



Designation: A451/A451M – 19

# Standard Specification for Centrifugally Cast Austenitic Steel Pipe for High-Temperature Service<sup>1</sup>

This standard is issued under the fixed designation A451/A451M; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope\*

1.1 This specification<sup>2</sup> covers austenitic alloy steel pipe for use in high-temperature, corrosive, or nuclear pressure service.

1.2 Several grades of austenitic stainless steel are covered as indicated in [Table 1](#).

1.3 Optional supplementary requirements are provided when additional testing may be required.

1.4 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.

NOTE 1—This specification is not intended to cover centrifugal pipe made from alloys containing more than 0.20 % carbon, such as are covered by Specification [A297/A297M](#).

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

1.5 *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 Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

## 2. Referenced Documents

2.1 *ASTM Standards:*<sup>3</sup>

[A297/A297M Specification for Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat Resistant, for General Application](#)

<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.

Current edition approved March 1, 2019. Published April 2019. Originally approved in 1961. Last previous edition approved in 2014 as A451/A451M – 14. DOI: 10.1520/A0451\_A0451M-19.

<sup>2</sup> For ASME Boiler and Pressure Vessel Code applications see related specification SA-451 in Section II of that Code.

<sup>3</sup> 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.

[A999/A999M Specification for General Requirements for Alloy and Stainless Steel Pipe](#)

[E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications](#)

[E94/E94M Guide for Radiographic Examination Using Industrial Radiographic Film](#)

[E165/E165M Practice for Liquid Penetrant Testing for General Industry](#)

[E186 Reference Radiographs for Heavy-Walled \(2 to 4½ in. \(50.8 to 114 mm\)\) Steel Castings](#)

[E280 Reference Radiographs for Heavy-Walled \(4½ to 12 in. \(114 to 305 mm\)\) Steel Castings](#)

[E446 Reference Radiographs for Steel Castings Up to 2 in. \(50.8 mm\) in Thickness](#)

2.2 *ANSI Standard:*<sup>4</sup>

[B46.1 Surface Texture](#)

## 3. Ordering Information

3.1 Orders for material to this specification shall include the following, as required, to describe the desired material adequately:

3.1.1 Quantity (feet, meters, or number of lengths),

3.1.2 Name of material (centrifugally cast pipe),

3.1.3 Grade ([Table 1](#)),

3.1.4 Size (outside or inside diameter and minimum wall thickness in inches or millimeters),

3.1.5 Length (specific or random, Specification [A999/A999M](#)),

3.1.6 End finish of Specification [A999/A999M](#),

3.1.7 Optional requirements ([9.4](#) and Supplementary Requirements S1 through S7),

3.1.8 Test report required ([Section 14](#)), and

3.1.9 Special requirements or additions to specification.

## 4. Materials and Manufacture

4.1 *Heat Treatment*—The pipe shall receive a heat treatment at the temperature and time specified in [Table 2](#), followed by a quench in water or rapid cool by other means.

<sup>4</sup> Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

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

**TABLE 1 Composition Requirements<sup>A,B</sup>**

Grade (UNS Number)	Element, %										
	Carbon	Manga- nese	Phospho- rus	Sulfur	Silicon	Nickel	Chromium	Molybde- num	Niobium <sup>C</sup>	Tantalum	Nitrogen
CPF3 (J92500)	0.03	1.50	0.040	0.040	2.00	8.0–12.0	17.0–21.0	...	...	...	...
CPF3A (J92500)	0.03	1.50	0.040	0.040	2.00	8.0–12.0	17.0–21.0	...	...	...	...
CPF8 (J92600)	0.08	1.50	0.040	0.040	2.00	8.0–11.0	18.0–21.0	...	...	...	...
CPF8A (J92600)	0.08	1.50	0.040	0.040	2.00	8.0–11.0	18.0–21.0	...	...	...	...
CPF3M (J92800)	0.03	1.50	0.040	0.040	1.50	9.0–13.0	17.0–21.0	2.0–3.0	...	...	...
CPF8M (J92804)	0.08	1.50	0.040	0.040	1.50	9.0–12.0	18.0–21.0	2.0–3.0	...	...	...
CPF10MC <sup>D</sup>	0.10	1.50	0.040	0.040	1.50	13.0–16.0	15.0–18.0	1.75–2.25	1.2 max, 10 × C min	...	...
CPF8C <sup>D</sup> (J92710)	0.08	1.50	0.040	0.040	2.00	9.0–12.0	18.0–21.0	...	1 max, 8 × C min	...	...
CPF8C (Ta max) <sup>E</sup>	0.08	1.50	0.040	0.040	2.00	9.0–12.0	18.0–21.0	...	1 max, 8 × C min	0.10	...
CPH8 (J93400)	0.08	1.50	0.040	0.040	1.50	12.0–15.0	22.0–26.0	...	...	...	...
CPH20 or CPH10 (J93402)	0.20 <sup>F</sup>	1.50	0.040	0.040	2.00	12.0–15.0	22.0–26.0	...	...	...	...
CPK20 (J94202)	0.20	1.50	0.040	0.040	1.75	19.0–22.0	23.0–27.0	...	...	...	...
CPE20N (J92802)	0.20	1.50	0.040	0.040	1.50	8.0–11.0	23.0–26.0	...	...	...	0.08–0.20

<sup>A</sup> Where ellipses (...) appear in this table there is no requirement, and the element need not be analyzed or reported.

<sup>B</sup> Values are maximums unless a range or a minimum is provided.

<sup>C</sup> Columbium (Cb) and Niobium (Nb) are interchangeable names for the same element 41.

<sup>D</sup> Grades CPF10MC and CPF8C may have a columbium plus tantalum content maximum of 1.35 %.

<sup>E</sup> No designation as yet assigned by ASTM International or Steel Founders' Society of America.

<sup>F</sup> By agreement between the manufacturer and the purchaser, the carbon content of Grade CPH20 may be restricted to 0.10 % max. When so agreed, the grade designation shall be CPH10.

**TABLE 2 Heat Treatment Requirements**

Grade	Temperature, min		Hold Time, h/in. of Thickness
	°F	°C	
CPF3, CPF3A, CPF8, CPF8A, CPF3M, CPF8M	1900	1040	1
CPF10MC, CPF8C, CPF8C (Ta max)	1950	1065	2
CPH8, CPH10, CPH20, CPK20	2100	1150	1
CPE20N	2225	1220	1

**4.2 Machining**—The pipe shall be machined on the inner and outer surfaces to a roughness value no greater than 250 μin. [6.35 μm] arithmetical average deviation (AA) from the mean line, as defined in American National Standard B46.1.

## 5. Chemical Composition

**5.1 Heat Analysis**—An analysis of each heat shall be made by the manufacturer to determine the percentages of elements specified in **Table 1**. The analysis shall be made on a test sample taken preferably during the pouring of the heat. The chemical composition thus determined shall conform to the requirements specified in **Table 1**.

**5.2 Product Analysis**—A product analysis may be made by the purchaser. The sample for analysis shall be selected so as to be thoroughly representative of the pipe being analyzed. The chemical composition thus determined shall conform to the requirements specified in **Table 1**.