



Designation: A 426/A 426M – 05

Standard Specification for Centrifugally Cast Ferritic Alloy Steel Pipe for High- Temperature Service¹

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1. Scope*

1.1 This specification² covers centrifugally cast alloy steel pipe intended for use in high-temperature, high-pressure service.

1.2 Several grades of ferritic steels are covered. Their compositions are given in [Table 1](#).

1.3 Supplementary Requirements S1 through S12 are provided. The supplementary requirements provide for additional tests of an optional nature and when desired shall be so stated in the order (Section 4).

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 each other. Combining values from the two systems may result in nonconformance with the specification.

2. Referenced Documents

2.1 ASTM Standards:³

[A 370](#) Test Methods and Definitions for Mechanical Testing of Steel Products

[A 609/A 609M](#) Practice for Castings, Carbon, Low-Alloy, and Martensitic Stainless Steel, Ultrasonic Examination Thereof

[A 941](#) Terminology Relating to Steel, Stainless Steel, Related Alloys, and Ferroalloys

[A 999/A 999M](#) Specification for General Requirements for Alloy and Stainless Steel Pipe

[E 94](#) Guide for Radiographic Examination

[E 165](#) Test Method for Liquid Penetrant Examination

[E 186](#) Reference Radiographs for Heavy-Walled (2 to 4½-in. [51 to 114-mm]) Steel Castings

[E 208](#) Test Method for Conducting Drop-Weight Test to Determine Nil-Ductility Transition Temperature of Ferritic Steels

[E 280](#) Reference Radiographs for Heavy-Walled (4½ to 12-in. [114 to 305-mm]) Steel Castings

[E 446](#) Reference Radiographs for Steel Castings Up to 2 in. [51 mm] in Thickness

[E 709](#) Practice for Magnetic Particle Examination

2.2 *ANSI Standard:*⁴

[B46.1](#) Surface Texture

2.3 *ASME Boiler and Pressure Vessel Code:*⁵

[Section IX](#) Welding Qualifications

3. Ordering Information

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

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

3.1.2 Name of material (centrifugally cast pipe),

3.1.3 Specification number,

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

3.1.5 Size (outside or inside diameter and minimum wall thickness),

3.1.6 Length (specific or random) (Section on Permissible Variations in Length of Specification [A 999/A 999M](#)),

3.1.7 End finish (Section on Ends of Specification [A 999/A 999M](#)),

3.1.8 Optional Requirements S1 through S12 and Section 14.1,

3.1.9 Test report required (Section on Certified Test Report of Specification [A 999/A 999M](#)),

3.1.10 Service temperature if over 1000°F [540°C] ([Note 1](#)), and

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 ASME Boiler and Pressure Vessel Code applications see related Specification SA-426 in Section II of that Code.

³ 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.

⁴ Available from American National Standards Institute, 25 W. 43rd St., 4th Floor, New York, NY 10036.

⁵ Available from American Society of Mechanical Engineers (ASME), Three Park Ave., New York, NY 10016-5990.

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

TABLE 1 Chemical Requirements

| Composition, % | | | | | | | |
|----------------|-----------|-----------|----------------------|-------------|-----------|------------|------------|
| Grade | Carbon | Manganese | Phos- phorus, max | Sulfur, max | Silicon | Chromium | Molybdenum |
| CP1 | 0.25 max | 0.30-0.80 | 0.040 | 0.045 | 0.10-0.50 | ... | 0.44-0.65 |
| CP2 | 0.10–0.20 | 0.30-0.61 | 0.040 | 0.045 | 0.10-0.50 | 0.50-0.81 | 0.44-0.65 |
| CP5 | 0.20 max | 0.30-0.70 | 0.040 | 0.045 | 0.75 max | 4.00-6.50 | 0.45-0.65 |
| CP5b | 0.15 max | 0.30-0.60 | 0.040 | 0.045 | 1.00-2.00 | 4.00-6.00 | 0.45-0.65 |
| CP9 | 0.20 max | 0.30-0.65 | 0.040 | 0.045 | 0.25-1.00 | 8.00-10.00 | 0.90-1.20 |
| CP11 | 0.05–0.20 | 0.30-0.80 | 0.040 | 0.045 | 0.60 max | 1.00-1.50 | 0.44-0.65 |
| CP12 | 0.05–0.15 | 0.30-0.61 | 0.040 | 0.045 | 0.50 max | 0.80-1.25 | 0.44-0.65 |
| CP15 | 0.15 max | 0.30-0.60 | 0.040 | 0.045 | 0.15-1.65 | ... | 0.44-0.65 |
| CP21 | 0.05–0.15 | 0.30-0.60 | 0.040 | 0.045 | 0.50 max | 2.65-3.35 | 0.80-1.06 |
| CP22 | 0.05–0.15 | 0.30-0.70 | 0.040 | 0.045 | 0.60 max | 2.00-2.75 | 0.90-1.20 |
| CPCA15 | 0.15 max | 1.00 max | 0.040 | 0.040 | 1.50 max | 11.5-14.0 | 0.50 max |

3.1.11 Special requirements or additions to specification.

4. General Requirements for Delivery

4.1 Material furnished under this specification shall conform to the applicable requirements of the current edition of Specification **A 999/A 999M** unless otherwise provided herein.

5. Materials and Manufacture

5.1 *Heat-Treatment*—The pipe shall be furnished in the normalized and tempered or liquid-quenched and tempered condition (**Note 1**). The temperature for tempering shall not be less than 1250°F [675°C] except for Grades CP1, CP2, CP11, CP12, and CP15 for which the temperature for tempering shall not be less than 1100°F [595°C].

5.1.1 Heat treatment shall be performed after the pipe has been allowed to cool below the transformation range. Definition of heat-treatment terms shall be as given in Terminology **A 941**.

NOTE 1—It is recommended that the temperature for tempering should be at least 100°F [55°C] above the intended service temperature. The purchaser shall advise the manufacturer of the service temperature when it is over 1000°F [540°C].

5.2 *Machining*—The pipe shall be machined on the inner and outer surfaces to a roughness value no greater than 250 μ in. [6.35 μm] arithmetical average deviation (AA) from the mean line unless otherwise specified as in ANSI **B46.1**.

6. Chemical Analysis

6.1 *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 preferable during the pouring of the heat. The chemical composition thus determined shall conform to the requirements specified in **Table 1**.

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

7. Tensile and Hardness Requirements

7.1 Steel used for the castings shall conform to the tensile and hardness requirements specified in **Table 2**.

TABLE 2 Tensile Properties and Hardness Requirements

| | |
|--|--------------|
| Tensile strength, min, psi [MPa]: | |
| Grade CP1 | 65 000 [450] |
| Grades CP11, CP22 | 70 000 [485] |
| Grades CP5, CP9, CPCA15 | 90 000 [620] |
| All other grades | 60 000 [415] |
| Yield strength, min, psi [MPa]: | |
| Grade CP1 | 35 000 [240] |
| Grades CP11, CP22 | 40 000 [275] |
| Grades CP5, CP9 | 60 000 [415] |
| Grade CPCA15 | 65 000 [450] |
| All other grades | 30 000 [205] |
| Elongation, min, %: ^A | |
| Grade CP1 | 24 |
| Grades CP11, CP22 | 20 |
| Grades CP5, CP9, CPCA15 | 18 |
| All other grades | 22 |
| Reduction of area, min, %: | |
| Grades CP1, CP2, CP11, CP12, CP15, CP21, CP22, CP5, CP5b, CP7, CP9 | 35 |
| Grade CPCA15 | 30 |
| Hardness, max, HB: | |
| Grades CP5, CP5b, CP9, CPCA15 | 225 |
| All other grades | 201 |

^AElongation in 2 in. [50 mm] using a standard round specimen, in either the transverse or longitudinal direction.

8. Permissible Variations in Dimensions

8.1 *Thickness*—The wall thickness shall not vary over that specified by more than 1/8 in. [3 mm]. There shall be no variation under the specified wall thickness.

9. Number of Tests

9.1 One tension and one hardness test shall be made from each heat.

9.2 If a specimen is machined improperly or if flaws are revealed by machining or during testing, the specimen may be discarded and another substituted from the same heat.

10. Retests

10.1 If the results of the mechanical tests for any heat do not conform to the requirements specified, the castings may be reheated and retested, but may not be re-austenitized more than twice.

11. Test Specimens

11.1 Test coupons from which tension test specimens are prepared shall be removed from heat-treated casting prolongations.