



Designation: A1120/A1120M – 21

Standard Specification for Electric-Resistance-Welded Carbon Steel Boiler, Superheater, Heat-Exchanger, and Condenser Tubes with Textured Surface¹

This standard is issued under the fixed designation A1120/A1120M; 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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

1. Scope

1.1 This specification covers average or minimum wall thickness electric resistance welded (ERW) tubing to be used for boilers, heat exchangers, condensers, and similar heat-transfer apparatus.

1.2 The tubing sizes and thicknesses usually furnished to the specification are 0.375 in. [9.5 mm] inside diameter (ID) to 1.5 in. [38 mm] outside diameter (OD) and 0.020 to 0.079 in. [0.5 to 2 mm], inclusive, in wall thickness. Tubing having other dimensions may be furnished provided such tubes comply with all other requirements of this specification.

1.3 The steel materials shall have the (1) external tube surface, (2) internal tube surface, or (3) both internal and external tube surfaces textured to improve heat transfer or fluid flow or both. Textured surface(s) are produced by cold forming a specified configuration on the surface(s) of base strip material before welding.

1.4 Optional supplementary requirements are provided and, when desired, shall be so stated on the purchase order.

1.5 *Units*—The values stated in either SI units or inch-pound units are to be regarded separately as standard. Within the text, the SI units are shown in brackets. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with the standard. The inch-pound units shall apply unless the “M” designation (SI) of the product specification is specified in the order.

1.6 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

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.

Current edition approved Nov. 1, 2021. Published December 2021. DOI: 10.1520/A1120_A1120M-21.

1.7 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 ASTM Standards:²

A450/A450M Specification for General Requirements for Carbon and Low Alloy Steel Tubes

A941 Terminology Relating to Steel, Stainless Steel, Related Alloys, and Ferroalloys

E140 Hardness Conversion Tables for Metals Relationship Among Brinell Hardness, Vickers Hardness, Rockwell Hardness, Superficial Hardness, Knoop Hardness, Scleroscope Hardness, and Leeb Hardness

E213 Practice for Ultrasonic Testing of Metal Pipe and Tubing

E273 Practice for Ultrasonic Testing of the Weld Zone of Welded Pipe and Tubing

E384 Test Method for Microindentation Hardness of Materials

2.2 ASME Standard:³

Section VIII Para UW-51

3. Terminology

3.1 *Definitions*—For definitions of general terms used in this specification, refer to Terminology A941.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *plain cylindrical ring gauges, n*—cylindrical metal ring whose inside diameter is furnished to gauge tolerance.

² 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.

³ Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Two Park Ave., New York, NY 10016-5990, <http://www.asme.org>.

3.2.2 *plain ending, n*—portion of the tube that has no surface texture.

3.2.3 *primary character, n*—largest texture impressed on material.

3.2.4 *primary pattern, n*—combination of primary characters.

3.2.5 *secondary character, n*—fine-cut texture impressed on material.

3.2.6 *secondary pattern, n*—combination of secondary characters.

3.2.7 *textured surface, n*—impressing a series of characters or textures into the material with the intent of improving heat transfer and fluid flow characteristics in the final welded tube.

3.3 *Symbols:*

3.3.1 D —Outside tube diameter-nominal.

3.3.2 DI —Inside tube diameter.

3.3.3 $ID1$ —Top of primary character to bottom of secondary character; see Fig. 1 cross-section A-A for view of primary character and secondary character pattern.

3.3.4 $ID2$ —Top of primary character to top of secondary character.

3.3.5 $ID3$ —Top of secondary character to top of secondary character.

3.3.6 $ID4$ —Top of primary character to bottom of primary character at intersection of the base (each on opposite sides of the tube).

3.3.7 $ID5$ —Top of primary character to top of primary character (each on opposite sides of the tube).

3.3.8 $ID6$ —Top of secondary character to bottom of secondary character.

3.3.9 P_a —Angle of the primary character unit (if any).

3.3.10 P_b —Angle of the secondary character unit (if any).

3.3.11 P_d —Primary character center spacing.

3.3.12 P_{hi} —Primary character height (inside).

3.3.13 P_{ho} —Primary character height (outside).

3.3.14 S_c —Secondary character center spacing.

3.3.15 S_d —Secondary character diameter.

3.3.16 S_{hi} —Secondary character height (inside).

3.3.17 S_{ho} —Secondary character height (outside).

3.3.18 W —Wall thickness (no pattern).

3.3.19 $W1$ —Wall thickness peak inside to valley outside (secondary character).

3.3.20 $W2$ —Wall thickness valley inside to peak outside (secondary character).

3.3.21 $W3$ —Wall thickness base of primary character.

3.3.22 $W4$ —Wall thickness in wall of the primary character.

4. Ordering Information

4.1 It is the responsibility of the purchaser to specify all requirements that are necessary for product ordered under this specification. Such requirements may include, but are not limited to:

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

4.1.2 Name of material (electric-resistance-welded tubes),

4.1.3 Size (outside diameter and minimum or average wall thickness),

4.1.4 Length (specific or random),

4.1.5 Optional requirements (product analysis, hydrostatic or nondestructive electric test, crush test, and bar coding),

4.1.6 Test report required (see Certification section of Specification A450/A450M),

4.1.7 Specification designation, and

4.1.8 Special requirements and any supplementary requirements selected.

4.2 Additional requirements may include the various inside or outside diameters (Fig. 1), textured wall thickness values (see Fig. 2), and length of untextured sections if required; effective diameter and wall thickness of the modified section; number of secondary textured character units per unit length; number of primary textured character units per unit length; and the total tube length.

5. Materials and Manufacture

5.1 The steel shall be killed.

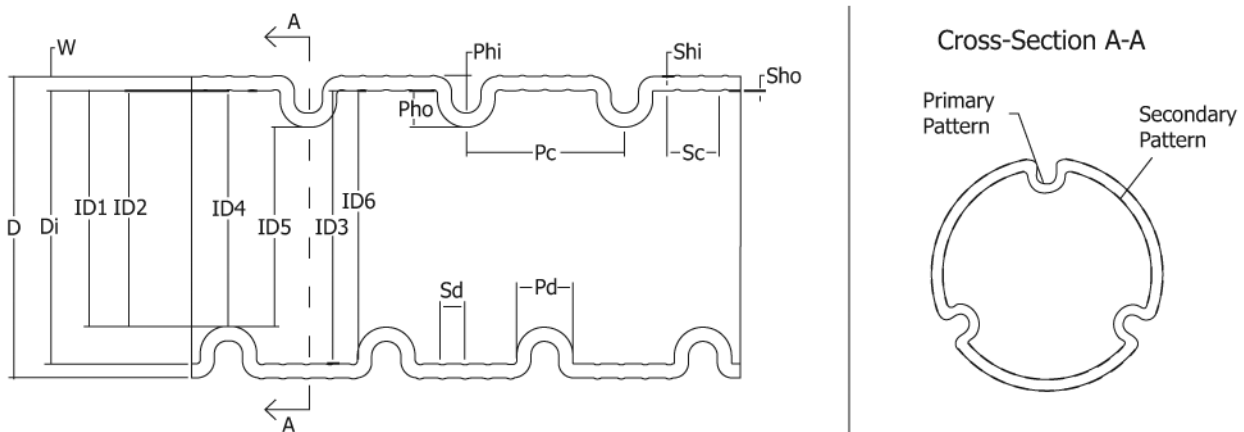


FIG. 1 Views of Representative Textured Tube Showing Variables that Describe Possible Primary and Secondary Texturizations that May be Applied to Inside Surface of Tube, Outside Surface of Tube, or Both Inside and Outside Surfaces of Tube

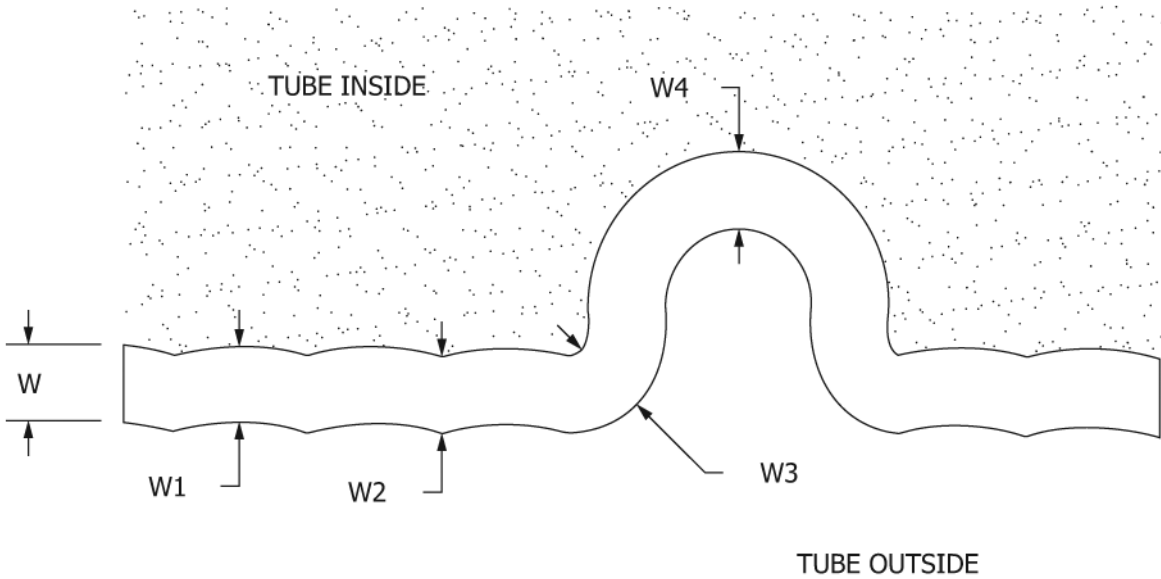


FIG. 2 Details Regarding Wall Thickness of Representative Sample Geometry of Patterns Used to Texture Flat Strip Material before it is Used to Create Welded Tube

5.2 The strip used to form welded tubes shall be textured by cold working on one or both surfaces before being formed into a tube.

5.3 The tubes may have plain ends or have untextured sections within the tube length as specified in the purchase order.

5.4 The tubes shall be made from flat rolled steel using an automatic electric-resistance welding process with no addition of filler metal.

5.5 Subsequent to welding and before final heat treatment, the tubes may be worked only in the welded portion. Cold working and the method of cold working on the weld shall be at the option of the manufacturer unless specified otherwise in the purchase order.

6. Chemical Composition

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

6.2 Supplying an alloy grade that specifically requires the addition of any element other than those listed in 6.1 is not permitted.

7. Heat Treatment

7.1 After welding, all tubes shall be heat treated at a temperature of 1650°F [900°C] or higher and followed by cooling in air or in the cooling chamber of a controlled atmosphere furnace.

TABLE 1 Steel Chemical Composition Requirements

| Element | |
|-------------------|-----------|
| Carbon, max % | 0.18 |
| Manganese, % | 0.27–0.63 |
| Phosphorus, max.% | 0.035 |
| Sulfur, max, % | 0.035 |

8. Product Analysis

8.1 For the purpose of product analysis, a lot consists of 250 pieces for all sizes or, when tubes are identified by heat number, all tubes within that heat.

8.2 When requested on the purchase order, a product analysis shall be made by the manufacturer or supplier from one tube per lot. The chemical composition thus determined shall conform to the requirements specified.

8.3 If the original test for product analysis fails, retest of two additional tubes per lot shall be made. Both retests, for the elements in question, shall meet the requirements of the specification; otherwise, all remaining material in the heat or lot shall be rejected; or at the option of the producer, each tube may be individually tested for acceptance and those pieces that do not meet the requirements of the specification shall be rejected.

8.4 Any tests that are specified and required are performed on textured lengths of the tube in accordance with this specification need not be performed on both the textured and the plain sections of the tube.

9. General Requirements

9.1 Material furnished under this specification shall conform to the applicable requirements of the current edition of Specification A450/A450M unless otherwise provided herein.

10. Tensile and Hardness Requirements

10.1 The term lot for tension and hardness tests applies to all tubes before cutting of the same specified outside diameter and wall thickness that are produced from the same heat of steel. When final heat treatment is in a batch-type furnace, a lot shall include only those tubes of the same size and the same heat that are heat treated in the same furnace charge. When the final heat treatment is in a continuous furnace, a lot shall