



## Designation: ~~A381-96 (Reapproved 2012)~~ A381/A381M - 18

# Standard Specification for Metal-Arc-Welded Carbon or High-Strength Low-Alloy Steel Pipe for Use With High-Pressure Transmission Systems<sup>1</sup>

This standard is issued under the fixed designation ~~A381~~; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope ~~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. (~~406 mm~~) [400 mm] and larger in outside diameter, with wall thicknesses from  $\frac{5}{16}$  to  $1\frac{1}{2}$  in. (~~7.9 [8 to 38 mm]~~) 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 (vastoning)~~, 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 ~~Nine~~ Eleven classes of pipe, based on minimum yield point requirements, are covered as indicated in Table 1.

1.4 The values stated in inch-pound units are This specification identifies various thermal treatments (3.1.9, 5.5 to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only, and 5.6 are not considered standard).

1.5 The following caveat applies to the test methods portion, Sections 9 and 10, and 11, 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 ~~health~~ environmental practices and determine the applicability of regulatory limitations prior to use.* <https://standards.iteh.ai/catalog/standards/sist/6236d20c-7632-4062-bff1-b93e01f42ba/astm-a381-a381m-18>

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:<sup>2</sup>

A370 Test Methods and Definitions for Mechanical Testing of Steel Products

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

~~E30~~ A751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel, Cast Iron, Open-Hearth Iron, and Wrought Iron Steel Products (Withdrawn 1995)

A1058 Test Methods for Mechanical Testing of Steel Products—Metric

### 2.2 ASME Boiler and Pressure Vessel Code:<sup>3</sup>

~~Section VIII—Pressure Vessels~~

~~Section IX—Welding Qualifications~~

<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 A01.09 on Carbon Steel Tubular Products.

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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

<sup>3</sup> Available from American Society of Mechanical Engineers, 345 E. 47th St., New York, NY 10017.

\*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. (50.8 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

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

2.3 ANSISME Standard:<sup>4</sup>

<https://standards.iteh.ai/>  
ANSISME B36.10 Welded and Seamless Wrought Steel Pipe

### 3. Ordering Information

3.1 Orders for material—metal-arc-welded steel pipe to this specification should 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 (metal-arc welded pipe),

3.1.3 Class (Table 1),

3.1.4 Material (carbon or alloy—high-strength low-alloy steel, Section 5),

3.1.5 Size (outside diameter and wall thickness),

3.1.6 Length (specific or random) (Section 13),

3.1.7 Ends (Section 14),

3.1.8 Heat treatment (~~stress-relieved or normalized~~)—(stress-relieved, normalized, or quenched and tempered) (see 5.5 and 5.6),

3.1.9 Optional requirements (see requirements: 5.2 (Note 3), Sections 11 and 15),

3.1.9.1 Manual welding (5.2, Note 3),

3.1.9.2 Hydrostatic test omission (9.3),

3.1.9.3 Radiography (11.2).

3.1.10 ASTM Specification number, designation A381 or A381M and year date.

3.1.11 Special requirements or exceptions to this specification.

### 4. General Requirements

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

### 5. Materials and Manufacture

5.1 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.

<sup>4</sup> Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, Society of Mechanical Engineers (ASME), ASME International Headquarters, Two Park Ave., New York, NY 10036, <http://www.ansi.org>, 10016-5990, <http://www.asme.org>.



5.2 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.

5.3 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.

5.4 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.

5.5 All pipe, after welding, shall be heat treated at a temperature of 1100°F (593°C)[595°C] or higher.

5.6 When specified in the purchase order, all pipe after welding shall be heated at 1650 to 1750°F (899[900 to 954°C] and air cooled-955°C] and air cooled or water quenched and tempered. Tempering temperature shall not exceed the lower transformation temperature.

6. Chemical Composition

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

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

6.3 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 5.1, 6.1, or 6.2.

6.4 For referee purposes, product analyses, Test Methods E30A751 shall be used.

7. Tensile Requirements

7.1 The tensile properties of transverse body-test specimens taken from the finished pipe shall conform to the requirements prescribed in Table 1. The tensile strength of the transverse weld-test specimens shall conform to that specified in Table 1.

7.2 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 wall thicknesses up to 3/4 in. (19 mm), incl, all transverse test specimens shall be approximately 1 1/2 in. (38 mm) wide in the gauge length and shall represent the in accordance with Test Methods and Definitions A370 full wall thickness of the pipe from which the specimen was cut (see Fig. 23, Test Methods and Definitions using full-size specimens or the largest obtainable sub-size specimen. A370). For pipe with wall thicknesses over 3/4 in. (19 mm); the standard 0.505-in. (12.83-mm) round tension test specimen with 2-in. (50.8-mm) gauge length [19 mm], full-size specimens shall be used (see Fig. 5; in accordance with Test Methods and Definitions A370).

7.3 If the tension test specimen from any lot of pipe fails to conform to the requirements for the particular grade of pipe ordered, the manufacturer may elect to make retests on two additional lengths of pipe pieces from the same lot, each of which shall conform to the requirements prescribed in Table 210.1 and 10.2. If one or both of the retests fail to conform to the requirements, the manufacturer may elect to test each of the remaining lengths of pipe in the lot. Retests are required only for the particular test with which the pipe specimen did not comply originally.

7.4 All test specimens/pieces which are flattened cold may shall be reheat treated before machining.

8. Transverse Guided-Bend Tests Weld

8.1 Transverse weld test specimens shall be subject to face and root guided-bend tests. The specimens shall be approximately 1/2 in. (38.1 mm) wide, at least 6 in. (152 mm) in length with the weld at the center, and shall be machined in in accordance with Fig. 1. One specimen shall be bent with the inside surface of the pipe against the plunger, and the Figure A2.13 of Test Methods

TABLE 2 Chemical Requirements for Carbon Steels on Product Analysis

Table with 3 columns: Element, Ladle, Check. Rows include Carbon, Manganese, Phosphorus, and Sulfur with their respective composition percentages.