1100 [593]					
L7M			100 [690]	80 [550]	18	50	235 HBW ^B or 99 HRB
2½ [65] and under ^A	quenched and tempered	1150 [620]					
L1			125 [860]	105 [725]	16	50	...
Austenitic Steels ^C							
Class 1: B8, B8C, B8M, B8P, B8F, B8T, B8LN, B8MLN, all diameters	carbide solution treated		75 [515]	30 [205]	30	50	223 HBW ^D or 96 HRB
Class 1A: B8A, B8CA, B8MA, B8PA, B8FA, B8TA, B8LNA, B8MLNA, all diameters	carbide solution treated in the finished condition		75 [515]	30 [205]	30	50	192 HBW or 90 HRB
Class 2: B8, B8C, B8P, B8F, B8T: ¾ [20] and under	carbide solution treated and strain hardened		125 [860]	100 [690]	12	35	321 HBW or 35 HRC
over ¾ to 1 [20 to 25], incl			115 [795]	80 [550]	15	35	321 HBW or 35 HRC
over 1 to 1¼ [25 to 32], incl			105 [725]	65 [450]	20	35	321 HBW or 35 HRC
over 1¼ to 1½ [32 to 40], incl ^A			100 [690]	50 [345]	28	45	321 HBW or 35 HRC
Class 2: B8M: ¾ [20] and under	carbide solution treated and strain hardened		110 [760]	95 [655]	15	45	321 HBW or 35 HRC
over ¾ to 1 [20 to 25], incl			100 [690]	80 [550]	20	45	321 HBW or 35 HRC
over 1 to 1¼ [25 to 32], incl			95 [655]	65 [450]	25	45	321 HBW or 35 HRC
over 1¼ to 1½ [32 to 40], incl ^A			90 [620]	50 [345]	30	45	321 HBW or 35 HRC

^A These upper diameter limits were established on the basis that these were the largest sizes commonly available that consistently met specification property limits. They are not intended as absolute limits beyond which bolting materials could no longer be certified to the specification.

^B To meet the tensile requirements, the Brinell hardness shall not be less than 200 HBW or 93 HRB.

^C Class 1 products are made from solution-treated material. Class 1A products are solution treated in the finished condition for corrosion resistance; heat treatment is critical for enhancing this physical property and meeting the mechanical property requirements. Class 2 products are made from solution-treated material that has been strain hardened. Austenitic steels in the strain-hardened condition may not show uniform properties throughout the cross section, particularly in sizes over ¾ in. [20 mm] in diameter.

^D For sizes ¾ in. [20 mm] in diameter and smaller, a maximum hardness of 241 HBW (100 HRB) is permitted.

TABLE 2 Impact Test Temperatures and Properties

Grade	Test Temperature		CVN Specimen Section Size, mm	Min Average Impact Toughness of Three Test Specimens, ft-lbf [J]	Min Impact Value of a Single Specimen of Set of Three, ft-lbf [J]
	°F	°C			
L7M, L70, L71, L72, L73	-100	-73	10 × 10	20 [27]	15 [20]
			10 × 7.5	16 [22]	12 [16]
			10 × 10	20 [27]	15 [20]
L7, L7A, L7B, L7C, L43	-150	-101	10 × 7.5	16 [22]	12 [16]
			10 × 10	40 [54]	30 [41]
			10 × 7.5	32 [44]	24 [32]
L1	-100	-73	10 × 7.5	32 [44]	24 [32]

F436/F436M Specification for Hardened Steel Washers Inch and Metric Dimensions

F606/F606M Test Methods for Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, Direct Tension Indicators, and Rivets

2.2 *ASME Standards*:⁴

B1.1 Screw Threads

B18.21.1 Washers: Helical Spring-Lock, Tooth Lock, and Plain Washers (Inch Series)

3. Ordering Information

3.1 It is the purchaser's responsibility to specify in the purchase order all information necessary to purchase the needed materials. Examples of such information include, but are not limited to, the following:

3.1.1 Quantity and size,

3.1.2 Heat-treated condition, that is, for the austenitic stainless steels, solution-treated (Class 1); solution-treated after finishing (Class 1A); and annealed and strain-hardened (Class 2),

3.1.3 Description of items required (bars, bolts, screws, or studs),

3.1.4 Nuts and washers, if required by the purchaser, in accordance with Section 10, and

3.1.5 Special requirements, in accordance with 5.1.1, 5.1.3, 5.1.4, and 13.1.

4. Common Requirements

4.1 Bolting materials and bolting components supplied to this specification shall conform to the requirements of Specification **A962/A962M**. These requirements include test methods, finish, thread dimensions, macroetch (carbon and alloy steels only) marking, certification, optional supplementary requirements, and others. Failure to comply with the requirements of Specification **A962/A962M** constitutes non-conformance with this specification. In case of conflict between the requirements in this specification and Specification **A962/A962M**, this specification shall prevail.

5. Materials and Manufacture

5.1 *Heat Treatment*:

5.1.1 Bolting materials shall be allowed to cool to room temperature after rolling or forging. Grades L7, L7A, L7B, L7C, L7M, L43, L1, L70, L71, L72, and L73 shall be reheated

to above the upper critical temperature and liquid quenched and tempered. Grades B8, B8C, B8M, B8T, B8F, B8P, B8LN, and B8MLN shall receive a carbide solution treatment. Products made from such material are described as Class 1. This shall consist of holding the bolting material for a sufficient time at a temperature at which the chromium carbide will go into solution and then cooling in air or in a liquid medium at a rate sufficient to prevent reprecipitation of the carbide. Bolting material thus treated is described as Class 1. If specified in the purchase order, bolting material shall be solution treated in the finished condition and shall be described as Class 1A.

5.1.2 Use of water quenching is prohibited for any ferritic grade when heat treatment is performed after heading or threading.

5.1.3 When increased mechanical properties are desired, austenitic bolting shall be solution annealed and strain hardened if specified in the purchase order; material so treated is identified as Class 2.

5.1.4 If scale-free bright finish is required, this shall be specified in the purchase order.

5.1.5 For L7M bolting, the final heat treatment, which may be the tempering or stress-relieving operation conducted at 1150 °F [620 °C] minimum, shall be done after machining or rolling of the threads and any type of cutting.

6. Mechanical Requirements

6.1 *Tensile Properties*:

6.1.1 Bolting material as represented by the tension specimens shall conform to the requirements as to tensile properties prescribed in **Table 1** at room temperature after heat treatment (see 5.1.1). Alternatively, Class 2 Strain Hardened Headed Bolting Components shall be tested full size after strain hardening to determine tensile strength and yield strength and shall conform to the requirements prescribed in **Table 1**. Should the results of full size tests conflict with results of tension specimen tests, full size test results shall prevail.

6.1.2 *Number of Tests*:

6.1.2.1 For heat-treated bars, one tension test and one impact test consisting of three specimens shall be made for each diameter of each heat represented in each tempering charge. When heat treated without interruption in continuous furnaces, the material in a lot shall be the same heat, same prior condition, same size, and subjected to the same heat treatment. Not fewer than two tensile tests and two impact tests are required for each lot containing 20 000 lbs [9000 kg] or less. Every additional 10 000 lbs [4500 kg] or fraction thereof requires an additional tensile test and impact test.

⁴ Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Two Park Ave., New York, NY 10016-5990, <http://www.asme.org>.