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EXHIBIT 153 PART 1

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Designation: A 106/A 106M - 04b

Standard Specification for Seamless Carbon Steel Pipe for High-Temperature S

This standard is issued under the fixed designation A 106/A 106M; the number immediately following the designatic of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the yea A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope*

1.1 This specification² covers seamless carbon steel pipe for high-temperature service (Note 1) in NPS ¹/₈ to NPS 48 [DN 6 to DN 1200] (Note 2) inclusive, with nominal (average) wall thickness as given in ASME B 36.10M. It shall be permissible to furnish pipe having other dimensions provided such pipe complies with all other requirements of this specification. Pipe ordered under this specification shall be suitable for bending, flanging, and similar forming operations, and for welding. When the steel is to be welded, it is presupposed that a welding procedure suitable to the grade of steel and intended use or service will be utilized.

Note 1-It is suggested, consideration be given to possible graphitization.

2. Referenced Documents

2.1 ASTM Standards: ³
A 530/A 530M Specification f Specialized Carbon and Allo E 213 Practice for Ultrasonic and Tubing
E 309 Practice for Eddy-Curre bular Products Using Magnet
E 381 Method of Macroetch Blooms, and Forgings

E 570 Practice for Flux Leakag netic Steel Tubular Products 2.2 ASME Standard:

ASME B 36.10M Welded an

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specification: Now standard does not purport to address addres

³ For referenced ASTM standards, visit t contact ASTM Customer Service at service(*Standards* volume information, refer to the st the ASTM website.

Buttwelding Ends One For Dummie

3.1.1 Quantity (feet, metres, or

specification:

⁴ Available from American Society of M International Headquarters, Three Park Ave.,

⁵ Available from Standardization Docum Section D, 700 Robbins Ave., Philadelphia,

⁶ Available from Steel Structures Paintin Floor, Pittsburgh, PA 15222-4656.

¹ This specification is under the jurisdiction of Committee A01 on Steel, Stainless Steel and Related Alloys and is the direct responsibility of Subcommittee A01.09 on Carbon Steel Tubular Products.

Current edition approved Oct. 1, 2004. Published October 2004. Originally approved in 1926. Last previous edition in 2004 as A 106/A 106M - 04a.

² For ASME Boiler and Pressure Vessel Code applications see related Specifications SA-106 in Section II of that Code.

*A Summary of Changes section appears at the end of this standard.

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∰ A 106/A 106M – 04b

- 3.1.2 Name of material (seamless carbon steel pipe),
- 3.1.3 Grade (Table 1),
- 3.1.4 Manufacture (hot-finished or cold-drawn),

3.1.5 Size (NPS [DN] and weight class or schedule number, or both; outside diameter and nominal wall thickness; or inside diameter and nominal wall thickness),

Related titles

6. General Requirements

6.1 Material furnished to this the applicable requirements of cation A 530/A 530M unless ot

7. Chemical Composition

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4.1 The steel shall be killed steel, with the primary melting process being open-hearth, basic-oxygen, or electric-furnace, possibly combined with separate degassing or refining. If secondary melting, using electroslag remelting or vacuum-arc remelting is subsequently employed, the heat shall be defined as all of the ingots remelted from a single primary heat.

4.2 Steel cast in ingots or strand cast is permissible. When steels of different grades are sequentially strand cast, identification of the resultant transition material is required. The producer shall remove the transition material by any established procedure that positively separates the grades.

4.3 For pipe NPS 11/2 [DN 40] and under, it shall be permissible to furnish hot finished or cold drawn.

4.4 Unless otherwise specified, pipe NPS 2 [DN 50] and over shall be furnished hot finished. When agreed upon between the manufacturer and the purchaser, it is permissible to furnish cold-drawn pipe.

5. Heat Treatment

5.1 Hot-finished pipe need not be heat treated. Cold-drawn pipe shall be heat treated after the final cold draw pass at a temperature of 1200 °F (650 °C) or higher.

TABLE 1	Chemical	Requirements
---------	----------	--------------

		Composition, %	
	Grade A	Grade B	Grade C
Carbon, max ^A	0.25	0.30	0.35
Manganese	0.27-0.93	0.29-1.06	0.29-1.06
Phosphorus, max	0.035	0.035	0.035
Sulfur, max	0.035	0.035	0.035
Silicon, min	0.10	0.10	0.10
Chrome, max ^B	0.40	0.40	0.40
Copper, max [®]	0.40	0.40	0.40
Molybdenum, max ⁸	0.15	0.15	0.15
Nickel, max ⁸	0.40	0.40	0.40
Vanadium, max ^B	0.08	0.08	0.08

Related titles

9. Product Analysis

9.1 At the request of the pur from each lot (Note 3) of 400 1 each size up to, but not including each lot of 200 lengths or fractic [DN 150] and over, shall be made finished pipe. The results of these the purchaser or the purchase conform to the requirements spe

9.2 If the analysis of one of t not conform to the requireme analyses shall be made on add original number from the sam conform to requirements specifie

Note 3-A lot shall consist of the Sections 9 and 21 of the same size and of steel.

10. Tensile Requirements

10.1 The material shall confor tensile properties given in Table

11. Bending Requirements

11.1 For pipe NPS 2 [DN 50] of pipe shall stand being bent cylindrical mandrel, the diameter outside diameter (as shown in As without developing cracks. When pipe shall stand being bent co cylindrical mandrel, the diameter outside diameter (as shown in AS without failure.

11.2 Subject to the approval hans die

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used For longitudinal strip tests For transverse strip tests, a deduction for each ½2-in. [0.8-mm] decrease in wall thickness below ½6 in. [7.9 mm] from the basic minimum elongation of the following percentage shall be made

^A The minimum elongation in 2 in. [50 mm] shall be determined by the following equation:

 $e = 625 \ 000 A^{0.2} / U^{0.9}$

A

e = 1 940A^{0.2} / U^{0.9}

1.25

for SI units, and

for inch-pound units,

where:

- e = minimum elongation in 2 in. [50 mm], %, rounded to the nearest 0.5 %,
- A = cross-sectional area of the tension test specimen, in.² [mm²], based upon specified outside diameter or nominal specimer rounded to the nearest 0.01 in. ² [1 mm²]. (If the area thus calculated is equal to or greater than 0.75 in. ² [500 mm²], the be used.), and
- U = specified tensile strength, psi [MPa].

the bend being 1 in. [25 mm], without cracking on the outside portion of the bent portion.

11.3 For pipe whose diameter exceeds 25 in. [635 mm] and whose diameter to wall thickness ratio is 7.0 or less, the bend test described in 11.2 shall be conducted instead of the flattening test.

Note 4-Diameter to wall thickness ratio = specified outside diameter/ nominal wall thickness.

Example: For 28 in. [711 mm] diameter 5.000 in. [127 mm] thick pipe the diameter to wall thickness ratio = 28/5 = 5.6 [711/127 = 5.6].

Related titles

shall be permissible for the full b with a nondestructive electric tes

A

1.0

13.3 Where specified in the permissible for pipe to be furnishe and without the nondestructive e this case, each length so furnished marking of the letters "NH." It s meeting the requirements of 13.1 pipe without either the hydrostat

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Fittingside surface authorsiwland twelvene's look bocations scales at these locations shalls that lies cause for rejection if the Difference is less than ten.

13. Hydrostatic Test

13.1 Except as allowed by 13.2, 13.3, and 13.4, each length of pipe shall be subjected to the hydrostatic test without leakage through the pipe wall.

13.2 As an alternative to the hydrostatic test at the option of the manufacturer or where specified in the purchase order, it 14.1 As an alternative to the h ASME B16.25-2017 Networking Alt-in the manufacturer or where pecifi alternative or addition to the hyd each pipe shall be tested with a 1 accordance with Practice E 213, F the marking of each length of pi the letters "NDE." It is the intent test to reject pipe with imperfect equal to or greater than that calibration standard.

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NPS

\$ 16

> 1/2 \$ 11/4

 $> 1\frac{1}{4} \le 2$

>2 ≤ 5

>5

14.2 Where the nondestructive electric test is performed, the
lengths shall be marked with the letters "NDE." The certifica-
tion, where required, shall state "Nondestructive Electric
Tested" and shall indicate which of the tests was applied. Also,
the letters "NDE" shall be appended to the product specifica-
tion number and material grade shown on the certification.

14.3 The following information is for the benefit of the user of this specification:

14.3.1 The reference standards defined in 14.4 through 14.6 are convenient standards for calibration of nondestructive testing equipment. The dimensions of such standards are not to be construed as the minimum sizes of imperfections detectable by such equipment.

14.3.2 The ultrasonic testing referred to in this specification

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8/17

DN

≤ 15

> 15 ≤ 32

> 32 ≤ 50

> 50 ≤ 125

> 125

14.5.2 Transverse Tangential

file with a 1/4-in. [6-mm] diame

milled tangential to the surface :

dinal axis of the pipe. The no

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Fittinghe detection Grashith Whaterently SMEB169-2007

14.3.5 The hydrostatic test referred to in Section 13 has the capability of finding defects of a size permitting the test fluid to leak through the tube wall and may be either visually seen or detected by a loss of pressure. Hydrostatic testing is not necessarily capable of detecting very tight, through-the-wall imperfections or imperfections that extend an appreciable distance into the wall without complete penetration.

14.3.6 A purchaser interested in ascertaining the nature (type, size, location, and orientation) of discontinuities that can be detected in the specific applications of these examinations is directed to discuss this with the manufacturer of the tubular product.

14.4 For ultrasonic testing, the calibration reference notches shall be, at the option of the producer, any one of the three common notch shapes shown in Practice E 213. The depth of notch shall not exceed $12\frac{1}{2}$ % of the specified wall thickness of the pipe or 0.004 in. [0.1 mm], whichever is greater.

14.5 For eddy current testing, the calibration pipe shall contain, at the option of the producer, any one of the following discontinuities to establish a minimum sensitivity level for rejection:

14.5.1 Drilled Hole—The calibration pipe shall contain depending upon the pipe diameter three holes spaced 120° apart or four holes spaced 90° apart and sufficiently separated longitudinally to ensure separately distinguishable responses. The holes shall be drilled radially and completely through the pipe wall, care being taken to avoid distortion of the pipe while drilling. Depending upon the pipe diameter the calibration pipe shall contain the following hole:

radial plane parallel to the pipe ax ASME BIG25 2017 Networking Alem Buitwelding ENUS, oblights and interwall thicknesses equal to and abc outside notch shall be used. Notcl % of the specified wall thicknewhichever is greater. Notch leng mm], and the width shall not diameter and inside diameter no ciently apart to allow separatio signals.

14.7 Pipe containing one or n duce a signal equal to or greater th calibration standard shall be rejec signal shall be reexamined.

14.7.1 Test signals produced by be identified, or produced by crack shall result in rejection of the pip retested. To be accepted, the pipe cation test to which it was origina the remaining wall thickness is permitted by this specification. The may be reduced by the amount sc

14.7.2 Test signals produced by those listed below may be evaluar provisions of Section 18:

- 14.7.2.1 Dinges,
- 14.7.2.2 Straightener marks,
- 14.7.2.3 Cutting chips,
- 14.7.2.4 Scratches,
- 14.7.2.5 Steel die stamps,
- 14.7.2.6 Stop marks, or

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14.7.2.7 Pipe reducer ripple.

14.8 The test methods described in this section are not necessarily capable of inspecting the end portion of pipes, a condition referred to as "end effect." The length of such end effect shall be determined by the manufacturer and, when specified in the purchase order, reported to the purchaser.

15. Nipples

15.1 Nipples shall be cut from pipe of the same dimensions and quality described in this specification.

16. Dimensions, Mass, and Permissible Variations

16.1 Mass—The mass of any length of pipe shall not vary more than 10 % over and 3.5 % under that specified. Unless otherwise agreed upon between the manufacturer and the purchaser, pipe in NPS 4 [DN 100] and smaller may be weighed in convenient lots; pipe larger than NPS 4 [DN 100] shall be weighed separately.

16.2 Diameter—The tolerances for diameter shall be in accordance with the following:

16.2.1 Except for pipe ordered as special outside diameter tolerance pipe or as inside diameter tolerance pipe, variations in outside diameter shall not exceed those given in Table 3.

16.2.2 For pipe over 10 in. [250 mm] OD ordered as special outside diameter tolerance pipe, the outside diameter shall not vary more than 1 % over or 1 % under the specified outside diameter.

16.2.3 For pipe over 10 in. [250 mm] ID ordered as inside diameter tolerance pipe, the inside diameter shall not vary more than 1 % over or 1 % under the specified inside diameter.

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

17.1.3 If definite lengths are ordered in single random lengths with 5 % 12 to 16 ft [3.7 to 4.8 m], with a minimum average of 35 f length of 22 ft [6.7 m] with 5 %

18. Workmanship, Finish and A

18.1 The pipe manufacturer shi ber of visual surface imperfecti assurance that they have been pro to depth. Exploration of all su required but consideration should exploring all surface imperfection 18.2.

18.2 Surface imperfections that of the nominal wall thickness or wall thickness shall be consider defects shall be given one of the

18.2.1 The defect shall be ren that the remaining wall thickness in 16.3.

18.2.2 Repaired in accordanc provisions of 18.6.

18.2.3 The section of pipe cont off within the limits of requireme 18.2.4 Rejected.

18.3 To provide a workmanlik ating conformance with 18.2 tl remove by grinding the following

18.3.1 Mechanical marks, abra of which imperfections are deepe

18.3.2 Visual imperfections co

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Over 11/2 to 4 [40 to 100] incl	1⁄32 (0.031)	0.8	1/32 (0.031)	0.8	testing device of appropriate accu
Over 4 to 8 [100 to	1/1s (0.062)	1.6	1/32 (0.031)	0.8	measurement determined by use o
Over 8 to 18 [200 to 450] incl	3/32 (0.093)	2.4	1⁄3≥ (0.031)	0.8	18.6 Weld repair shall be pe
Over 18 to 26 [450 to 650], incl	1/a (0.125)	3.2	1/32 (0.031)	0.8	approval of the purchaser and in a
Over 26 to 34 [650 to 850], incl	5⁄32 (0.156)	4.0	Vaz (0.031)	0.8	18.7 The finished pipe shall be
Over 34 to 48 [850 to 1200], incl	¾ ₁₆ (0.187)	4.8	1/32 (0.031)	0.8	Note 5—Marks and abrasions are de marks, roll marks, ball scratches, score

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E 380, Metric Practice

3. Description of Terms

3.1 *Strand*—All strand shall be of the sevenwire type having a center wire enclosed tightly by six helically placed outer wires with a uniform pitch of not less than 12 and not more than 16 times the nominal diameter of the strand.

4. Ordering Information

4.1 Orders for seven-wire stress relieved strand under this specification shall include the following information: 5.3 Stress Relieving—A strand shall be subjected t continuous heat treatment scribed mechanical propert which may result from the s ation are considered norm appearance of this strand.

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¹ This specification is under the Committee A-1 on Steel, Stainless ? and is the direct responsibility of S Steel Reinforcement.

Current edition approved Sep November 1974. Originally public Last previous edition A 416 - 68.

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astm.a633.1979 | Heat Treating | Structural Steel



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