



Standard Specification for Steel Line Pipe, Black, Furnace-Butt-Welded¹

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1. Scope

1.1 This specification covers furnace-butt-welded, black, plain-end or threaded-end, steel pipe for use in the conveyance of fluids under pressure. Pipe in sizes NPS $\frac{1}{2}$ to 4, inclusive, with nominal wall thickness 0.350 in. [8.9 mm] or less, as given in ASME B36.10M is included. Pipe having other dimensions, in this size range, may be furnished provided such pipe complies with all other requirements of this specification.

1.2 For plain-end pipe, it is intended that the pipe be capable of being circumferentially welded in the field when welding procedures in accordance with the requirements of the applicable pipeline construction code are used.

1.3 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

A450/A450M Specification for General Requirements for Carbon and Low Alloy Steel Tubes
A530/A530M Specification for General Requirements for Specialized Carbon and Alloy Steel Pipe
A751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products
A941 Terminology Relating to Steel, Stainless Steel, Related Alloys, and Ferroalloys

2.2 ASME Standard:

ASME B36.10M Welded and Seamless Wrought Steel Pipe³

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 Society of Mechanical Engineers (ASME), ASME International Headquarters, Three Park Ave., New York, NY 10016-5990.

2.3 API Standards:

5L Specification for Line Pipe⁴

5B Specification for Threading, Gauging, and Thread Inspection of Casing, Tubing, and Line Pipe Threads⁴

3. Terminology

3.1 *Definitions*—For terminology used in this specification, refer to Terminology A941.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *furnace-butt-welded pipe, n*—pipe produced in multiple lengths from coiled skelp and subsequently cut into individual lengths, having its longitudinal butt joint forge welded by the mechanical pressure developed in rolling the hot-formed skelp through a set of round pass welding rolls.

3.2.2 *lot, n*—a quantity of pipe of the same ordered diameter, heat, wall thickness, and grade as given in Table 1.

3.2.3 *specified outside diameter (OD), n*—the outside diameter specified in the purchase order or the outside diameter listed in ASME B36.10M for the nominal pipe size specified in the purchase order.

4. General Requirements

4.1 Pipe furnished under this specification shall conform to the applicable requirements of Specification A530/A530M unless otherwise provided herein.

5. Ordering Information

5.1 It is the purchaser's responsibility to specify in the purchase order all information necessary to purchase the needed material. Examples of such information include, but are not limited to, the following:

5.1.1 Specification designation and year-date,

5.1.2 Quantity (feet or metres),

5.1.3 Grade (A or B),

5.1.4 Size (either nominal (NPS) or outside diameter, and wall thickness),

5.1.5 Length,

5.1.6 End finish (plain-end, special plain-end, or threaded-end, see 15.1),

5.1.7 End use of the pipe,

⁴ Available from The American Petroleum Institute (API), 1220 L. St., NW, Washington, DC 20005.

TABLE 1 Lot Size and Sample Size for Mechanical Testing

Size Designation	Lot Size	Sample Size
<NPS 2	25 tons [23 Mg] or fraction thereof	1
NPS 2 through NPS 4	50 tons [45 Mg] or 500 lengths, or fraction thereof	1

5.1.8 Special requirements, and

5.1.9 Bar coding (see 18.3).

6. Materials and Manufacture

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

6.2 The pipe shall be made by the furnace-butt-welding process.

7. Chemical Composition

7.1 The steel shall contain, by heat and product analyses, no more than 0.25 % carbon, 1.20 % manganese, 0.045 % sulfur, and 0.045 % phosphorus.

7.2 As a minimum, the required analysis shall contain the following elements: carbon, manganese, phosphorus, sulfur, chromium, columbium, copper, molybdenum, nickel, silicon, and vanadium.

7.3 Product analyses shall be made on at least two samples from each heat of steel.

7.4 All analyses shall be in accordance with Test Methods, Practices, and Terminology A751.

7.5 If one or both of the product analyses representing a heat fails to conform to the specified requirements, the heat shall be rejected, or analyses shall be made on double the original number of test samples that failed, each of which shall conform to the specified requirements.

8. Tensile Requirements

8.1 The material shall conform to the requirements for tensile properties given in Table 2 and in 8.4.

8.2 The yield strength corresponding to a total extension under load of 0.5 % of the gage length shall be determined.

8.3 Longitudinal tests shall be performed for all pipe. Such tests shall be either strip specimens taken 90° from the weld or full section specimens, at the option of the manufacturer.

8.4 The minimum elongation in 2 in. [50 mm] for each grade shall be that determined by the following equation:

$$e = CA^{0.2}/U^{0.9} \quad (1)$$

TABLE 2 Tensile Requirements

Grade	Yield Strength, min		Tensile Strength, min	
	psi	MPa	psi	MPa
A	30 000	205	48 000	330
B	35 000	240	60 000	415

where:

e = minimum elongation in percent, rounded to the nearest percent,

C = constant = 625 000 [1940],

A = cross-sectional area of the tensile test specimen in in.² [mm²], based upon the specified outside diameter or the nominal specimen width and the specified wall thickness, rounded to the nearest 0.01 in.² [1 mm²]. If the area thus calculated is greater than 0.75 in.² [485 mm²], the value of 0.75 in.² [485 mm²] shall be used, and

U = specified minimum tensile strength, psi [MPa].

9. Flattening Test

9.1 A test specimen at least 4 in. [100 mm] in length shall be flattened cold between parallel plates in three steps, with the weld located either 0° or 90° from the line of direction of force, as required in 9.2.1. Except as allowed by 9.3, during the first step, which is a test for ductility of the weld, no cracks or breaks on the inside, outside, or end surfaces at the weld shall be present before the distance between the plates is less than two thirds of the specified diameter of the pipe. As a second step, the flattening shall be continued as a test for ductility away from the weld. During the second step, no cracks or breaks on the inside, outside, or end surfaces away from the weld, shall be present before the distance between the plates is less than one third of the specified outside diameter of the pipe but is not less than five times the wall thickness of the pipe. During the third step, which is a test for soundness, the flattening shall be continued until the test specimen breaks or the opposite walls of the test specimen meet. Evidence of laminated or unsound material or of incomplete weld that is revealed by the flattening test shall be cause for rejection.

9.2 The flattening test specified in 9.1 shall be made as follows:

9.2.1 Test specimens taken from the front end of the first pipe intended to be supplied from each coil and the back end of the last pipe intended to be supplied from each coil shall be flattened with the weld located at 90° from the line of direction of force.

9.2.2 Test specimens taken from pipe at any two locations intermediate to the front end of the first pipe and the back end of the last pipe intended to be supplied from each coil shall be flattened with the weld located at 0° from the line of direction of force.

9.3 When low D -to- t ratio pipe is tested, because the strain imposed due to geometry is unreasonably high on the inside surface at the six and twelve o'clock locations, cracks at these locations shall not be cause for rejection if the D -to- t ratio is less than 10.

10. Hydrostatic Test

10.1 Each length of pipe shall be subjected to the hydrostatic test without leakage through the weld seam or the pipe body.

10.2 Each length of pipe NPS 2 or larger shall be tested, by the manufacturer, to a minimum hydrostatic pressure calculated from the following relationship:

Inch-Pound Units:

$$P = 2 St/D \times C \quad (2)$$

SI Units:

$$P = 2000 St/D \times C \quad (3)$$

where:

P = minimum hydrostatic test pressure, psi [kPa],
 S = specified minimum yield strength, psi [MPa],
 t = specified wall thickness, in. [mm],
 D = specified outside diameter, in. [mm], and
 C = 0.60.

10.3 For pipe sizes smaller than NPS 2, the test pressures shall be as given in **Table 3**. For pipe in sizes smaller than NPS 2 with wall thicknesses lighter than those listed, the test pressure for the next heavier listed specified wall thickness shall be used. For intermediate specified outside diameters smaller than NPS 2, the test pressures given for the next smaller specified outside diameter shall be used.

10.4 When computed test pressures are not an exact multiple of 10 psi [100 kPa], they shall be rounded to the nearest 10 psi [100 kPa].

10.5 The minimum hydrostatic test pressure required to satisfy these requirements need not exceed 3000 psi [20 700 kPa]. This does not prohibit testing at a higher pressure at the manufacturer's option. The hydrostatic test pressure shall be maintained for not less than 5 s for all pipe sizes.

11. Nondestructive Testing

11.1 The weld seam of each length of pipe NPS 2 [DN 50] or larger shall be tested with a nondestructive electric test as follows:

11.1.1 *Ultrasonic or Electromagnetic Inspection*—Any equipment utilizing the ultrasonic or electromagnetic principles and capable of continuous and uninterrupted inspection of the weld seam shall be used. The equipment shall be checked with an applicable reference standard as described in **11.2** at least once every 8 h of inspection to demonstrate the effectiveness of the inspection procedures. The equipment shall be adjusted to produce well-defined indications when the reference standard is scanned by the inspection unit in a manner simulating the

inspection of the product. The location of the equipment shall be at the manufacturer's option.

11.2 *Reference Standards*—Reference standards shall have both the outside diameter and wall thickness within the tolerances specified for the production pipe to be inspected and may be of any convenient length as determined by the pipe manufacturer. Reference standards shall be either full sections or coupons taken from the pipe. Reference standards shall contain machined notches as shown in **Fig. 1**, one on the inside surface and one on the outside surface, or a drilled hole as shown in **Fig. 1**, at the option of the pipe manufacturer. The notches shall be parallel to the weld seam, and shall be separated by a distance sufficient to produce two separate and distinguishable signals. The $\frac{1}{8}$ -in. [3-mm] drilled hole shall be drilled through the wall and perpendicular to the surface of the reference standard as shown in **Fig. 1**. Care should be taken in the preparation of the standard to ensure freedom from fins, other edge roughness, and distortion of the pipe.

NOTE 1—The calibration standards shown in **Fig. 1** are convenient standards for calibration of nondestructive testing equipment. The dimensions of such standards should not be construed as the minimum size imperfection detectable by such equipment.

11.3 *Acceptance Limits*—**Table 4** gives the height of acceptance limit signals in percent of the height of signals produced by the calibration standards. Imperfections in the weld seam that produce a signal greater than the acceptance limit given in **Table 4** shall be considered defects unless the pipe manufacturer can demonstrate that the imperfection does not reduce the effective wall thickness to below 87.5 % of the specified wall thickness.

11.4 Surface condition, operator qualification, extent of examination, and standardization procedure shall be in accordance with the provisions of Specification **A450/A450M**.

12. Number of Tests

12.1 Tension testing shall be performed on a lot basis, with the lot size and sample sizes as given in **Table 1**.

13. Retests

13.1 If the results of the tension test for any lot fails to conform to the applicable requirements given in **Table 2**, retests are permitted to be made on additional pipe of double the original number from the same lot, each of which shall conform to the specified requirements.

13.2 If any flattening test fails to conform to the requirements specified in **9.1**, each length in the failed multiple shall be rejected or flattening tests shall be made using test specimens taken from each end of each individual length in the failed multiple. Such tests shall be made with the weld alternately at 0° and 90° from the line of direction of force.

14. Dimensions, Mass, and Permissible Variations

14.1 The dimensions and masses per unit length of some of the pipe sizes included in this specification are given in ASME B36.10M. The mass per unit length of pipe having an intermediate specified outside diameter, or intermediate specified wall thickness, or both, shall be calculated using the equation in **14.2**.

TABLE 3 Hydrostatic Test Pressure

NPS Designator	Outside Diameter		Wall Thickness		Test Pressure, min	
	in.	mm	in.	mm	psi	kPa
$\frac{1}{2}$	0.840	21.3	0.109	2.8	700	4800
			0.147	3.7	850	5900
$\frac{3}{4}$	1.050	26.7	0.113	2.9	700	4800
			0.154	3.9	850	5900
1	1.315	33.4	0.133	3.4	700	4800
			0.179	4.6	850	5900
			0.250	6.4	950	6500
$1\frac{1}{4}$	1.660	42.2	0.140	3.6	1300	9000
			0.191	4.9	1900	13 100
			0.250	6.4	2000	13 800
$1\frac{1}{2}$	1.900	48.3	0.145	3.7	1300	9000
			0.200	5.1	1900	13 100
			0.281	7.1	2050	14 100

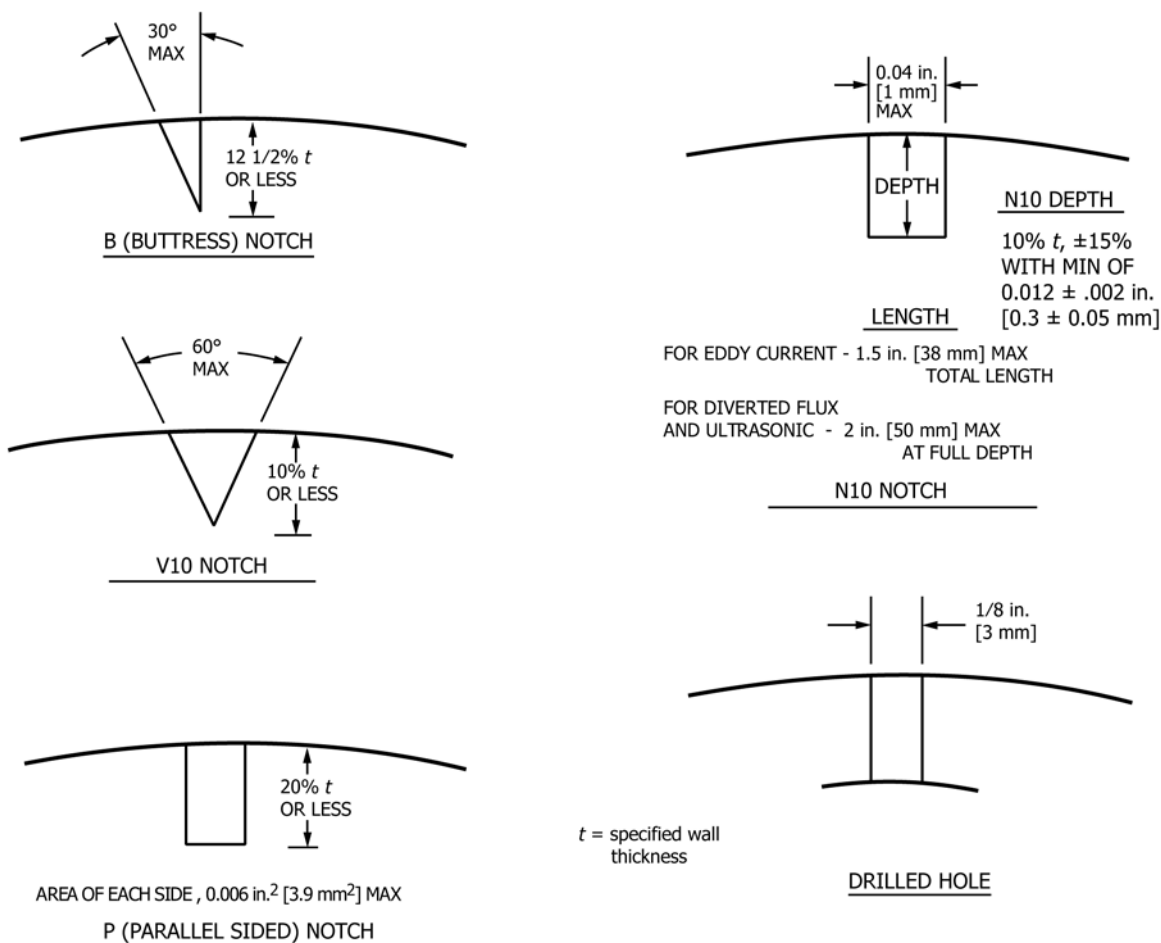


FIG. 1 Calibration Standards

TABLE 4 Acceptance Limits

Type of Notch	Size of Hole		Acceptance Limit Signal, %
	in.	mm	
N10, V10	1/8	3	100
B, P			80

14.2 *Mass*—The mass of a single length of pipe shall not vary more than +10 %, −5.0 % from its theoretical mass, as calculated using its mass per unit length and its measured length. Pipe masses per unit length not listed in ASME B36.10M shall be calculated using the following equation:

Inch-Pound Units:

$$M = t(D - t) \times 10.69 \quad (4)$$

SI Units:

$$M = t(D - t) \times 0.024 \, 66 \quad (5)$$

where:

M = mass per unit length, lb/ft [kg/m],
 D = specified outside diameter, in. [mm], and
 t = specified wall thickness, in. [mm].

14.3 *Wall Thickness*—The wall thickness at any point shall be not more than 12.5 % under the specified wall thickness.

14.4 *Length*—Unless otherwise agreed upon between the purchaser and the manufacturer, pipe shall be furnished in the nominal lengths and within the tolerances given in Table 5, as specified.

14.5 *Outside Diameter*—For pipe NPS 1½ [DN 40] and under, the outside diameter at any point shall not vary more than $\pm 1/64$ in. [0.4 mm] from the specified outside diameter. For pipe NPS 2 [DN 50] and over, the outside diameter shall not vary more than ± 1 % from the specified outside diameter.

15. End Finish

15.1 Plain-end pipe shall be furnished with ends beveled to an angle of 30°, +5°, −0°, measured from a line drawn perpendicular to the axis of the pipe, and with a root face of 1/16

TABLE 5 Tolerance on Length

Nominal Length		Minimum Length		Minimum Average Length for Each Order Item		Maximum Length	
ft	m	ft	m	ft	m	ft	m
20	6	9.0	2.74	17.5	5.33	22.5	6.86
40	12	14.0	4.27	35.0	10.67	45.0	13.72
50	15	17.5	5.33	43.8	13.35	55.0	16.76

in. [1.6 mm] \pm $\frac{1}{32}$ in. [0.8 mm], or shall have another plain-end configuration, as specified in the purchase order.

15.2 Threaded-end pipe shall be furnished with threaded ends that are in accordance with the gaging practice and tolerances of API Standard 5B.

15.3 One end of each length of threaded-end pipe shall be provided with a coupling conforming to the requirements of API Specification 5L.

16. Workmanship, Finish, and Appearance

16.1 Surface imperfections that penetrate more than 10 % of the specified wall thickness or encroach on the minimum permissible wall thickness shall be considered defects. Pipe with defects shall be given one of the following dispositions:

16.1.1 The section of the pipe containing the defect shall be cut off within the requirements for length.

16.1.2 The length shall be rejected.

16.2 Wall thickness measurements shall be made with a mechanical caliper or with a properly calibrated nondestructive testing device of appropriate accuracy. In case of a dispute, the measurement determined by the use of a mechanical caliper shall govern.

16.3 Repairs of the weld seam or pipe body, by welding, shall not be permitted.

16.4 Pipe shall be reasonably straight.

17. Certification

17.1 Where specified in the purchase order or contract, the purchaser shall be furnished certification that samples representing each lot have been either tested or inspected as directed in this specification and the requirements have been met. Where specified in the purchase order or contract, a report of the test results shall be furnished.

18. Product Marking

18.1 Except as allowed by 18.2, each length of pipe shall be legibly marked to show the specification number, the name or brand of the manufacturer, FBW, the grade, the specified wall thickness, the specified outside diameter, the heat number or heat code, and the length. The length shall be marked in feet and tenths of a foot, or metres to two decimal places, whichever is applicable.

18.2 For bundled pipe NPS 1½ or smaller, it shall be permissible for the required markings to be included on a tag that is fastened securely to each bundle.

18.3 In addition to the requirements of 18.1 and 18.2, bar coding is acceptable as a supplementary identification method. The purchaser may specify in the order that a specific bar coding system be used.

19. Keywords

19.1 black steel pipe; furnace-butt-welded pipe; line pipe

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