~~Designation:A660–96 (Reapproved 2010)~~ Designation: A660/A660M – 11

Standard Specification for Centrifugally Cast Carbon Steel Pipe for High-Temperature Service[1]

This standard is issued under the fixed designation A660/A660M; 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[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.

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

1.4 The values stated in either inch-pound units or SI units are to be regarded separately as standard. Within the text, the SI units are shown in brackets. The values stated in each system are not exact equivalents; therefore, each system must be used independently of each other. Combining values from the two systems may result in nonconformance with the specification.

2. Referenced Documents

2.1 *ASTM Standards:*[3]

A530/A530M Specification for General Requirements for Specialized Carbon and Alloy Steel Pipe
E94 Guide for Radiographic Examination
E114 Practice for Ultrasonic Pulse-Echo Straight-Beam Contact Testing
E125 Reference Photographs for Magnetic Particle Indications on Ferrous Castings
E142 Method for Controlling Quality of Radiographic Testing
E186 Reference Radiographs for Heavy-Walled (2 to 412-in. (50.8 to 114-mm)) Steel Castings
E381 Method of Macroetch Testing Steel Bars, Billets, Blooms, and Forgings
E446 Reference Radiographs for Steel Castings Up to 2 in. (50.8 mm) in Thickness

2.2 *ANSI Standards:*

B36.10 American Standard for Welded and Seamless Wrought Steel Pipe[4]
B46.1 Surface Texture[4]

2.3 *MSS Standards:*

SP-54~~Quality Standard for Steel Castings—Radiographic Inspection Method~~ Quality Standard for Steel Castings for Valves, Flanges, and Fittings and Other Piping Components - Radiographic Examination Method[5]

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),

[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 A01.18 on Castings.

Current edition approved ~~April~~Nov. 1, ~~2010.~~2011. Published ~~May 2010.~~December 2011. Originally approved in 1972. Last previous edition approved in ~~2005~~2010 as A660 – 96 ~~(2005).~~(2010). DOI: ~~10.1520/A0660-96R10.~~10.1520/A0660_A0660M-11.

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

[3] 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.

[4] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

[5] Available from Manufacturers Standardization Society of the Valve and Fittings Industry (MSS), 127 Park St., NE, Vienna, VA 22180-4602, http://www.mss-hq.com.

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

3.1.5 Length (specific or random), (Permissible Variations in Length Section of Specification A530/A530M),
3.1.6 End finish (Ends Section of Specification A530/A530M),
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 A530/A530M),
3.1.9 Specification designation, and
3.1.10 Special requirements.

4. General Requirements

4.1 Material furnished under this specification shall conform to the applicable requirements of the current edition of Specification A530/A530M 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)~~[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.
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 A530/A530M.