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AMERICAN SOCIETY FOR TESTING AND MATERIALS
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Standard Specification for Centrifugally Cast Carbon Steel Pipe for High-Temperature Service[1]

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1. Scope

1.1 This specification[2] covers carbon steel pipe made by the centrifugal casting process intended for use in high-temperature, high-pressure service. Pipe ordered under this specification shall be suitable for fusion welding, bending, and other forming operations.

1.2 Several grades of carbon steels are covered. Their compositions are given in Table 1.

1.3 Supplementary requirements (S1 to S9) of an optional nature are provided. The supplementary requirements call for additional tests to be made, and when desired shall be so stated in the order, together with the number of such tests required.

1.4 The values stated in inch-pound units are to be regarded as the standard.

TABLE 1 Chemical Requirements

	Composition, max,%		
	Grade WCA	Grade WCB	Grade WCC
Carbon	0.25[A]	0.30	0.25[B]
Manganese	0.70[A]	1.00	1.20[B]
Phosphorus	0.035	0.035	0.035
Sulfur	0.035	0.035	0.035
Silicon	0.60	0.60	0.60

[A] For each reduction of 0.01 % below the specified maximum carbon content, an increase of 0.04 % manganese above the specified maximum will be permitted up to a maximum of 1.10 %.

[B] For each reduction of 0.01 % below the specified maximum carbon content, an increase of 0.04 % manganese above the specified maximum will be permitted to a maximum of 1.40 %.

2. Referenced Documents

2.1 *ASTM Standards:*

A 530/A 530M Specification for General Requirements for Specialized Carbon and Alloy Steel Pipe[3]

E 94 Guide for Radiographic Testing[4]

E 114 Practice for Ultrasonic Pulse-Echo Straight-Beam Examination by the Contact Method[4]

E 125 Reference Photographs for Magnetic Particle Indications on Ferrous Castings[4]

E 142 Method for Controlling Quality of Radiographic Testing[4]

E 186 Reference Radiographs for Heavy-Walled (2 to 4½-in. (51 to 114-mm)) Steel Castings[4]

E 381 Method of Macroetch Testing Steel Bars, Billets, Blooms, and Forgings[5]

E 446 Reference Radiographs for Steel Castings up to 2 in. (51 mm) in Thickness[4]

2.2 *ANSI Standards:*

B36.10 American Standard for Welded and Seamless Wrought Steel Pipe[6]

B46.1 Surface Texture[6]

2.3 *MSS Standards:*

SP-54 Quality Standard for Steel Castings—Radiographic Inspection Method[7]

3. Ordering Information

3.1 Orders for material under this specification should include the following, as required, to describe the desired material adequately:

3.1.1 Quantity (feet, metres, or number of lengths),

3.1.2 Name of material (centrifugally cast pipe),

3.1.3 Grade (Table 1),

3.1.4 Size (outside or inside diameter and minimum wall thickness),

3.1.5 Length (specific or random), (Permissible Variations in Length Section of Specification A 530/A 530M),

3.1.6 End finish (Ends Section of Specification A 530/A 530M),

3.1.7 Optional Requirements (Sections 7.2, 8.2, 8.3, 11.1, Section 12 and S1 to S9 (Supplementary Requirements),

3.1.8 Test report required (Certification Section of Specification A 530/A 530M),

3.1.9 Specification designation, and

3.1.10 Special requirements.

[1] 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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[2] For ASME Boiler and Vessel Code applications see related Specification SA-660 in Section II of that Code.

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

[4] *Annual Book of ASTM Standards*, Vol 03.03.

[5] *Annual Book of ASTM Standards*, Vol 03.01.

[6] Available from American National Standards Institute, 11 West 42nd St., 13th Floor, New York, NY 10036.

[7] Available from the Manufacturers' Standardization Society of the Valve and Fittings Industry, 1815 N. Fort Myer Drive, Arlington, VA 22209.

4. General Requirements

4.1 Material furnished under this specification shall conform to the applicable requirements of the current edition of Specification A 530/A 530M unless otherwise provided herein.

5. Materials and Manufacture

5.1 *Machining*:

5.1.1 All centrifugally cast pipe shall have both the inner and outer surfaces machined.

5.1.2 After heat treatment, the pipe shall be machined to a finish with a roughness value no greater than 250 µin. (6.35 µm) arithmetical average deviation (AA), terms as defined in ANSI B46.1 unless otherwise specified.

5.2 *Heat Treatment*:

5.2.1 All pipe shall receive a heat treatment proper for its design and chemical composition.

5.2.2 Castings shall be heat treated after they have been allowed to cool below the transformation range.

6. Temperature Control

6.1 Furnace temperatures for heat treating shall be effectively controlled by pyrometers.

7. Chemical Requirements

7.1 The steel shall conform to the requirements as to chemical composition prescribed in Table 1.

7.2 *Product Analysis*:

7.2.1 At the request of the purchaser, a product analysis shall be made by the manufacturer on every heat.

7.2.2 The results of these analyses shall be reported to the purchaser or his representative, and shall conform to the requirements specified in Table 1.

7.2.3 If the analysis of one of the tests specified in 7.2.1 does not conform to the requirements specified, an analysis of each pipe from the same heat may be made, and all pipes conforming to the requirements shall be accepted.

8. Mechanical Requirements

8.1 *Tensile Properties*:

8.1.1 The material shall conform to the requirements as to tensile properties prescribed in Table 2.

8.1.2 *Transverse or Longitudinal Tension Test*—One test shall be made on a specimen from one end of one length of pipe representing each heat in each heat-treatment lot.

8.2 *Flattening Test*:

8.2.1 A flattening test shall be performed when requested by the purchaser or when stated by the purchaser on the order that the pipe is to be upset, swaged, expanded, bent, or formed by some other operation.

TABLE 2 Tensile Requirements

	WCA		WCB		WCC	
	ksi	MPa	ksi	MPa	ksi	MPa
Tensile strength, min	60	414	70	483	70	483
Yield strength, min	30	207	36	248	40	276
Elongation in 2 in. or 50 mm, min, %	24		22		22	
Reduction of area, min, %	35		35		35	

8.2.2 A flattening test need not be performed on heavy wall pipe which is not to be upset, swaged, expanded, bent, or formed in some other manner.

8.2.3 When required by 8.2, a test shall be made on specimens cut from one end of each length of pipe.

8.2.4 A flattening test when required shall be performed in accordance with the requirements for seamless and centrifugally cast pipe in the Flattening Test Requirements Section of Specification A 530/A 530M.

NOTE 1—In heavy-walled small-diameter tubing the flattening test specimen may be bored out so that the *OD/t* ratio will be greater than 11.0.

8.3 *Hydrostatic Test*:

8.3.1 Each length of pipe shall be hydrostatically tested in accordance with the Hydrostatic Test Requirements Section of Specification A 530/A 530M when requested by the purchaser and stated on the order. If performance of the hydrostatic test is not required by the purchaser, the manufacturer shall guarantee pipe to pass the test and mark each length of pipe with the letters "NH" immediately following the specification number, indicating that the pipe has not been hydrostatically tested.

8.3.2 When required by 8.3, each length of pipe shall be subjected to the hydrostatic test. The test pressure shall be maintained for not less than 5 min.

9. Permissible Variation in Wall Thickness

9.1 The wall thickness shall not vary over the specified minimum wall thickness by more than 10 %. There shall be no variation under the specified minimum wall thickness.

NOTE 2—A system of standard pipe sizes has been approved by the American National Standards Institute, as ANSI B36.10. This system may be used for obtaining pipe under this specification.

10. Workmanship and Finish

10.1 The pipe shall have a finish as provided in 5.2 and it shall be reasonably straight and free from injurious defects.

11. Rework and Retreatment

11.1 *Imperfections*—The surface of the casting shall be inspected visually for cracks and hot tears. These imperfections shall be removed, and their removal verified by visual inspection of the resultant cavities. Imperfections located by inspecting with Supplementary Requirements S7, S8, or S9 shall be removed or reduced to an acceptable size.

11.2 *Blending*—If removal of the imperfection does not infringe upon the minimum wall thickness, the depression may be blended uniformly into the surrounding surface.

11.3 *Repair by Welding*—Imperfections that infringe upon the minimum wall thickness may be repaired by welding subject to approval by the purchaser. Only qualified operators and procedures in accordance with ASME Boiler and Pressure Vessel Code, Section IX, shall be used. All weld repairs shall be inspected to the same quality standards used to inspect the pipe.

11.4 *Reheat Treatment*—Local or full heat treatment in accordance with 5.2 shall follow welding. Local grinding following welding and retreating shall be considered as meeting the requirements of 5.1.