



# Standard Specification for Steel Castings, Stainless, Precipitation Hardening<sup>1</sup>

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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.

<sup>1</sup> 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:<sup>2</sup>

[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:<sup>3</sup>

[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.

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

<sup>3</sup> 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**, 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**<sup>A, B</sup>

| Condition | PH <sup>C</sup> Temperature, °F[°C]            | Time in hours minimum | Cooling Treatment |
|-----------|--|-----------------------|-------------------|
| SA        | Not precipitation hardened (see <b>5.2.3</b> ) |                       |                   |
| 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          |

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

<sup>B</sup> See **Note 1**.

<sup>C</sup> ±25°F [15°C].

**TABLE 2 Chemical Requirements**<sup>A</sup>

| Grade                 | CB7Cu-1                | CB7Cu-2                |
|-----------------------|------------------------|------------------------|
| UNS                   | J92180                 | J92110                 |
| Type                  | 17-4                   | 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 <sup>B</sup> | 0.15–0.35 <sup>B</sup> |
| Nitrogen <sup>C</sup> | 0.05                   | 0.05                   |

<sup>A</sup> Limits are percent maximum unless shown as a range or stated otherwise.

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

<sup>C</sup> To be determined and reported when specified by the order or contract.