



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

This standard is issued under the fixed designation A 381; 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

1.1 This specification covers straight seam, double-submerged-arc-welded steel pipe (Note 1) suitable for high-pressure service, 16 in. (406 mm) and larger in outside diameter, with wall thicknesses from  $\frac{5}{16}$  to  $1\frac{1}{2}$  in. (7.9 to 38 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), 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 Nine classes of pipe, based on minimum yield point requirements, are covered as indicated in Table 1.

1.3 The values stated in inch-pound units are to be regarded as the standard. The metric equivalents of inch-pound units may be approximate.

1.4 The following hazard caveat applies to the test methods portion, Sections 9 and 10, only. *This standard does not purport to address all of the safety problems, 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:

A 370 Test Methods and Definitions for Mechanical Testing of Steel Products<sup>2</sup>

A 530/A 530M Specification for General Requirements for Specialized Carbon and Alloy Steel Pipe<sup>3</sup>

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee A-1 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> Annual Book of ASTM Standards, Vol 01.03.

<sup>3</sup> Annual Book of ASTM Standards, Vol 01.01.

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

E 30 Test Methods for Chemical Analysis of Steel, Cast Iron, Open-Hearth Iron, and Wrought Iron<sup>4</sup>

2.2 ASME Boiler and Pressure Vessel Code:

Section VIII Pressure Vessels<sup>5</sup>

Section IX Welding Qualifications<sup>5</sup>

2.3 ANSI Standard:<sup>2</sup>

ANSI B36.10 Welded and Seamless Wrought Steel Pipe

## 3. Ordering Information

3.1 Orders for material 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 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) (see 5.6),

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

3.1.10 Specification number, and

3.1.11 Special requirements or exceptions to this specification.

## 4. General Requirements

4.1 Material furnished to this specification shall conform to

<sup>4</sup> Annual Book of ASTM Standards, Vol 03.05.

<sup>5</sup> Available from American Society of Mechanical Engineers, 345 E. 47th St., New York, NY 10017.

the applicable requirements of the current edition of Specification A 530/A 530M, 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.

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) or higher.

5.6 When specified in the purchase order, all pipe after welding shall be heated at 1650 to 1750°F (899 to 954°C) and air cooled.

**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, Test Methods E 30 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 gage length and shall represent the full wall thickness of the pipe from which the specimen was cut (see Fig. 23, Test Methods and Definitions A 370). 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) gage length shall be used (see Fig. 5, Test Methods and Definitions A 370).

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 from the same lot, each of which shall conform to the requirements prescribed in Table 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 which are flattened cold may 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 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 accordance with Fig. 1. One specimen shall be bent with the inside surface of the pipe against the plunger, and the other specimen with the outside surface against the plunger. The dimensions of the plunger for the bending jig shall be in accordance with Fig. 2 and the other dimensions shall be substantially as shown in Fig. 2.

8.2 The bend test shall be acceptable if no cracks or other defects exceeding 1/8 in. (3.17 mm) in any direction are present in the weld metal or between the weld and pipe metal after bending. Cracks which originate along the edges of the specimen during testing, and that are less than 1/4 in. (6.35 mm), measured in any direction, shall not be considered.

**9. Hydrostatic Test**

9.1 Each length of pipe with wall thickness of 1/2 in. (12.7 mm) and less shall be tested to a hydrostatic pressure which will produce in the pipe wall a stress of not less than 85 % of the minimum specified yield point. This pressure shall be determined by the following equation:

$$P = 2St/D$$

where:

*P* = hydrostatic test pressure, psi,

*S* = 85 % of the specified minimum yield strength of Table 1,

*t* = specified wall thickness, in., and

*D* = specified outside diameter, in.

9.2 Each length of pipe with a wall thickness over 1/2 in.

**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