Designation: A426/A426M – 11

Standard Specification for Centrifugally Cast Ferritic Alloy Steel Pipe for High-Temperature Service[1]

This standard is issued under the fixed designation A426/A426M; 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[2] 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. 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.

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

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[3]

A370 Test Methods and Definitions for Mechanical Testing of Steel Products

A609/A609M Practice for Castings, Carbon, Low-Alloy, and Martensitic Stainless Steel, Ultrasonic Examination Thereof

A941 Terminology Relating to Steel, Stainless Steel, Related Alloys, and Ferroalloys

A999/A999M Specification for General Requirements for Alloy and Stainless Steel Pipe

E94 Guide for Radiographic Examination

E165 Practice for Liquid Penetrant Examination for General Industry

E186 Reference Radiographs for Heavy-Walled (2 to 412-in. (50.8 to 114-mm)) Steel Castings

E208 Test Method for Conducting Drop-Weight Test to Determine Nil-Ductility Transition Temperature of Ferritic Steels

E280 Reference Radiographs for Heavy-Walled (412 to 12-in. (114 to 305-mm)) Steel Castings

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

E709 Guide for Magnetic Particle Testing

2.2 *ANSI Standard:*[4]

B46.1 Surface Texture

2.3 *ASME Boiler and Pressure Vessel Code:*[5]

Section IX Welding and Brazing Qualifications

2.4 *AWS Specifications*[6]

A5.5/A5.5M Low Alloy Steel Electrodes for Shielded Metal Arc Welding

A5.23/A5.23M Low Alloy Steel Electrodes and Fluxes for Submerged Arc Welding

A5.28/A5.28M Low Alloy Steel Electrodes and Rods for Gas Shielded Arc Welding

A5.29/A5.29M Low-Alloy Steel Electrodes for Flux Cored Arc Welding

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,

[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 (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

[5] Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Three Park Ave., New York, NY 10016-5990, http://www.asme.org.

[6] Available from American Welding Society, 550 NW LeJuene Rd., Miami, FL 33126, http://www.aws.org

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

TABLE 1 Chemical Requirements[A]

Grade	UNS Number	Composition, % Carbon	Manganese	Phosphorus, max	Sulfur, max	Silicon	Chromium	Molybdenum	Other
CP1	J12521	0.25 max	0.30-0.80	0.030	0.025	0.10-0.50	. . .	0.44-0.65	. . .
CP2	J11547	0.10–0.20	0.30-0.61	0.030	0.025	0.10-0.50	0.50-0.81	0.44-0.65	. . .
CP5	J42045	0.20 max	0.30-0.70	0.030	0.025	0.75 max	4.00-6.50	0.45-0.65	. . .
CP5b	J51545	0.15 max	0.30-0.60	0.030	0.025	1.00-2.00	4.00-6.00	0.45-0.65	. . .
CP9	J82090	0.20 max	0.30-0.65	0.030	0.025	0.25-1.00	8.00-10.00	0.90-1.20	. . .
CP91	J84090	0.08–0.12	0.30–0.60	0.030	0.010	0.20–0.50	8.0–9.5	0.85–1.05	nickel, 0.40 max.; columbium, 0.060–0.10; nitrogen, 0.030–0.070; vanadium, 0.18–0.25; aluminum, 0.02 max.; titanium, 0.01 max; zirconium, 0.01 max.
CP11	J12072	0.05–0.20	0.30-0.80	0.030	0.025	0.60 max	1.00-1.50	0.44-0.65	. . .
CP12	J11562	0.05–0.15	0.30-0.61	0.030	0.025	0.50 max	0.80-1.25	0.44-0.65	. . .
CP15	J11522	0.15 max	0.30-0.60	0.030	0.025	1.15-1.65	. . .	0.44-0.65	. . .
CP21	J31545	0.05–0.15	0.30-0.60	0.030	0.025	0.50 max	2.65-3.35	0.80-1.06	. . .
CP22	J21890	0.05–0.15	0.30-0.70	0.030	0.025	0.60 max	2.00-2.75	0.90-1.20	. . .
CPCA15	J91150	0.15 max	1.00 max	0.030	0.025	1.50 max	11.5-14.0	0.50 max	. . .

[A] Where ellipses appear in this table there is no requirement.

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 A999/A999M),

3.1.7 End finish (Section on Ends of Specification A999/A999M),

3.1.8 Optional Requirements S1 through S12 and Section 15.1,

3.1.9 Test report required (Section on Certified Test Report of Specification A999/A999M),

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

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 A999/A999M 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]. Grade CP91 shall be ausenitized at 1900 – 1975 °F (1040 – 1080 °C) and tempered at 1350 – 1470 °F (730 – 800 °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 A941.

NOTE 1—Except for Grade CP91, 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 (Note 2).

NOTE 2—The role of alloying elements in the development of Grade CP91 has been extensively investigated. V and Nb contribute to precipitation strengthening by forming fine and coherent precipitation of M(C,N)X carbo-nitrides in the ferrite matrix. V also precipitates as VN during tempering or during creep. Therefore, the addition of strong nitride