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Standard Specification for Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over)[1]

This standard is issued under the fixed designation A139/A139M; 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~~ Scope*

1.1 This specification covers five grades of electric-fusion (arc)-welded straight-seam or helical-seam steel pipe. Pipe of NPS 4 (Note 1) and larger with nominal (average) wall thickness of 1.0 in. [25.4 mm] and less are covered. Listing of standardized dimensions are for reference (Note 2). The grades of steel are pipe mill grades having mechanical properties which differ from standard plate grades. The pipe is intended for conveying liquid, gas, or vapor.

NOTE 1—The dimensionless designator NPS (nominal pipe size) has been substituted in this standard for such traditional terms as "nominal ~~diameter,"~~ ~~size,"~~diameter," "size," and "nominal size."

NOTE 2—A comprehensive listing of standardized pipe dimensions is contained in ASME B36.10M.

NOTE 3—The suitability of pipe for various purposes is somewhat dependent on its dimensions, properties, and conditions of service. For example, for high-temperature service see applicable codes and Specification A691.

1.2 The values stated in either inch-pound units or in SI units are to be regarded separately as standard. Within the text, the SI units are shown in brackets. The values in each system are not exact equivalents; therefore, each system is to be used independently of the other.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

A370 Test Methods and Definitions for Mechanical Testing of Steel Products

A691 Specification for Carbon and Alloy Steel Pipe, Electric-Fusion-Welded for High-Pressure Service at High Temperatures

A751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products

~~E59 Practice for Sampling Steel and Iron for Determination of Chemical Composition (Withdrawn 1996)~~[3]

2.2 *American Welding Society Standard:*[3]

AWS B2.1 Standard for Welding Procedure and Performance Qualifications Welding Handbook, Vol 1, 8th ed

2.3 *ASME Standards:*[4]

ASME B36.10M Welded and Seamless Wrought Steel Pipe

ASME B36.19M Stainless Steel Pipe

ASME Boiler and Pressure Vessel Code, Section IX

3. Ordering Information

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

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

3.1.2 Name of material (electric-fusion-(arc) welded steel pipe),

3.1.3 Grade (Table 1),

3.1.4 Size (NPS, or outside diameter, and nominal wall thickness, or schedule number),

3.1.5 Lengths (specific or random, Section 17),

3.1.6 End finish (Section 18),

[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 A01.09 on Carbon Steel Tubular Products.

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[2] 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.

[3] Available from American Welding Society (AWS), 550 NW LeJeune Rd., Miami, FL 33126, http://www.aws.org.

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

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

TABLE 1 Chemical Requirements

Element	Composition, max, %				
	Grade A	Grade B	Grade C	Grade D	Grade E
Carbon	0.25	0.26	0.28	0.30	0.30
Manganese	1.00	1.00	1.20	1.30	1.40
Phosphorus	0.035	0.035	0.035	0.035	0.035
Sulfur	0.035	0.035	0.035	0.035	0.035

3.1.7 Hydrostatic test pressure (Section 16, Note 8, and Note 9),
3.1.8 ASTM specification designation, and
3.1.9 End use of material.

4. Process

4.1 The steel shall be made by one or more of the following processes: open-hearth, basic-oxygen, or electric-furnace.

4.2 Steel may be cast in ingots or may be strand cast. When steels of different grades are sequentially strand cast, identification of the resultant transition material is required. The producer shall remove the transition material by any established procedure that positively separates the grades.

NOTE 4—The term "basic-oxygen steelmaking" is used generically to describe processes in which molten iron is refined to steel under a basic slag in a cylindrical furnace lined with basic refractories, by directing a jet of high-purity gaseous oxygen onto the surface of the hot metal bath.

5. Manufacture

5.1 The longitudinal edges of the steel shall be shaped to give the most satisfactory results by the particular welding process employed. The weld shall be made by automatic (Note 5) means (except tack welds if used) and shall be of reasonably uniform width and height for the entire length of the pipe.

NOTE 5—Upon agreement between the purchaser and the manufacturer, manual welding by qualified procedure and welders may be used as an equal alternative under these specifications.

5.2 All weld seams made in manufacturing pipe shall be made using complete joint penetration groove welds.

6. Chemical Composition

6.1 The steel shall conform to the chemical requirements prescribed in Table 1 and the chemical analysis shall be in accordance with Test Methods, Practices, and Terminology A751.

7. Tensile Requirements for the Steel

7.1 Longitudinal tension test specimens taken from the steel shall conform to the requirements as to tensile properties prescribed in Table 2. At the manufacturer's option, the tension test specimen for sizes 8⅝ in. [219.1 mm] in outside diameter and larger may be taken transversely as described in 19.4.

7.2 The yield point shall be determined by the drop of the beam, by the halt in the gage of the testing machine, by the use of dividers, or by other approved methods. The yield strength corresponding to a permanent offset of 0.2 % of the gage length of the specimen, or to a total extension of 0.5 % of the gage length under load shall be determined.

8. Tensile Requirements of Production Welds

8.1 Reduced-section tension test specimens taken perpendicularly across the weld in the pipe, with the weld reinforcement removed, shall show a tensile strength not less than 95 % of the minimum specified in Section 7. At the manufacturer's option, the test may be made without removing the weld reinforcement, in which case the tensile strength shall be not less than that specified in Section 7.

9. Heat Analysis

9.1 An analysis of each heat of steel shall be made by the manufacturer to determine the percentages of the elements specified in Section 6. This analysis shall be made from a test ingot taken during the pouring of the heat. When requested by the purchaser, the chemical composition thus determined shall be reported to the purchaser or his representative, and shall conform to the requirements specified in Section 6.

10. Product Analysis

10.1 An analysis may be made by the purchaser on samples of pipe selected at random and shall conform to the requirements specified in Section 6. Samples for chemical analysis, except for spectrochemical analysis, shall be taken in accordance with ~~Method~~ Test Method, Practices, and Terminology ~~E59~~A751. The number of samples shall be determined as follows:

TABLE 2 Tensile Requirements

	Grade A	Grade B	Grade C	Grade D	Grade E
Tensile strength, min, ksi [MPa]	48 [330]	60 [415]	60 [415]	60 [415]	66 [455]
Yield strength, min, ksi [MPa]	30 [205]	35 [240]	42 [290]	46 [315]	52 [360]
Elongation in 2 in. or 50 mm, min, %:					
Basic minimum elongation for walls 5/16 in. [7.9 mm] and over in thickness, longitudinal strip tests	35	30	25	23	22
For longitudinal strips tests, a deduction for each 1/32-in. [0.8-mm] decrease in wall thickness below 5/16 in. [7.9 mm] from the basic minimum elongation of the following percentage[A]	1.75[A]	1.50[A]	1.25	1.50	2.0
Elongation in 8 in. or 200 mm, min, %[B,C]	Inch Pound Units, *1500/specified minimum tensile strength (ksi)* SI Units, *10 300/specified minimum tensile strength [MPa]*				

[A] The table below gives the computed minimum values.
[B] For wall thicknesses ½ in. [12.7 mm] and greater, the elongation may be taken in 8 in. or 200 mm.
[C] The elongation in 8 in. or 200 mm need not exceed 30 %.

Wall Thickness		Elongation in 2 in. or 50 mm, min, %	
in.	mm	Grade A	Grade B
5/16 (0.312)	7.9	35.00	30.00
9/32 (0.281)	7.1	33.25	28.50
1/4 (0.250)	6.4	31.50	27.00
7/32 (0.219)	5.6	29.75	25.50
3/16 (0.188)	4.8	28.00	24.00
5/32 (0.156)	4.0	26.25	22.50
1/8 (0.125)	3.7	24.50	21.00
3/32 (0.094)	2.4	22.75	19.50
1/16 (0.062)	1.6	21.00	18.00

Note—The above table gives the computed minimum elongation values for each 1/32-in. [0.8-mm] decrease in wall thickness. Where the wall thickness lies between two values shown above, the minimum elongation value shall be determined by the following equation:

Grade	Equation Inch-Pound Units	Equation SI Units
A	$E = 56t + 17.50$	$E = 2.20t + 17.50$
B	$E = 48t + 15.00$	$E = 1.89t + 15.00$
C	$E = 40t + 12.50$	$E = 1.57t + 12.50$
D	$E = 48t + 8$	$E = 1.89t + 8$
E	$E = 64t + 2$	$E = 2.52t + 2$

where:
E = elongation in 2 in. or 50 mm, %, and
t = actual thickness of specimen, in. [mm]

NPS	Number of Samples Selected
Under 14	2 for each lot of 200 pipes or fraction thereof
14 to 36, incl	2 for each lot of 100 pipes or fraction thereof
Over 36	2 for each 3000 ft or fraction thereof

10.2 *Retests*—If the analysis of either length of pipe or length of skelp does not conform to the requirements specified in Section 6, analyses of two additional lengths from the same lot shall be made, each of which shall conform to the requirements specified.

11. Dimensions, Mass, and Permissible Variations

11.1 *Mass*—The specified mass per unit length shall be calculated using the following equation:

$$M = C(D - t)t \tag{1}$$

where:

C = 10.69 [0.02466],
M = mass per unit length, lb/ft [kg/m],
D = outside diameter, in. [mm], specified or calculated (from inside diameter and wall thickness), and
t = specified wall thickness, in. (to 3 decimal places) [mm] (to 2 decimal places)

NOTE 6—The mass per unit length given in ASME B36.10M and ASME B36.19M and the calculated mass given by the equation of 11.1 are for carbon steel pipe. The mass per unit length of pipe made of ferritic stainless steels may be about 5 % less, and that made of austenitic stainless steel about 2 % greater than the values given. The specified mass of an individual pipe length shall be calculated as its specified mass per unit length times its length.

11.1.1 The mass of any length of pipe shall not vary more than 10 % over its specified mass.

11.1.2 The mass of any length of pipe shall not vary more than 5 % under the specified mass if the specified wall thickness is 0.188 in. [4.78 mm] or less or more than 5.5 % under if the specified wall thickness is greater than 0.188 in. [4.78 mm].