Designation: A 747/A 747M – 04

Standard Specification for Steel Castings, Stainless, Precipitation Hardening[1]

This standard is issued under the fixed designation A 747/A 747M; 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-annealed condition and subsequently precipitation hardened to the desired high-strength mechanical properties specified in Table S14.1 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 The values stated in either inch-pound units or SI units are to be regarded separately as standard. Within the text, the 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.

2. Referenced Documents

2.1 *ASTM Standards:* [2]

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

A 732/A 732M Specification for Castings, Investment, Carbon and Low Alloy Steel for General Application, and Cobalt Alloy for High Strength at Elevated Temperatures

A 781/A 781M Specification for Castings, Steel and Alloy, Common Requirements, for General Industrial Use

E 38 Methods for Chemical Analysis of Nickel-Chromium and Nickel-Chromium-Iron Alloys[3]

E 353 Test Methods for Chemical Analysis of Stainless, Heat-Resisting, Maraging, and Other Similar Chromium-Nickel-Iron Alloys

2.2 *ASME Standard:*[4]

ASME Boiler and Pressure Vessel Code, Supplementary Requirements S6, S14, and S27

3. General Conditions for Delivery

3.1 Material furnished to this specification shall be in accordance with the requirements of Specification A 781/A 781M, including any supplementary requirements that are indicated in the purchase order. Failure to comply with the general requirements of Specification A 781/A 781M constitutes nonconformance with this specification. In case of conflict between the requirements of this specification and Specification A 781/A 781M, this specification shall prevail.

4. Ordering Information

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

4.1.1 Specification number and grade (Table 1),

4.1.2 Heat treatment condition (SA, H900, and so forth), Table 2,

4.1.3 Drawing or pattern,

4.1.4 Options in the specification, if any, in accordance with 5.2, 6.3, and Section 7, and

4.1.5 Supplementary requirements, if any, including the standards of acceptance.

4.1.6 Notice when the castings are to be used in equipment covered by the ASME Boiler and Pressure Vessel Code, Supplementary Requirements S6, S14, and S27 are mandatory and must 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).

[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.

Current edition approved Sept. 1, 2004. Published September 2004. Originally approved in 1977. Last previous edition approved in 1999 as A 747/A 747M – 99.

[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] Withdrawn.

[4] Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Three Park Ave., New York, NY 10016-5990.

TABLE 1 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	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 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.

TABLE 2 Precipitation Hardening Heat Treatment[A,B]

Condition	PH[C] Temperature, °F[°C]	Time, h and min	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].

5.2 *Heat Treatment*—Castings may be given a homogenization heat treatment in accordance with 5.2.1 at the producer's option or when specified by the purchaser (see S26) 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 2).

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].

5.2.2 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 2 for the heat-treatment condition ordered. (See Note 1)

5.2.4 When the order of contract specifies a minimum columbium 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 1.

6.2 When the H900 condition is ordered, the minimum columbium content (Table 1) shall not apply. It is recommended that columbium other than that in revert material not be added.

6.3 *Methods of Analysis*—Analytical procedures for nitrogen analysis are not included in Methods E 38 or Test Methods E 353, so if the contract or order specifies that the nitrogen content is to be reported, the method of analysis shall be agreed upon by purchaser and producer.

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.

8. Keywords

8.1 precipitation hardening stainless steel; stainless steel; steel castings