



Designation: A381/A381M – 23

Standard Specification for Metal-Arc-Welded Carbon or High-Strength Low-Alloy Steel Pipe for Use With High-Pressure Transmission Systems¹

This standard is issued under the fixed designation A381/A381M; 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 covers straight seam, double-submerged-arc-welded carbon or high-strength low-alloy steel pipe (**Note 1**) suitable for high-pressure service, 16 in. [400 mm] and larger in outside diameter, with wall thicknesses from $\frac{5}{16}$ to $1\frac{1}{2}$ in. [8 to 40 mm]. The pipe is intended for fabrication of fittings and accessories for compressor or pump-station piping. Pipe ordered to this specification shall be suitable for bending, flanging, corrugating, and similar operations.

NOTE 1—A comprehensive listing of standardized pipe dimensions is contained in ANSI B36.10.

NOTE 2—The term “double welded” is commonly used in the gas and oil transmission industry, for which this pipe is primarily intended, to indicate welding with at least two weld passes, of which one is on the outside of the pipe and one on the inside. For some sizes of the pipe covered by this specification, it becomes expedient to use manual welding, in which case the provisions of **Note 3** shall be followed.

1.2 This specification is expressed in both inch-pound units and in SI units; however, unless the purchase order or contract specifies the applicable M specification designation (SI units), the applicable inch-pound units shall apply. 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 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.

1.3 Eleven classes of pipe, based on minimum yield point requirements, are covered as indicated in **Table 1**.

1.4 This specification identifies various thermal treatments (**4.1.9**, **6.5**, and **6.6**).

1.5 The following caveat applies to the test methods portion, Sections **10**, **11**, and **12**, only. *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.

1.6 *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:²

A370 Test Methods and Definitions for Mechanical Testing of Steel Products

A530/A530M Specification for General Requirements for Specialized Carbon and Alloy Steel Pipe

A751 Test Methods and Practices for Chemical Analysis of Steel Products

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

A1058 Test Methods for Mechanical Testing of Steel Products—Metric

2.2 ASME Boiler and Pressure Vessel Code:³

Section VIII

Section IX

2.3 ASME Standard:⁴

ASME B36.10 Welded and Seamless Wrought Steel Pipe

3. Terminology

3.1 *Definitions of Terms*—For definitions of terms used in this standard, refer to:

3.1.1 Terminology **A941** for general steel terminology,

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 Society of Mechanical Engineers, 345 E. 47th St., New York, NY 10017.

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

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



TABLE 1 Tensile Requirements

Class	Yield Strength, min, psi [MPa]	Tensile Strength, min, psi [MPa]	Elongation in 2 in. [50 mm], min, %
Y 35	35 000 [240]	60 000 [415]	26
Y 42	42 000 [290]	60 000 [415]	25
Y 46	46 000 [316]	63 000 [435]	23
Y 48	48 000 [330]	62 000 [430]	21
Y 50	50 000 [345]	64 000 [440]	21
Y 52	52 000 [360]	66 000 [455]	20
Y 56	56 000 [385]	71 000 [490]	20
Y 60	60 000 [415]	75 000 [515]	20
Y 65	65 000 [450]	77 000 [535]	20
Y 70	70 000 [485]	82 000 [565]	18
Y 80	80 000 [550]	90 000 [620]	16

3.1.2 Test Methods and Definitions **A370** or Test Methods **A1058** for mechanical testing of steel products terminology, and

3.1.3 Test Methods and Practices **A751** for chemical analysis of steel products terminology.

4. Ordering Information

4.1 Orders for metal-arc-welded steel pipe to this specification should include the following, as required, to describe the desired material adequately:

- 4.1.1 Quantity (feet, centimetres, or number of lengths),
- 4.1.2 Name of material (metal-arc welded pipe),
- 4.1.3 Class (**Table 1**),
- 4.1.4 Material (carbon or high-strength low-alloy steel, **Section 6**),
- 4.1.5 Size (outside diameter and wall thickness),
- 4.1.6 Length (specific or random) (**Section 14**),
- 4.1.7 Ends (**Section 15**),
- 4.1.8 Heat treatment (stress-relieved, normalized, or quenched and tempered) (see **6.5** and **6.6**),
- 4.1.9 Optional requirements:
 - 4.1.9.1 Manual welding (**6.2**, **Note 3**),
 - 4.1.9.2 Hydrostatic test omission (**10.3**),
 - 4.1.9.3 Radiography (**12.2**).
- 4.1.10 ASTM Specification designation A381 or A381M and year date.
- 4.1.11 Special requirements or exceptions to this specification.

5. General Requirements

5.1 Material furnished to this specification shall conform to the applicable requirements of the current edition of Specification **A530/A530M**, unless otherwise provided herein.

6. Materials and Manufacture

6.1 The steel plate used in the manufacture of the pipe shall be of suitable welding quality carbon steel, or of suitable welding quality high-strength, low-alloy steel, as agreed upon between the manufacturer and purchaser.

6.2 The longitudinal edges of the plate shall be shaped to give the most satisfactory results by the particular welding process employed. The plate shall be properly formed and may be tacked preparatory to welding. The weld (except tack welds)

shall be made preferably by the automatic submerged-arc-welding process (**Note 3**) and shall be of reasonably uniform width and height for the entire length of the pipe.

NOTE 3—By agreement between the manufacturer and the purchaser, manual welding by qualified welders using a qualified procedure may be used as an equal alternate to this specification.

6.3 Both longitudinal and circumferential (if any) joints shall be double welded, full penetration welds being made in accordance with procedures and by welders or welding operators qualified in accordance with the ASME Boiler and Pressure Vessel Code, Section IX.

6.4 The contour of the reinforcement shall be smooth, with no valley or groove along the edge or in the center of the weld, and the deposited metal shall be fused smoothly and uniformly into the plate surface. The finish of the welded joint shall be reasonably smooth and free from irregularities, grooves, or depressions.

6.5 All pipe, after welding, shall be heat treated at a temperature of 1100°F [595°C] or higher.

6.6 When specified in the purchase order, all pipe after welding shall be heated at 1650 to 1750°F [900 to 955°C] and air cooled or water quenched and tempered. Tempering temperature shall not exceed the lower transformation temperature.

7. Chemical Composition

7.1 The carbon steels shall conform to the requirements as to chemical composition specified in **Table 2**.

7.2 The high-strength low-alloy steels shall be of specified chemical composition in order to ensure weldability and specified minimum tensile properties including elongation.

7.3 Mill test reports, as provided by the manufacturer of the plate, shall be furnished representing the chemical analysis of each heat of steel from which the plates are rolled. This chemical analysis shall conform to the requirements of **6.1**, **7.1**, or **7.2**.

7.4 For product analyses, Test Methods and Practices **A751** shall be used.

8. Tensile Requirements

8.1 The tensile properties of transverse body-test specimens shall conform to the requirements prescribed in **Table 1**. The tensile strength of the weld-test specimens shall conform to that specified in **Table 1**.

8.2 Transverse body-test specimens shall be taken approximately opposite the weld; transverse weld-test specimens shall be taken with the weld at the center of the specimen. For pipe

TABLE 2 Chemical Requirements for Carbon Steels on Product Analysis

Element	Composition, %, max	
	Ladle	Check
Carbon	0.26	0.30
Manganese	1.40	1.50
Phosphorus	0.025	0.030
Sulfur	0.025	0.025