



Designation: A747/A747M – 23

Standard Specification for Steel Castings, Stainless, Precipitation Hardening¹

This standard is issued under the fixed designation A747/A747M; 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 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 heat-treated condition and subsequently precipitation hardened to the desired high-strength mechanical properties specified in [Table S51.1](#) with little danger of cracking or distortion.

1.3 The material is not intended for use in the solution heat-treated 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 nonconformance with the standard. Within the text, the SI units are shown in brackets.

1.7 *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 Recom-*

mendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.

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](#)

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](#), Specification [A957/A957M](#) shall prevail.

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 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>.

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

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).
- 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.
- 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, S51, and S52 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 heat treatment in accordance with 5.2.2 and, unless ordered in the solution heat-treated 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), may be used in place of the homogenization heat treatment.

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

5.2.3 The 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 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 niobium content (Table 2) shall not apply. It is recommended that niobium other than that in revert material not be added.

7. Repair by Welding

7.1 Unless agreed upon between purchaser and supplier, repairs shall be made only in one of the following conditions: homogenized, solution heat treated, H1100, H1150, H1150M, H1150DBL, or stress relieved at 1150 °F ± 25 °F [620 °C ± 15 °C] for a minimum of 4 h. See Note 2.

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 heat treated and aged after welding. Castings welded in the stress-relieved condition shall receive the specified heat treatment after welding.

7.3 When agreed upon between purchaser and supplier, castings may be repaired in the as-cast, H900, H925, H1025, and H1075 condition.

NOTE 2—Weldability will be reduced in these precipitation-hardened conditions due to high hardness, low ductility.

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

Condition	PH Temperature, ^C °F [°C]	Time in hours, minimum	Cooling Treatment
Solution heat treated	Not precipitation hardened		
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

Element	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
Niobium ^B	0.15–0.35 ^C	0.15–0.35 ^C
Nitrogen ^D	0.05	0.05

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

^B Niobium (Nb) and columbium (Cb) are interchangeable names for the same element 41.

^C See 5.2.4 and 6.2. When the H900 condition is ordered, the minimum niobium content shall not apply.

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

8. Keywords

8.1 precipitation hardening stainless steel; stainless steel; steel castings

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 S1.1—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

S14. Tension Test Cut From Castings

S18. Hot Isostatic Pressing (HIPing)

S50. Hardness Test

S50.1 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 S51.1** and shall be

reported to the purchaser or their representative.

S50.2 The test method depends on the size and configuration of the casting and must be agreed upon between purchaser and supplier.

S50.3 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.

S51. Tension Test

S51.1 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 heat-treated condition (see **5.2.2**). The results shall be in accordance with the requirements specified in **Table S51.1** and shall be reported to the purchaser or their representative.

TABLE S51.1 Mechanical Properties^{A,B}

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

^A Where ellipses (. . .) appear there is no requirement and values need not be reported.

^B All values are minimums unless stated as a maximum.

^C If subsize tension test bars are used, the gauge length/gauge diameter ratio must be 4 to 1 to ensure elongation values comparable with those of the standard test specimen.