Designation: A 1006/A 1006M – 00

Standard Specification for Steel Line Pipe, Black, Plain End, Laser Beam Welded[1]

This standard is issued under the fixed designation A 1006/A 1006M; 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 laser beam welded, black, plain end steel pipe for use in the conveyance of fluids under pressure. Pipe in sizes NPS 1 to 26, inclusive, with nominal wall thickness 0.750 in. [19.1 mm] or less, as given in Table 1, 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 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, without combining values in any way.

1.4 The following precautionary statement pertains to the test method portion, Section 14, of this specification. *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 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[2]

A 530/A 530M Specification for General Requirements for Specialized Carbon and Alloy Steel Pipe[2]

A 450/A 450M Specification for General Requirements for Carbon, Ferritic Alloy, and Austenitic Alloy Steel Tubes[2]

A 751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products[3]

A 941 Standard Terminology Relating to Steel, Stainless Steel, Related Alloys, and Ferroalloys[2]

TABLE 1 Dimensions and Weight [Mass] Per Unit Length

NOTE 1—Pipe having an outside diameter and/or wall thickness intermediate to those listed in this table are also permitted.

NPS	Outside Diameter		Wall Thickness		Weight [Mass] per Unit Length	
Designator	in.	mm	in.	mm	lb/ft	kg/m
1	1.315	33.4	0.133	3.4	1.68	2.52
			0.358	9.1	3.66	4.55
1¼	1.660	42.2	0.140	3.6	2.27	3.43
			0.382	9.7	5.22	7.77
1½	1.900	48.3	0.145	3.7	2.72	4.07
			0.400	10.2	6.41	9.58
2	2.375	60.3	0.083	2.1	2.03	3.01
			0.436	11.1	9.04	13.47
2½	2.875	73.0	0.083	2.1	2.48	3.67
			0.552	14.0	13.71	20.37
3	3.500	88.9	0.083	2.1	3.03	4.50
			0.600	15.2	18.60	27.63
3½	4.000	101.6	0.083	2.1	3.48	5.15
			0.318	8.1	12.52	18.68
4	4.500	114.3	0.083	2.1	3.92	5.81
			0.674	17.1	27.57	40.99
5	5.563	141.3	0.083	2.1	4.86	7.21
			0.750	19.1	38.59	57.56
6	6.625	168.3	0.083	2.1	5.80	8.61
			0.750	19.1	47.10	70.27
8	8.625	219.1	0.125	3.2	11.36	17.04
			0.750	19.1	63.14	94.20
10	10.750	273.1	0.156	4.0	17.67	26.54
			0.750	19.1	80.18	119.64
12	12.750	323.9	0.172	4.4	23.13	34.67
			0.750	19.1	96.21	143.56
14	14.000	355.6	0.188	4.8	27.76	41.52
			0.750	19.1	106.23	158.49
16	16.000	406.7	0.188	4.8	31.78	47.54
			0.750	19.1	122.27	182.42
18	18.000	457	0.188	4.8	35.80	53.53
			0.750	19.1	138.30	206.25
20	20.000	508	0.219	5.6	46.31	69.38
			0.750	19.1	154.34	230.27
22	22.000	559	0.219	5.6	50.99	76.42
			0.750	19.1	170.37	254.30
24	24.000	610	0.250	6.4	63.47	95.26
			0.750	19.1	186.41	278.32
26	26.000	660	0.250	6.4	68.82	103.15
			0.750	19.1	202.44	301.87

2.2 *API Publication:*

API RP 5L3 Recommended Practice for Conducting Drop-Weight Tear Tests on Line Pipe[4]

[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] *Annual Book of ASTM Standards*, Vol 01.01.

[3] *Annual Book of ASTM Standards*, Vol 01.02.

[4] Available from American Petroleum Institute, 1220 L Street, N.W., Washington, DC 20005-4070.

2.3 *ASME Standard:*

ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications[5]

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *laser beam welding, n*—a welding process that utilizes a laser beam to produce melting of full thickness of edges to be welded, followed by the fusion of those edges.

3.1.2 *specified outside diameter, n*—the outside diameter shown in the purchase order or in Table 1 for the applicable NPS size.

3.2 *Definitions*—For definitions of other terms used in this specification, refer to Terminology A 941.

TABLE 2 Tensile Requirements

Grade	Yield Strength,[A] min.		Yield Strength,[A] max.		Tensile Strength, min.	
	psi	MPa	psi	MPa	psi	MPa
35	35 000	240	65 000	450	60 000	415
50	50 000	345	77 000	530	70 000	485
60	60 000	415	80 000	550	75 000	515
70	70 000	485	87 000	600	80 000	550
80	80 000	550	97 000	670	90 000	620

[A]Yield strength requirements are not applicable for transverse weld tests.

4. Ordering Information

4.1 Information items to be considered, if appropriate, for inclusion in the purchase order are as follows:

4.1.1 Specification designation and year of issue,

4.1.2 Quantity (feet or metres),

4.1.3 Grades (see Table 2 or 8.6),

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

4.1.5 Nominal length (see 16.3),

4.1.6 End finish (plain end beveled or special, see 17.1),

4.1.7 Bar coding (see 20.3),

4.1.8 Special requirements, and

4.1.9 Supplementary requirements.

5. General Requirements

5.1 Pipe furnished under this specification shall conform to the applicable requirements of Specification A 530/A 530M unless otherwise provided herein.

6. Materials and Manufacture

6.1 Pipe shall be welded from one side by the laser beam welding process using a single pass with an appropriate shielding gas. The pipe shall have one longitudinal seam. The weld shall be made in accordance with a qualified welding procedure as specified in ASME Boiler and Pressure Vessel Code, Section IX, Paragraph QW-264. The edges may be preheated.

6.2 The internal and external weld protrusion resulting from the welding process shall be removed, in accordance with the requirements of 18.1 and 18.2.

6.3 The weld seam and its heat affected zone shall receive either a normalizing heat treatment or a continuous in-line heat treatment in such a manner that no untempered martensite remains. Complete penetration and coverage of the weld and the weld heat affected zone by this heat treatment shall be confirmed by periodic metallographic examination of weld area cross-section specimens at least once per working shift.

7. Chemical Composition

7.1 The steel shall contain no more than 0.22 % carbon, 0.015 % sulfur, and 0.025 % phosphorus, by heat and product analyses.

7.2 The steel shall contain no more than 0.0007 % boron, by heat analysis.

7.3 The carbon equivalent (CE) value for each heat shall not exceed 0.40 %, calculated using the product analyses and the following equation:

$$CE = C + F\left[\frac{Mn}{6} + \frac{Si}{24} + \frac{Cu}{15} + \frac{Ni}{20} + \frac{Cr + Mo + V + Cb}{5}\right] \quad (1)$$

where:

F = a compliance factor that is dependent upon the carbon content, as shown below:

Carbon Content, %	F	Carbon Content, %	F
<0.06	0.53	0.14	0.85
0.06	0.54	0.15	0.88
0.07	0.56	0.16	0.92
0.08	0.58	0.17	0.94
0.09	0.62	0.18	0.96
0.10	0.66	0.19	0.97
0.11	0.70	0.20	0.98
0.12	0.75	0.21	0.99
0.13	0.80	0.22	1.00

7.4 A heat analysis shall be made for each heat of steel furnished under this specification.

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

7.6 All analyses shall be in accordance with Test Methods, Practices, and Terminology A 751, and shall include all elements required in the carbon equivalent equation of 7.3, in addition to titanium, phosphorus, sulfur, and boron, except that the product analysis for boron is not required. Titanium is reported for information only and is not a cause for rejection.

7.7 If one or both of the product analyses representing a heat fails to conform to the specified requirements, the heat shall be rejected, or two additional analyses shall be made on the sample that failed, each of which shall conform to the specified requirements.

8. Tensile Property Requirements

8.1 The material shall conform to the requirements for tensile properties given in Table 2 and in 8.6. The yield strength maxima apply only to pipe NPS 8 and larger.

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

8.3 A test specimen taken across the weld shall show a tensile strength not less than the minimum tensile strength specified for the grade of pipe required. Test specimens shall

[5] Available from ASME International, Three Park Avenue, New York, NY 10016-5990.