



Standard Specification for Steel Castings, Stainless, Precipitation Hardening¹

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1. Scope*

1.1 This specification covers iron-chromium-nickel-copper corrosion-resistant steel castings, capable of being strengthened by precipitation hardening heat treatment.

1.2 These castings may be used in services requiring corrosion resistance and high strengths at temperatures up to 600°F [315°C]. They may be machined in the solution-annealed condition and subsequently precipitation hardened to the desired high-strength mechanical properties specified in [Table S24.1](#) with little danger of cracking or distortion.

1.3 The material is not intended for use in the solution-annealed condition.

NOTE 1—If the service environment in which the material is to be used is considered conducive to stress-corrosion cracking, precipitation hardening should be performed at a temperature that will minimize the susceptibility of the material to this type of attack.

1.4 Supplementary requirements of an optional nature are provided for use at the option of the purchaser. The Supplementary requirements shall apply only when specified individually by the purchaser in the purchase order or contract.

1.5 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.

1.6 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.

1.6.1 Within the text, the SI units are shown in brackets.

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 A01.18 on Castings.

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2. Referenced Documents

2.1 ASTM Standards:²

[A781/A781M](#) Specification for Castings, Steel and Alloy, Common Requirements, for General Industrial Use

[A957/A957M](#) Specification for Investment Castings, Steel and Alloy, Common Requirements, for General Industrial Use

[A1067/A1067M](#) Specification for Test Coupons for Steel Castings

[A1080](#) Practice for Hot Isostatic Pressing of Steel, Stainless Steel, and Related Alloy Castings

2.2 ASME Standard:³

[ASME Boiler and Pressure Vessel Code, Supplementary Requirements Section II, Part A](#)

3. General Conditions for Delivery

3.1 Except for investment castings, castings furnished to this specification shall be in accordance with the requirements of Specification [A781/A781M](#), including any supplementary requirements that are indicated in the purchase order. Failure to comply with the general requirements of Specification [A781/A781M](#) constitutes nonconformance with this specification. In case of conflict between the requirements of this specification and Specification [A781/A781M](#), this specification shall prevail.

3.2 Steel investment castings furnished to this specification shall conform to the requirements of Specification [A957/A957M](#), including any supplementary requirements that are indicated in the purchase order. Failure to comply with the general requirements of Specification [A957/A957M](#) constitutes nonconformance with this specification. In case of conflict between the requirements of this specification and Specification [A957/A957M](#), [A957/A957M](#) shall prevail.

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 of Mechanical Engineers (ASME), ASME International Headquarters, Three Park Ave., New York, NY 10016-5990, <http://www.asme.org>.

4. Ordering Information

4.1 Orders for material to this specification should include the following:

- 4.1.1 Quantity,
- 4.1.2 Specification designation and date of issue,
- 4.1.3 Grade designation **Table 1**, and
- 4.1.4 Description of casting by part, pattern, or drawing number. (Dimensional tolerances and machined surfaces should be indicated on the casting drawing).
- 4.1.5 Heat treatment condition (SA, H900, and so forth), see **5.2** and **Table 1**,
- 4.1.6 Options in the specification, if any, in accordance with **5.2** and **Section 7**, and
- 4.1.7 Supplementary requirements, if any, including the standards of acceptance.
- 4.1.8 For ASME Boiler & Pressure Vessel Code applications and equipment, if applicable, supplementary requirements S6, S14, and S27 are mandatory and shall be specified in the purchase order.

5. Materials and Manufacture

5.1 The steel shall be made by the electric furnace process with or without separate refining such as argon-oxygen decarburization (AOD).

5.2 *Heat Treatment*—Castings may be given a homogenization heat treatment in accordance with **5.2.1** at the supplier's option or when specified by the purchaser (see S56) prior to solution heat treatment. All castings, whether homogenized or not, shall be given a solution treatment in accordance with **5.2.2** and unless ordered in the solution-annealed condition shall be precipitation hardened to the ordered condition (**Table 1**).

5.2.1 Homogenization heat treatment shall consist of heating the castings and test material to a minimum of 1900°F [1040°C], holding for a minimum of 1½ h, and cooling to below 90°F [30°C].

5.2.1.1 When agreed upon between purchaser and supplier, supplementary requirement S18, Hot Isostatic Pressing (HIPing), in accordance with Practice **A1080** may be used in place of the homogenization heat treatment.

5.2.2 Solution annealing heat treatment shall consist of heating the castings and test material to 1925°F ± 50°F [1050°C ± 30°C], holding the 30 min/in. [1.2 min/mm] of section but not less than 30 min, and cooling to below 90°F [30°C].

5.2.3 Temperature used for precipitation hardening shall be maintained within the range of ±25°F [±15°C] of that listed in **Table 1** for the heat-treatment condition ordered. (See **Note 1**.)

5.2.4 When the order or contract specifies a minimum columbium (niobium) content, the minimum precipitation hardening temperature shall be 925°F [495°C].

6. Chemical Composition

6.1 The steel shall be in accordance with the requirements as to chemical composition prescribed in **Table 2**.

6.2 When the H900 condition is ordered, the minimum columbium (niobium) content (**Table 2**) shall not apply. It is recommended that columbium (niobium) other than that in revert material not be added.

7. Repair by Welding

7.1 Repairs shall be made only in one of the following conditions: homogenized, solution annealed, H1100, H1150, H1150M, H1150DBL, or stress relieved at 1150°F ± 25°F [620°C ± 15°C] for a minimum of 4 h.

7.2 Castings welded in one of the aged conditions noted in **7.1** shall be post weld heat treated by the same aging treatment used prior to welding, or, where necessary to meet mechanical property requirements, shall be solution annealed and aged after welding. Castings welded in the stress-relieved condition shall receive the specification heat treatment after welding.

7.3 When agreed upon between purchaser and supplier castings may be repaired in the as-cast condition. (See S58.)

8. Keywords

8.1 precipitation hardening stainless steel; stainless steel; steel castings

TABLE 1 Precipitation Hardening Heat Treatment^{A, B}

Condition	PH ^C Temperature, °F[°C]	Time in hours minimum	Cooling Treatment
SA	Not precipitation hardened (see 5.2.3)		
H900	900 [480]	1.5	air cool
H925	925 [495]	1.5	air cool
H1025	1025 [550]	4.0	air cool
H1075	1075 [580]	4.0	air cool
H1100	1100 [595]	4.0	air cool
H1150	1150 [620]	4.0	air cool
H1150M	1400 [760]	2.0	air cool
	1150 [620]	4.0	air cool
H1150 DBL	1150 [620]	4.0	air cool
	1150 [620]	4.0	air cool

^A The furnace and controls used shall be calibrated and capable of uniformity of heating in order to ensure consistent results.

^B See **Note 1**.

^C ±25°F [15°C].

TABLE 2 Chemical Requirements^A

Grade UNS Type	CB7Cu-1 J92180 17-4	CB7Cu-2 J92110 15-5
Carbon	0.07	0.07
Manganese	0.70	0.70
Phosphorus	0.035	0.035
Sulfur	0.03	0.03
Silicon	1.00	1.00
Chromium	15.50–17.70	14.0–15.50
Nickel	3.60–4.60	4.50–5.50
Copper	2.50–3.20	2.50–3.20
Columbium (niobium)	0.15–0.35 ^B	0.15–0.35 ^B
Nitrogen ^C	0.05	0.05

^A Limits are percent maximum unless shown as a range or stated otherwise.

^B See **5.2.4** and **6.2**. When the H900 condition is ordered, the minimum columbium content shall not apply.

^C To be determined and reported when specified by the order or contract.



SUPPLEMENTARY REQUIREMENTS

A list of standardized supplementary requirements for use at the option of the purchaser is described in Specifications **A781/A781M** and **A957/A957M**. Those that are considered suitable for use with this specification are listed below by title only. Additional supplementary requirements suitable for use with this specification at the option of the purchaser are described below. One or more of the supplementary requirements indicated below may be included in the purchaser's order or contract. When so included, a supplementary requirement shall have the same force as if it were in the body of the specification. Supplementary requirements details not fully described shall be agreed upon between the purchaser and the supplier, but shall not negate any of the requirements in the body of the specification.

S1. Magnetic Particle Examination

NOTE 2—When CB7CU-1 alloy is inspected by magnetic particle method, false indications may be caused by ferrite stringers or traces of retained austenite in the microstructure. Liquid penetrant methods may be used to confirm the presence or absence of a discontinuity when such indications are noted.

S2. Radiographic Examination**S3. Liquid Penetrant Examination****S5. Examination of Weld Preparation****S6. Certification****S10. Hardness Test**

S10.1 Rockwell or Brinell hardness tests shall be made from each heat treatment load for each heat. The results shall conform to the requirements in **Table S24.1** and shall be reported to the purchaser or his representative.

S10.2 The test method depends on the size and configuration of the casting and must be agreed upon between purchaser and supplier.

S10.3 Brinell tests may be made on the end of the tension specimen unless the order requires it to be made on a casting, in which case, where possible, the test shall be made on a boss or extension located on the casting suitable for testing in the Brinell tester.

S14. Tension Test Cut From Castings

S18. Hot Isostatic Pressing (HIPing)—In accordance with Practice **A1080**.

S24. Tension Test

S24.1 Tensile properties shall be determined from material representing each heat. The bar from which the test specimen is taken shall be heat treated with production castings to the same procedure as the castings it represents, unless the castings are ordered in the solution-annealed condition (**5.2.2**). The results shall be in accordance with the requirements specified in **Table S24.1** and shall be reported to the purchaser or his representative.

S24.2 When the contract or order specifies that the castings are to be furnished in the solution-annealed condition, the manufacturer shall test specimens representing the castings that

TABLE S24.1 Mechanical Properties

Alloy Type	PH Heat Treatment	Hardness,		Yield Strength 0.2 % Offset, min, ksi [MPa]	Tensile Strength, ksi [MPa]	Elongation in 2 in. [51 mm], min, % ^A
		HBW	HRC			
CB7Cu-1	H900	375 min	40 min	145 [1000]	170 [1170]	5
	H925	375 min	40 min	150 [1035]	175 [1205]	5
	H1025	311 min	33 min	140 [965]	150 [1035]	9
	H1075	277 min	29 min	115 [795]	145 [1000]	9
	H1100	269 min	28 min	110 [760]	135 [930]	9
	H1150	269 min	28 min	97 [670]	125 [860]	10
	H1150M	310 max	33 max	...	...	...
	H1150 DBL	310 max	33 max	...	...	...
	H900	375 min	40 min	145 [1000]	170 [1170]	5
	H925	375 min	40 min	150 [1035]	175 [1205]	5
CB7Cu-2	H1025	311 min	33 min	140 [965]	150 [1035]	9
	H1075	277 min	29 min	115 [795]	145 [1000]	9
	H1100	269 min	28 min	110 [760]	135 [930]	9
	H1150	269 min	28 min	97 [670]	125 [860]	10
	H1150M	310 max	33 max	...	...	...
	H1150 DBL	310 max	33 max	...	...	...
	H900	375 min	40 min	145 [1000]	170 [1170]	5
	H925	375 min	40 min	150 [1035]	175 [1205]	5
	H1025	311 min	33 min	140 [965]	150 [1035]	9
	H1075	277 min	29 min	115 [795]	145 [1000]	9

^A If sub-size tension test bars are used, the gauge length/gauge diameter ratio must be 4 to 1 to assure elongation values comparable with those of the standard test specimen.

have been given the precipitation heat treatment specified by the purchaser in accordance with **Table 1**.

S24.3 Where possible, the standard 2-in. [50-mm] gauge length specimens shall be used. When investment castings are ordered, specimens may be cast to shape or machined from coupons to dimensions. Standard subsize specimens may be used when a 2-in. gauge length specimen is not feasible. When subsize specimens are used, the gauge length shall be four times the gauge diameter. The recommended coupons are found in Specification **A1067/A1067M**. The specific coupon to be tested shall be agreed upon between purchaser and supplier.

S24.4 If any test specimen shows defective machining or develops flaws, it may be discarded and another specimen substituted from the same lot. A retest shall be allowed if the percentage elongation of any tension test specimen is less than that specified in **Table S24.1**, or if any part of the fracture is more than 3/4 in. [19 mm] from the center of a standard 2-in. [50-mm] gauge length established by scribe scratches on the untested specimen.

S27. Product Marking

S27.1 The manufacturer's name or identification mark and the pattern number shall be cast or stamped on all castings except those of such small size as to make such marking

impractical. To minimize small defects caused by dislodged particles of molding sand, the number of cast identification marks should be minimized. When further specified, the heat numbers shall be marked on individual castings.

S27.2 When the castings are too small to mark individually, a symbol traceable to the lot shall be placed on the castings and the required identification then placed on a tag affixed to the container in which these castings are shipped.

S56. Homogenization Heat Treatment

S56.1 The homogenization heat treatment shall consist of heating the castings and test material to a minimum of 1900°F [1040°C], holding for a minimum of 1½ h, and cooling to below 90°F [30°C].

S58. As-Cast Welding

S58.1 When agreed upon between purchaser and supplier castings may be repaired in the as-cast condition.

S58.2 When castings are welded in the as-cast condition they shall be homogenize heat treated using the Hot Isostatic Pressing process (HIPing) (see **5.2.1.1**).

SUMMARY OF CHANGES

Committee A01 has identified the location of selected changes to this standard since the last issue (A747/A747M – 16) that may impact the use of this standard. (Approved XXXX)

- (1) Added Specification **A1067/A1067M** to Section 2: Reference Documents; Removed Test Methods A0370.
- (2) Revised S10. Hardness Test: Combined Brinell and Rockwell into one supplementary requirement. Eliminated S13 and reference to Test Methods A370.
- (3) Renumbered S14 to S24. Tension Test and eliminated references to Test Methods A370; added reference to Specification **A1067/A1067M**.

- (4) Renumbered S26 to S56. Homogenization Heat Treatment.
- (5) Revised S14. Tension Test to S14. Tension Test Cut From Castings.
- (6) Renumbered Table S14.1 to S24.1 Mechanical Properties.
- (7) In Section **4.1.8**, eliminated S8, S15, and S24 and renumbered S14 to S24.
- (8) Added Rockwell C Hardness to Table 24.1.
- (9) Corrected numbering errors throughout.

Committee A01 has identified the location of selected changes to this standard since the last issue (A747/A747M – 12) that may impact the use of this standard. (Approved Feb. 1, 2016.)

- (1) Added reference to **A1080** in Section 2.
- (2) Revised wording in **4.1.8**.
- (3) Added HIP in accordance with Practice **A1080** in Section 5.
- (4) Added HIP in accordance with Practice **A1080** in Section S18.

- (5) Added new Section S58—As-Cast Welding.
- (6) Corrected numbering errors throughout.



A747/A747M – 16a

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