
Standard Specification for Castings, Iron-Chromium, Iron- Chromium-Nickel, Corrosion Resistant, for General Application

AASHTO Designation: M 163M/M 163-24¹

Technically Revised: 2024

Editorially Revised: 2024

Technical Subcommittee: 4f, Metals

ASTM Designation: A743/A743M-21



**American Association of State Highway and Transportation Officials
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1. SCOPE

- 1.1. This specification covers iron-chromium and iron-chromium-nickel alloy castings for general corrosion-resistant application. The grades covered by this specification represent types of alloy castings suitable for broad ranges of application, which are intended for a wide variety of corrosion environments.
- Note 1**—For alloy castings for severe corrosion-resistant service, reference should be made to M 285M/M 285. For general heat-resistant alloy castings, reference should be made to ASTM A297/A297M. For nickel alloy castings for corrosion-resistant service, reference should be made to ASTM A494/A494M.
- 1.2. The values stated either in SI units or inch-pound units are to be regarded separately as standard. Within the text, the inch-pound 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. SI units are applicable for material ordered to M 163M and inch-pound units are applicable for material ordered to M 163.
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2. REFERENCED DOCUMENTS

- 2.1. *AASHTO Standards:*
- M 285M/M 285, Castings, Iron-Chromium-Nickel, Corrosion Resistant, for Severe Service
 - M 339M/M 339, Thermometers Used in the Testing of Construction Materials
 - T 244, Mechanical Testing of Steel Products
- 2.2. *ASTM Standards:*
- A262, Standard Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels
 - A297/A297M, Standard Specification for Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat Resistant, for General Application
 - A494/A494M, Standard Specification for Castings, Nickel and Nickel Alloy

- A781/A781M, Standard Specification for Castings, Steel and Alloy, Common Requirements, for General Industrial Use
- A890/A890M, Standard Specification for Castings, Iron-Chromium-Nickel-Molybdenum Corrosion-Resistant, Duplex (Austenitic/Ferritic) for General Application
- A957/A957M, Standard Specification for Investment Castings, Steel and Alloy, Common Requirements, for General Industrial Use
- E1, Standard Specification for ASTM Liquid-in-Glass Thermometers
- E230, Standard Specification and Temperature-Electromotive Force (emf) Tables for Standardized Thermocouples
- E2877, Standard Guide for Digital Contact Thermometers

2.3. *Other Standard:*

- IEC 60584-1: 2013, Thermocouples - Part 1: EMF specifications and tolerances

3. GENERAL CONDITIONS FOR DELIVERY

- 3.1. Except for investment castings, castings furnished to this specification shall conform to the requirements of ASTM A781/A781M, including any supplementary requirements that are indicated on the purchase order. Failure to comply with the general requirements of ASTM A781/A781M constitutes nonconformance with this specification. In case of conflict between the requirements of this specification and ASTM A781/A781M, this specification shall prevail.
- 3.2. Steel investment castings furnished to this specification shall conform to the requirements of ASTM A957/A957M, including any supplementary requirements that are indicated in the purchase order. Failure to comply with the general requirements of ASTM A957/A957M constitutes nonconformance with this specification. In case of conflict between the requirements of this specification and ASTM A957/A957M, this specification shall prevail.

4. ORDERING INFORMATION

- 4.1. *Orders for material to this specification should include the following, as required, to describe the material adequately:*
- 4.1.1. Description of the casting by pattern number or drawing,
- 4.1.2. Grade,
- 4.1.3. Heat treatment,
- 4.1.4. Options in the specification,
- 4.1.5. Whether castings are to be produced using the investment casting process, and
- 4.1.6. Supplementary requirements desired, including the standards of acceptance.

5. PROCESS

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

6. HEAT TREATMENT

- 6.1. Castings shall be heat treated in accordance with the requirements in Table 1. The oven or furnace used to heat castings shall be capable of operation at the temperatures required and shall have an indicating controller or pyrometer accurate within $\pm 10^{\circ}\text{C}$ [$\pm 18^{\circ}\text{F}$], as corrected, if necessary, by standardization (see Note 2).
- 6.1.1. When measuring temperatures during heat treatment, the thermometer for measuring oven or furnace temperature shall meet the requirements of M 339M/M 339 with a temperature range of at least 550 to 1260°C (1022 to 2300°F), and an accuracy of $\pm 5^{\circ}\text{C}$ [$\pm 9^{\circ}\text{F}$] (see Note 3).
- 6.1.2. When measuring temperatures during heat treatment, the thermometer for measuring the temperature of the specimen being heated shall meet the requirements of M 339M/M 339 with a temperature range of at least 550 to 1260°C (1022 to 2300°F), and an accuracy of $\pm 5^{\circ}\text{C}$ [$\pm 9^{\circ}\text{F}$] (see Note 4).

Note 2—Proper heat treatment of these alloys is usually necessary to enhance corrosion resistance and, in some cases, to meet mechanical properties. Minimum heat-treat temperatures are specified; however, it is sometimes necessary to heat treat at higher temperatures, hold for some minimum time at temperature, and then rapidly cool the castings in order to enhance the corrosion resistance and meet mechanical properties.

Note 3—Thermometer types suitable for use include ASTM E230 thermocouple thermometer, Type K, Class Special.

Note 4—Thermometer types suitable for use include ASTM E2877 digital metal stem thermometers or non-contact infrared thermometers.

Table 1—Heat Treatment Requirements

Grade	Heat Treatment
CA6N	Heat to 1040°C [1900°F], air cool, reheat to 815°C [1500°F], air cool, and age at 425°C [800°F], holding at each temperature sufficient time to heat casting uniformly to temperature.
CA6NM	Heat to 1010°C [1850°F] minimum, air cool to 95°C [200°F] or lower prior to any optional intermediate temper and prior to the final temper. The final temper shall be between 565°C [1050°F] and 620°C [1150°F].
CA15, CA15M, CA40, CA40F	(1) Heat to 955°C [1750°F] minimum, air cool and temper at 595°C [1100°F] minimum, or (2) Anneal at 790°C [1450°F] minimum.
CA28MWV	(1) Heat to 1025–1050°C [1875–1925°F], quench in air or oil, and temper at 620°C [1150°F] minimum, or (2) Anneal at 760°C [1400°F] minimum.
CB30, CC50	(1) Heat to 790°C [1450°F] minimum and air cool, or (2) Heat to 790°C [1450°F] minimum and furnace cool.
CB6	Heat between 980°C [1800°F] and 1050°C [1920°F], forced air, cool to 50°C [120°F] maximum, and temper between 595°C and 625°C [1100°F and 1160°F].
CE30, CH10, CH20, CK20	Heat to 1093°C [2000°F] minimum, hold for sufficient time to heat casting to temperature, quench in water or rapid cool by other means.
CF3, CF3M, CF3MN	(1) Heat to 1040°C [1900°F] minimum, hold for sufficient time to heat casting to temperature, quench in water or rapid cool by other means. (2) As cast if corrosion resistance is acceptable.
CF8, CF8C, CF8M, CF16F, CF16Fa, CF20, CG3M, CG8M, CG12	Heat to 1040°C [1900°F] minimum, hold for sufficient time to heat casting to temperature, quench in water or rapid cool by other means.
CF10SMnN	Heat to 1065°C [1950°F] minimum, hold for sufficient time to heat casting to temperature, quench in water or rapid cool by other means.
CK3MCuN, CK35MN, CN3M, CN3MN	Heat to 1200°C [2200°F] minimum, hold for 4 h minimum, quench in water or rapid cool by other means.
CG6MMN, CN7M	Heat to 1120°C [2050°F] minimum, hold for sufficient time to heat casting to temperature, quench in water or rapid cool by other means.
CN7MS	Heat to 1150°C [2100°F] minimum, 1180°C [2150°F] maximum, hold for sufficient time (2 h minimum) to heat casting to temperature and quench in water.
HG10MNN	As-cast

7. CHEMICAL REQUIREMENTS

7.1. The chemical requirements are shown in Table 2.