



# Standard Specification for Steel Line Pipe, Black, Plain End, Laser Beam Welded<sup>1</sup>

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<sup>2</sup>
- A 530/A 530M Specification for General Requirements for Specialized Carbon and Alloy Steel Pipe<sup>2</sup>
- A 450/A 450M Specification for General Requirements for Carbon, Ferritic Alloy, and Austenitic Alloy Steel Tubes<sup>2</sup>
- A 751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products<sup>3</sup>
- A 941 Standard Terminology Relating to Steel, Stainless Steel, Related Alloys, and Ferroalloys<sup>2</sup>

**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.

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

<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> Annual Book of ASTM Standards, Vol 01.01.

<sup>3</sup> Annual Book of ASTM Standards, Vol 01.02.

<sup>4</sup> 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<sup>5</sup>

## 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, <sup>A</sup> min.		Yield Strength, <sup>A</sup> 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

<sup>A</sup>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

<sup>5</sup> Available from ASME International, Three Park Avenue, New York, NY 10016-5990.

exhibit at least 10 % elongation in 2 in. [50 mm]. This test is not required for pipe under NPS 8.

8.4 Transverse tension tests shall be performed on NPS 8 and larger and the specimens shall be taken opposite the weld. All transverse test specimens shall be approximately 1½ in. [38 mm] wide in the gage length and shall represent the full wall thickness of the pipe from which the specimen was cut.

8.5 For pipe smaller than NPS 8, longitudinal tests shall be performed. Such tests shall be either strip specimens taken approximately 90° from the weld or full section specimens, at the option of the manufacturer.

8.6 Grades intermediate to those shown in Table 2 may be furnished. For such grades, the permissible yield strength range shall be as given in Table 2 for the next higher grade, and the required minimum tensile strength shall exceed the required minimum yield strength by the same amount as is given in Table 2 for the next higher grade.

8.7 The minimum elongation in 2 in. [50 mm] for all grades shall be determined by the following equation:

$$e = C \frac{A^{0.2}}{U^{0.9}} \quad (2)$$

where:

$e$  = minimum elongation in 2 in. [50 mm], percent, rounded to the nearest percent,

$C$  = 625 000 [1940],

$A$  = the lesser of 0.75 in<sup>2</sup> [485 mm<sup>2</sup>] and the cross-sectional area of the tensile test specimen, based on the specified outside diameter or the nominal specimen width and the specified wall thickness, rounded to the nearest 0.01 in<sup>2</sup> [1 mm<sup>2</sup>], and

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

## 9. Charpy V-Notch Test

9.1 Pipe body test specimens shall be taken approximately 90° from the weld.

9.2 The Charpy test specimens used shall be those given in Table 3, except that it shall be permissible to use ⅔ or ½ size

test specimens as required when the absorbed energy is expected to exceed 80 % of the full scale capacity of the testing machine.

9.3 The minimum average absorbed energy of pipe body for any Charpy V-notch test shall be calculated from the equation given below for pipe NPS 5 through NPS 26. Values calculated by this equation as less than 30 ft-lbf [40 J] shall be taken as 30 ft-lbf [40 J] minimum average.

$$CV(\text{fullsize}) = C \times \sqrt{D} \times S^{1.5} \quad (3)$$

where:

$CV$  = minimum average value required, ft-lbf [J],

$C$  = 0.024 [0.000 354],

$D$  = specified outside diameter, in. [mm], and

$S$  = 0.72 × specified minimum yield strength, ksi [MPa].

NOTE 1—Charpy testing is not required on any pipe smaller than NPS 5 or for pipe NPS 5 or larger with insufficient specified wall thickness to permit at least ½ size specimens to be obtained.

9.4 When subsize specimens are used, the minimum average absorbed energy shall be that specified for full size specimens multiplied by 0.67 (for ⅔ size specimens) or 0.50 (for ½ size specimens), rounded to the nearest whole number.

9.5 Testing shall be conducted at a test temperature of 32°F [0°C], or lower.

9.6 For pipe body tests, each Charpy specimen shall exhibit at least 75 % shear area.

## 10. Weld Ductility Test

10.1 *Flattening Test*—The flattening test shall be conducted by tests on full section specimens of 2 in. [50 mm] minimum length. The specimens shall be flattened cold between parallel plates. The weld shall be placed at 90° and at 0° from the direction of applied force. No crack or breaks exceeding ⅓ in. [3 mm] in any direction in the weld or in the parent metal shall occur on the outside surface until the distance between the plates is less than the value of  $H$  in the following equation, except that cracks that occur at the edges of the specimen and are less than ¼ in. [6 mm] long shall not be cause for rejection:

**TABLE 3 Relationship Between Pipe Dimensions and Required Charpy Specimens**

NOTE 1—Charpy testing is not required on any pipe smaller than NPS 5 or for pipe NPS 5 or larger with insufficient specified wall thickness to permit at least ½ size specimens to be obtained.

Specified OD in. [mm]	Specified Wall Thickness, in. [mm]				
	Full Size Transverse	⅔ Size Transverse	½ Size Transverse	⅔ Size Longitudinal	½ Size Longitudinal
5⅝ [141.3]	0.469 and thicker [11.9 and thicker]	0.371 to 0.468 [9.4 to 11.8]	0.338 to 0.370 [8.8 to 9.3]	0.310 to 0.337 [7.9 to 9.2]	0.245 to 0.309 [6.2 to 7.8]
6⅝ [168.3]	0.460 and thicker [11.7 and thicker]	0.334 to 0.459 [8.5 to 11.6]	0.301 to 0.333 [7.6 to 8.4]	...	0.244 to 0.300 [6.2 to 7.5]
8⅝ [219.1]	0.450 and thicker [11.4 and thicker]	0.318 to 0.449 [8.1 to 11.3]	0.267 to 0.317 [6.5 to 8.0]	...	0.242 to 0.256 [6.1 to 6.4]
10¾ [273.1]	0.443 and thicker [11.3 and thicker]	0.311 to 0.442 [7.9 to 11.2]	0.246 to 0.310 [6.2 to 7.8]	...	0.241 to 0.245 [6.1]
12¾ [323.9]	0.438 and thicker [11.1 and thicker]	0.307 to 0.437 [7.8 to 11.0]	0.241 to 0.306 [6.1 to 7.7]	...	...
14 [355.6]	0.436 and thicker [11.1 and thicker]	0.305 to 0.435 [7.7 to 11.0]	0.238 to 0.304 [6.1 to 7.6]	...	...
≥16 [≥406.4]	0.434 and thicker [11.0 and thicker]	0.304 to 0.433 [7.7 to 10.9]	0.237 to 0.303 [6.0 to 7.6]	...	...

$$H = \frac{3.05 t}{(0.05 + 3 t/D)} \quad (4)$$

where:

- $H$  = distance between flattening plates, in. [mm],
- $t$  = specified wall thickness, in. [mm], and
- $D$  = specified outside diameter, in. [mm].

10.2 *Guided Bend Test*—Root and face guided bend tests shall be conducted in accordance with Test Methods and Definitions A 370. The specimens shall not fracture completely and shall not reveal any cracks or ruptures in the fusion line longer than 1/8 in. [3 mm], except that cracks that occur at the edges of the specimen and are less than 1/4 in. [6 mm] long shall not be cause for rejection.

## 11. Hydrostatic Test

11.1 Each length of pipe shall be subjected to the hydrostatic test without leakage through the wall.

11.2 Except as allowed by 11.5, each length of pipe NPS 2 or larger shall be tested, by the manufacturer, to a minimum hydrostatic pressure determined using the following relationship:

inch pound units:

$$P = 2 \frac{St}{D} \times C \quad (5)$$

SI units:

$$P = 2000 \frac{St}{D} \times C \quad (6)$$

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],
- $C$  = 0.60 for pipe NPS 2 through NPS 5,  
= 0.75 for pipe larger than NPS 5 through NPS 8,  
= 0.85 for pipe larger than NPS 8 through NPS 18, and  
= 0.90 for pipe larger than NPS 18.

11.3 For pipe sizes smaller than NPS 2, the test pressures given in Table 4 are arbitrary. For intermediate diameters smaller than NPS 2, the test pressures given for the next smaller diameter shall be used.

**TABLE 4 Hydrostatic Test Pressure**

NPS Designer	Specified Outside Diameter in. [mm]	Specified Wall Thickness in. [mm]	Test Pressure, Minimum psi [kPa]
1	1.315 [33.4]	0.133 [3.4]	700 [4800]
		0.179 [4.6]	850 [5900]
		0.250 [6.4]	950 [6600]
		03.58 [9.1]	1000 [6900]
1¼	1.660 [42.2]	0.140 [3.6]	1300 [9000]
		0.191 [4.9]	1900 [13 100]
		0.250 [6.4]	2000 [13 800]
		0.382 [9.7]	2300 [15 900]
1½	1.900 [48.3]	0.145 [3.7]	1300 [9000]
		0.200 [5.1]	1900 [13 100]
		0.281 [7.1]	2000 [13 800]
		0.400 [10.2]	2300 [15 900]

11.4 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].

11.5 The minimum hydrostatic test pressure required to satisfy these requirements need not exceed 3000 psi [20 700 kPa]; however 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 sizes.

## 12. Nondestructive Examination

12.1 *General*—The weld seam of each length of pipe shall be subjected to ultrasonic inspection in accordance with 12.2.

### 12.2 Ultrasonic Inspection:

12.2.1 Any equipment utilizing the ultrasonic 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 12.2.2 at least once every working turn with no more than 8 h between such checks 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 for final inspection shall be after hydrostatic test.

12.2.2 *Reference Standards*—Reference standards shall have the same diameter and thickness as the product being 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 one machined notch on the inside surface and one machined notch on the outside surface or a drilled hole, with the following dimensions:

Parallel Sided Notch	Drilled Hole
Depth: 5 %t ± 15 % with min. depth of 0.012 ± 0.002 in. [0.3 ± 0.05 mm]	1/16 in. [1.6 mm] dia.
Width: 0.04 in. [1 mm] max.	
Length: 2 in. [50 mm] min. at full depth	

NOTE 2—The reference standards defined in 12.2.2 contain simulated flaws for calibration of nondestructive testing equipment. The dimensions of these flaws should not be construed as the minimum size imperfection detectable by such equipment.

12.2.3 Surface condition, operator qualification, extent of examination, and standardization procedure shall be in accordance with the provisions of Specification A 450/A 450M.

12.2.4 *Acceptance Limits*—Table 5 gives the height of acceptance limit signals in percent of the height of signals produced by the reference flaws. Imperfections in the weld seam that produce a signal greater than the acceptance limit given in Table 5 shall be considered defects.

**TABLE 5 Acceptance Limits**

Type of Notch	Acceptance Limit Signal %
Parallel Sided Notch	100
Drilled Hole	100

12.3 *Disposition of Pipe Containing Defects*—Pipe containing defects shall be given one or more of the following dispositions:

- 12.3.1 The pipe length shall be rejected.
- 12.3.2 The portion of the pipe containing the defect shall be cut off.
- 12.3.3 The defect shall be removed by grinding, provided that the remaining wall thickness is within specified limits.
- 12.3.4 The defect shall be repaired by welding.

**13. Number of Tests**

13.1 Tensile testing of the pipe body and weld shall be at a frequency of one test per lot. Each lot, as given in Table 6, shall consist of each combination of specified outside diameter, specified wall thickness, and heat.

13.2 A flattening test as described in 10.1 shall be conducted on test specimens from each end of each coil length for each pipe size NPS 2 and larger. In the event of a weld stop, the test shall be performed on each pipe end adjacent to the weld stop.

13.3 For pipe NPS 10 and larger, a guided bend test shall also be performed in accordance with 10.2, at a frequency of one test per lot of 50 lengths or less of each combination of specified outside diameter, specified wall thickness, and grade.

13.4 Charpy V-notch testing of the pipe body shall be as given in Table 6 for each combination of specified outside diameter, specified wall thickness, and heat.

**14. Test Methods**

14.1 The mechanical properties testing required by this specification shall conform to those described in Test Methods and Definitions A 370.

**15. Dimensions And Weight [Mass] Per Unit Length**

15.1 The dimensions and weight [mass] per unit length shall be as given in Table 1. The weight [mass] per unit length of pipe having an intermediate outside diameter and/or wall thickness shall be determined using the following equation:

inch-pound units:

$$W = 10.69(D-t)t \tag{7}$$

SI units:

$$W = 0.02466(D-t)t \tag{8}$$

where:

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

**16. Permissible Variation in Weight [Mass] and Dimensions**

16.1 *Weight [Mass]*—The weight [mass] of a single length of pipe shall not vary more than +10 %, -3.5 % from its

theoretical weight [mass]. The weight [mass] of any order item shall not be more than 1.75 % under its theoretical weight [mass].

16.2 *Wall Thickness*—The minimum wall thickness at any point shall not be more than 8 % under the specified wall thickness.

16.3 *Length*—Unless otherwise agreed upon between the purchaser and the manufacturer, pipe shall be furnished in the nominal lengths and within the permissible variation in Table 7, as specified.

16.4 *Diameter*—Pipe sizes NPS 20 and smaller shall permit the passage over the ends, for a distance of 4 in. [100 mm], of a ring gage that has a bore diameter no larger than the specified outside diameter plus the diameter plus tolerance. Diameter measurements of pipe larger than NPS 20 shall be made with a diameter tape. Diameter measurements (away from the ends) of pipe NPS 20 and smaller shall be made with a snap gage, caliper, or other device that measures actual diameter in a single plane.

**17. End Finish**

17.1 Pipe furnished to this specification shall be plain-end beveled 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 in. [1.6 mm] ± 1/32 in. [0.8 mm], or with the special plain-end configurations specified in the purchase order.

**18. Workmanship, Finish and Appearance**

18.1 The depth of groove resulting from the removal of the internal weld protrusion shall not be greater than that given in Table 8 for the applicable wall thickness. Depth of groove is defined as the difference between the wall thickness measured approximately 1 in. [25 mm] from the weld line and the remaining wall under the groove.

18.2 The external weld protrusion shall not extend above the surface of the pipe by more than 0.010 in. [0.25 mm].

18.3 Surface imperfections that penetrate more than 8 % of the specified wall thickness or encroach on the minimum wall thickness shall be considered defects. Pipe with surface defects shall be given one of the following dispositions:

18.3.1 The defect shall be removed by grinding, provided that a smooth curved surface remains and the remaining wall thickness is within specified limits.

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

18.3.3 The length shall be rejected.

18.4 Wall thickness measurements shall be made with a mechanical caliper or with a properly calibrated nondestructive

**TABLE 7 Permissible Variations on Lengths**

Nominal Length		Minimum Length		Minimum Avg. Length Maximum 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	13	17.5	5.33	43.8	13.35	55.0	16.76
60	18	21.0	6.40	52.5	16.0	65.0	19.81
80	24	28.0	8.53	70.0	21.34	85.0	25.91

**TABLE 6 Lot Size and Sample Size For Mechanical Testing**

Size Designation	Lot Size	Sample Size
< NPS 2	50 tons or fraction thereof	1
NPS 2 through NPS 5	400 lengths	1
NPS 6 through NPS 12	200 lengths	1
> NPS 12	100 lengths	1

**TABLE 8 Depth of Groove Tolerance**

Specified Wall Thickness (t), in. [mm]	Maximum Depth of Groove, in. [mm]
0.150 [3.8] or less	0.10t
>0.150 [3.8] to < 0.300 [7.5]	0.015 [0.4]
0.300 [7.5] or greater	0.05t

testing device of appropriate accuracy. In case of a dispute, the measurement determined by the use of a mechanical caliper shall govern.

18.5 Repairs of the pipe body, by welding, are not permitted.

18.6 *Repair of the Weld*—Defects in welds may be repaired only by agreement between the purchaser and the manufacturer; such repairs shall be in accordance with Specification A 530/A 530M, except that the repair depth shall not exceed 70 % of the specified wall thickness of the pipe and back-to-back repairs are not permitted. No repair of repair weld is permitted.

18.7 Pipe smaller than NPS 4 shall be reasonably straight. For all other pipe, the measured deviation from a straight line shall not exceed 0.2 % of the length.

18.8 The pipe shall contain no dents greater than 10 % of the specified outside diameter or ¼ in. [6.4 mm], whichever is smaller, measured as the gap between the lowest point of the

dent and a prolongation of the original contour of the pipe. Cold formed dents deeper than ⅛ in. [3.2 mm] shall be free of sharp-bottom gouges. The gouges may be removed by grinding, provided that the remaining wall thickness is within specified limits. The length of the dent in any direction shall not exceed one half the pipe diameter.

## 19. Certification

19.1 A certified test report shall be furnished.

## 20. Package Marking

20.1 Each length of pipe shall be legibly marked by stenciling to show: specification number, the name or brand of the manufacturer, LBW, the grade, wall thickness, diameter, heat number, and the length, except as allowed in 20.2. The length shall be marked in feet and tenths of a foot, or metres to two decimal places, as applicable.

20.2 For pipe NPS 1½ and smaller that is bundled, the information in 20.1 may be marked on a tag that is securely fastened to each bundle.

20.3 In addition to the requirements of 20.1 and 20.2, bar coding is acceptable as a supplementary identification method. The purchaser may specify in the order a specific bar coding system to be used.

## 21. Keywords

21.1 black steel pipe; laser beam welded; line pipe

## SUPPLEMENTARY REQUIREMENTS

The following supplementary requirement shall apply only when specified in the purchase order.

### S1. Drop-Weight Tear Testing

S1.1 The drop-weight tear test shall be conducted in accordance with API RP 5L3.

S1.2 The temperature selected for conducting the drop-weight tear test, the test frequency, and the criteria for acceptance shall be as specified in the purchase order.

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