



Designation: A1082/A1082M – 16

Standard Specification for High Strength Precipitation Hardening and Duplex Stainless Steel Bolting for Special Purpose Applications¹

This standard is issued under the fixed designation A1082/A1082M; 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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

1. Scope*

1.1 This specification covers high strength stainless steel bolting materials and bolting components for special purpose applications such as pressure vessels. Several grades of precipitation-hardened and duplex (ferritic-austenitic) stainless steels are covered. Selection will depend upon design, service conditions, mechanical properties and characteristics related to the application.

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

1.3 Supplementary Requirements are provided for use at the option of the purchaser. The Supplementary Requirements shall only apply when specified individually by the purchaser in the purchase order or contract.

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

1.5 The values stated in either SI units or inch-pound units are to be regarded separately as standard. Within the text, the SI units are shown in brackets. 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.

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:²

[A276/A276M](#) Specification for Stainless Steel Bars and Shapes

[A370](#) Test Methods and Definitions for Mechanical Testing of Steel Products

[A479/A479M](#) Specification for Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels

[A564/A564M](#) Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes

[A959/A959M](#) Guide for Specifying Harmonized Standard Grade Compositions for Wrought Stainless Steels

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

2.2 ASNT Documents:³

[ASNT SNT-TC-1A](#) Recommended Practice for Personnel Qualification and Certification in Nondestructive Testing

3. Ordering Information

3.1 The inquiry and order shall indicate the following, as required, to describe the desired material adequately:

3.1.1 Quantity (weight or number of pieces),

3.1.2 Description of item (bars, bolts, nuts, etc.),

3.1.3 UNS Designation or Type (see [Table 1](#)),

3.1.4 Heat-Treat Condition (see [7.1.1](#)),

3.1.5 Dimension/Threads, etc. (see the section in Specification [A962/A962M](#) titled “Workmanship, Finish, and Appearance”), and

3.1.6 Supplementary Requirements, if any.

4. Common Requirements

4.1 Bolting materials and components supplied to this specification shall conform to the requirements of Specification [A962/A962M](#). These requirements include test methods, finish, thread dimensions, marking, terminology, testing,

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.

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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 American Society for Nondestructive Testing (ASNT), P.O. Box 28518, 1711 Arlingate Ln., Columbus, OH 43228-0518, <http://www.asnt.org>.

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

TABLE 1 Chemical Requirements^A

UNS Designation ^B	Type ^B	Carbon	Manganese	Phosphorus	Sulfur	Silicon	Chromium	Nickel	Molybdenum	Nitrogen	Other Elements
Duplex (Ferritic-Austenitic) Grades											
S31100	...	0.06	1.00	0.045	0.030	1.00	25.0-27.0	6.0-7.0	...	...	Ti 0.25
S31260	...	0.030	1.00	0.030	0.030	0.75	24.0-26.0	5.5-7.5	2.5-3.5	0.10-0.30	Cu 0.20-0.80, W 0.10-0.50
S31803	...	0.030	2.00	0.030	0.020	1.00	21.0-23.0	4.5-6.5	2.5-3.5	0.08-0.20	...
S32101	...	0.040	4.0-6.0	0.040	0.030	1.00	21.0-22.0	1.35-1.70	0.10-0.80	0.20-0.25	Cu 0.10-0.80
S32202	...	0.030	2.00	0.040	0.010	1.00	21.5-24.0	1.0-2.80	0.45	0.18-0.26	...
S32205	2205	0.030	2.00	0.030	0.020	1.00	22.0-23.0	4.5-6.5	3.0-3.5	0.14-0.20	...
S32304	2304	0.030	2.50	0.040	0.030	1.00	21.5-24.5	3.0-5.5	0.05-0.60	0.05-0.20	Cu 0.05-0.60
S32506	...	0.030	1.00	0.040	0.015	0.90	24.0-26.0	5.5-7.2	3.0-3.5	0.08-0.20	W 0.05-0.30
S32550	255	0.040	1.50	0.040	0.030	1.00	24.0-27.0	4.5-6.5	2.9-3.9	0.10-0.25	Cu 1.50-2.50
S32750	2507	0.030	1.20	0.035	0.020	0.80	24.0-26.0	6.0-8.0	3.0-5.0	0.24-0.32	Cu 0.50
S32760	...	0.030	1.00	0.030	0.010	1.00	24.0-26.0	6.0-8.0	3.0-4.0	0.20-0.30	Cu 0.50-1.00, W 0.50-1.00, %Cr+3.3x%Mo +16x%N≥40
S32906	...	0.030	0.80-1.50	0.030	0.030	0.50	28.0-30.0	5.8-7.5	1.50-2.60	0.30-0.40	Cu 0.80
S32950	...	0.030	2.00	0.035	0.010	0.60	26.0-29.0	3.5-5.2	1.00-2.50	0.15-0.35	...
S39277	...	0.025	0.80	0.025	0.002	0.80	24.0-26.0	6.5-8.0	3.0-4.0	0.23-0.33	Cu 1.20-2.00, W 0.80-1.20
Precipitation Hardening Grades											
S15700	632	0.09	1.00	0.040	0.030	1.00	14.0-16.0	6.5-7.7	2.00-3.00	...	Al 0.75-1.50
S17400	630	0.07	1.00	0.040	0.030	1.00	15.0-17.0	3.0-5.0	...	...	Cu 3.0-5.0, Cb +Ta 0.15-0.45
S17600	635	0.08	1.00	0.040	0.030	1.00	16.0-17.5	6.0-7.5	...	...	Al 0.40, Ti 0.40-1.20
S17700	631	0.09	1.00	0.040	0.030	1.00	16.0-18.0	6.5-7.7	...	...	Al 0.75-1.50
S35500	634	0.10-0.15	0.50-1.25	0.040	0.030	0.50	15.0-16.0	4.0-5.0	2.5-3.2	0.07-0.13	Cb 0.10-0.50

^A Maximum or range unless otherwise indicated.

^B See Guide A959/A959M.

TABLE 2 Solution Treatment and Mechanical Property Requirements for PH Grades^A

UNS Designation	Type	Solution Treatment ^{B,C} °F [°C]	Mechanical Property Requirements in the Solution Treated Condition				Hardness ^D	
			Tensile Strength ksi [MPa]	Yield Strength ksi [MPa]	Elongation in 2" [50 mm] or 4D, min. %	Reduction of Area, min. %	Rockwell, maximum	Brinell, maximum
S15700	632	...	...	...	...	...	100 HRB	269
S17400	630	Cool to below 90 [32]	...	...	...	...	38 HRC	363
S17600	635	Air Cool	120 [825]	75 [515]	10	45	32 HRC	302
S17700	631	...	...	...	...	...	98 HRB	229
S35500	634	Hold at ≤ -100 [-73] for at least 3 hours	...	...	...	...	...	363

^A Values shown are minimums or ranges unless maximum is indicated.

^B 1900 [1040] ± 25°F [15°C].

^C Quenched in water unless the table specifies another media.

^D Either Rockwell or Brinell testing is permitted unless thickness is below ½" in which case Rockwell is preferred.

certification, optional supplementary requirements, and others. Failure to comply with the requirements of Specification A962/A962M constitutes nonconformance with this specification. In case of conflict between the requirements of this specification and Specification A962/A962M, this specification shall prevail.

5. Materials and Manufacture

5.1 Bars shall be produced in accordance with Specifications A276/A276M, A479/A479M or A564/A564M as applicable. Finish (hot or cold, ground, rough turned, drawn, etc.) shall be at the option of the manufacturer unless otherwise specified in the purchase order or contract.

5.2 Bolting components shall be produced in accordance with this specification and the requirements of Specification A962/A962M.

6. Chemical Composition

6.1 Each alloy shall conform to the chemical composition requirements prescribed in Table 1.

7. Heat Treatment

7.1 Precipitation Hardening (PH) Stainless Steels:

7.1.1 Bolting materials ordered to a Type or UNS designation only shall be furnished in the solution treated condition in accordance with Table 2 or Table 3. Age hardened bolting

TABLE 3 Age Hardening Heat Treatment and Mechanical Property Requirements for PH Grades^A

Type	Condition	Suggested Hardening and/or Aging Temperatures, Time at Temperature, and Quench Media °F [°C] ^{B,C,D,E}	Maximum Thickness inch [mm] inclusive	Mechanical Properties						
				Tensile Strength ksi [MPa]	Yield Strength ksi [MPa]	Elongation in 2" [50 mm] or 4D %	Reduction of Area, %	Hardness ^F		Impact Ft-lbf [J]
								Rockwell, HRC	Brinell	
630	H900	900 [480], 1 hour	8	190 [1310]	170 [1170]	10	35	40	388	...
630	H925	925 [495], 4 hours	8	170 [1170]	155 [1070]	10	38	38	375	5 [6.8]
630	H1025	1025 [550], 4 hours	8	155 [1070]	145 [1000]	12	45	35	331	15 [20]
630	H1075	1075 [580], 4 hours	8	145 [1000]	125 [860]	13	45	32	311	20 [27]
630	H1100	1100 [595], 4 hours	8	140 [965]	115 [795]	14	45	31	302	25 [34]
630	H1150	1150 [620], 4 hours	8	135 [930]	105 [725]	16	50	28	277	30 [41]
630	H1150D	1150 [620] for 4 hrs., air cool plus 1150 [620] for 4 hrs., air cool	8	125 [860]	105 [725]	16	50	24-33	255-311	30 [41]
630	H1150M	1400 [760] for 2 hrs., air cool plus 1150 [620] for 4 hrs., air cool	8	115 [795]	75 [520]	18	55	24	255	55 [75]
631	RH950	1750 [955] for 10 min. to 1 h, rapidly cool to room temperature. Cool within 24 hrs. to -100 ± 10 [-75 ± 5], hold 8 hrs. min. Warm in air to room temperature. Heat to 950 [510] hold 1 h, air cool.	4	185 [1280]	150 [1030]	6	10	41	388	...
631	TH1050	1400 [760] for 90 min. Cool to 55 ± 5 [15 ± 3] within 1 h, hold ½ h min., heat to 1050 [565], hold for 90 min., air cool	6	170 [1170]	140 [965]	6	25	38	352	...
632	RH950	Same as Type 631	4	200 [1380]	175 [1210]	7	25	44	415	...
632	TH1050	Same as Type 631	6	180 [1240]	160 [1100]	8	25	38	375	...
634	H1000	1750 [955] for 10 min. to 1 h, water quench. Cool to -100 [75] min., hold 3 hrs. min. Temper at 1000 [540] hold for 3 h min, air cool.	...	170 [1170]	155 [1070]	12	25	37	341	...
635	H950	950 [510], ½ h	...	190 [1310]	170 [1170]	8	25	39	363	...
635	H1000	1000 [540], ½ h	...	180 [1240]	160 [1100]	8	30	37	352	...
635	H1050	1050 [565], ½ h	...	170 [1170]	150 [1035]	10	40	35	331	...

^A Values shown are minimums or ranges unless maximum is indicated.

^B ± 25°F [15°C]

^C Temperatures are suggested and may be varied to obtain the required tensile properties.

^D Time refers to the minimum time the material is at temperature and may be extended to obtain required ductility properties.

^E Quenching shall be accomplished using air or gas cooling unless the table specifies another media.

^F Either Rockwell or Brinell testing is permitted unless thickness is below ½" in which case Rockwell is preferred.

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materials ordered to both a Type and Condition shall meet the requirements of **Table 3**.

7.2 Duplex (Ferritic-Austenitic) Stainless Steels:

7.2.1 Duplex Stainless (Ferritic-Austenitic) Steels shall be furnished in the solution-annealed condition as noted in **Table 4**.

8. Mechanical Properties

8.1 Samples taken from product (see the section in Specification **A962/A962M** titled "Mechanical Properties") shall conform to the mechanical properties of **Tables 2-4**.

8.2 Age hardened bolting material shall be capable of meeting the requirements prescribed in **Table 3**. Impact testing is required when S1 is invoked in the purchase order or contract.

8.3 Number of Tests:

8.3.1 *Bolting Material*—See **8.4** for hardness testing of bar. See the section in Specification **A962/A962M** titled "Number of Tests" for all other tests except those covered in **8.3.2**.

8.3.2 *Full Size Bolting Components*—Headed bolts with a 1½ in. [37 mm] body diameter and smaller, with a body length three times the diameter or longer and a required maximum

tensile load of 160 000 lb/f [705 kN], produced by upsetting or forging (hot or cold) shall be subjected to full size testing. The testing shall be in addition to the tensile testing specified in **8.3.1**. The lot size shall be as shown in Specification **A962/A962M** (see the section titled Number of Tests). Failure shall occur in the body or threaded section with no failure, or indications of failure, such as cracks, at the junction of the head and shank. Wedge tensile testing is not required for flat countersunk head or socket button products.

8.4 Hardness Test:

8.4.1 *Bolting Material Bars 2 in. [50 mm] and Over*—One test on each mill-treated length.

8.4.2 *Bolting Material Bars Under 2 in. [50 mm]*—One test on at least 10 % of the mill treated lengths.

9. Nuts

9.1 Nuts made from the grades listed in this specification shall be furnished when specified in the purchase order. The mechanical test requirements of Section **8** apply in addition to requirements specified in the purchase order or contract. Hardness testing shall be done following the completion of all production heat treatment operations. See S5 for proof load testing and S6 for cross-sectional hardness testing.