Designation: A1012 – 02 (Reapproved 2007)

Standard Specification for Seamless and Welded Ferritic, Austenitic and Duplex Alloy Steel Condenser and Heat Exchanger Tubes With Integral Fins[1]

This standard is issued under the fixed designation A1012; 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 describes seamless and welded ferritic, austenitic and duplex alloy steel tubing on which the external or internal surface, or both, has been modified by a cold forming process to produce an integral enhanced surface for improved heat transfer. The tubes are used in surface condensers, evaporators, heat exchangers and similar heat transfer apparatus in unfinned end diameters up to and including 1 in. (25.4 mm). Boiler tubes are excluded.

1.2 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

1.3 The following precautionary statement pertains to the test method portion only, Section 12, 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:*[2]

A213/A213M Specification for Seamless Ferritic and Austenitic Alloy-Steel Boiler, Superheater, and Heat-Exchanger Tubes

A249/A249M Specification for Welded Austenitic Steel Boiler, Superheater, Heat-Exchanger, and Condenser Tubes

A268/A268M Specification for Seamless and Welded Ferritic and Martensitic Stainless Steel Tubing for General Service

A269 Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service

A688/A688M Specification for Welded Austenitic Stainless Steel Feedwater Heater Tubes

A789/A789M Specification for Seamless and Welded Ferritic/Austenitic Stainless Steel Tubing for General Service

A803/A803M Specification for Welded Ferritic Stainless Steel Feedwater Heater Tubes

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

A1016/A1016M Specification for General Requirements for Ferritic Alloy Steel, Austenitic Alloy Steel, and Stainless Steel Tubes

3. Terminology

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

3.2 *Symbols (Integral Fin Tube Nomenclature)*:

D = outside diameter of unenhanced section
D_i = inside diameter of unenhanced section
d_r = root diameter of enhanced section outside of tube
d_o = outside diameter of enhanced section
d_i = inside diameter of enhanced section
W = wall thickness of unenhanced section
W_f = wall thickness of enhanced section
F_h = height of fin—enhanced section outside of tube
F_m = mean fin thickness—enhanced section outside of tube
P = mean rib pitch—enhanced section inside of tube
R_h = height of rib—enhanced section inside of tube
H_a = rib helix angle—enhanced section inside of tube
T_t = transition taper

4. Ordering Information

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

4.1.1 ASTM designation and year of issue (this specification);

[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 A01.10 on Stainless and Alloy Steel Tubular Products.

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[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.

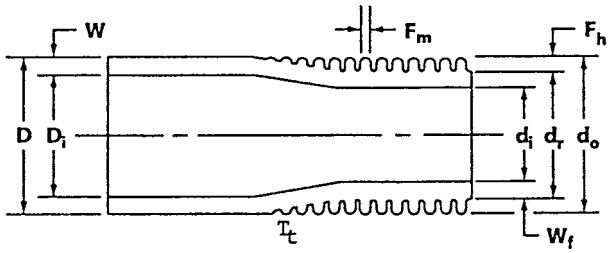

FIG. 1 Outside Enhancement Only

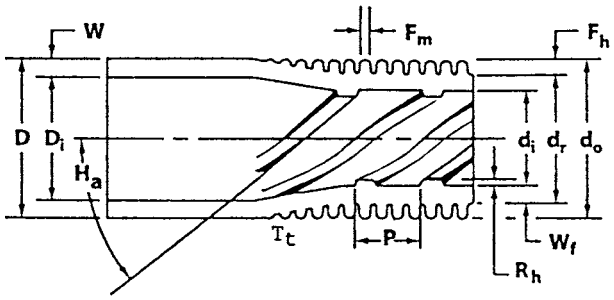

FIG. 2 Outside and Inside Enhancement

4.1.2 ASTM designation and year of issue (plain tube specification);

4.1.3 Welded or seamless;

4.1.4 Alloy grade and UNS designation;

4.1.5 Dimensions; plain tube outside diameter, plain tube wall thickness (average or minimum specified), length and location of unenhanced surfaces and the total tube length. Configuration of enhanced surfaces (fins per unit length, fin height, wall thickness under fin, rib pitch, rib height, etc.) shall be as agreed upon between the manufacturer and purchaser (see Figs. 1 and 2).

4.1.6 Temper (as-finned or stress relief annealed);

4.1.7 Quantity;

4.1.8 Packaging;

4.1.9 Nondestructive tests;

4.1.10 Customer inspection;

4.1.11 Mill test report;

4.1.12 Certification.

5. General Requirements

5.1 Material furnished under this specification shall conform to the applicable requirements of Specification A1016/A1016M unless otherwise provided herein.

5.2 Enhanced (integrally finned) sections of the tube shall be produced by cold forming the tubing in such a manner that exterior fins, wall under the fin and inside ribs (when specified) are homogeneous.

5.3 Tubes described by this specification shall be furnished with unenhanced (plain) ends.

5.4 Enhanced sections of the tube are normally supplied in the "as finned" temper (cold worked condition produced by the enhancing operation). The unenhanced sections of the tube shall be in the annealed condition and shall be suitable for rolling-in operations.

6. Materials and Manufacture

6.1 The integrally enhanced (finned) tubes shall be manufactured from seamless, welded, or welded/cold worked plain tubes that conform to one of the following ASTM specifications: A213/A213M, A249/A249M, A268/A268M, A269, A688/A688M, A789/A789M, A803/A803M.

7. Temper

7.1 The tube after enhancing shall normally be supplied in the as-finned temper. When specified by the purchaser, for bending, coiling or other fabricating operations, enhanced portions of the tube may be stress relief annealed or solution annealed.

7.2 Heat treatment of enhanced sections, or bend areas, or both, shall be in accordance with the governing plain tube specification.

8. Chemical Composition

8.1 The tubing specified shall conform to the chemical requirements prescribed in the governing plain tube specification.

9. Tensile Requirements

9.1 The tube prior to the finning operation, or unenhanced portions of the finned tube, shall conform to the requirements for tensile properties prescribed in the governing plain tube specification.

10. Permissible Variations in Dimensions

10.1 *Diameter*—The outside diameter of the unenhanced sections shall not exceed the diameter tolerances shown in the governing plain tube specification as measured by micrometers and verified by "go" and "no go" ring gages. The diameter over the enhanced sections shall not exceed the diameter of the plain sections involved, as determined by a "go" ring gage unless otherwise specified. The dimensions of the ring gages shall be as described in 10.1.1 and 10.1.2.

10.1.1 The inside diameter dimension of the "go" ring gage shall be equal to the nominal tube diameter, plus the maximum tolerance, plus .002 in. The length of the "go" ring gage shall be 1 in. (25.4 mm) minimum.

10.1.2 The inside diameter dimension of the "no go" ring gage shall be equal to the nominal tube diameter minus the maximum tolerance. The length of the "no go" ring gage shall be 1 in. (25.4 mm) minimum.

10.2 *Wall Thickness*—The wall thickness of enhanced and unenhanced sections shall not exceed the thickness tolerances shown in the governing plain tube specification unless otherwise agreed to between the manufacture and purchaser. No tube at any point shall be less than the minimum thickness specified in the plain sections or in the enhanced sections.

10.3 *Length*—The length of the tubes shall not be less than that specified, but may exceed the specified value by the amounts given in Table 1.

10.3.1 The length of plain ends, as measured from the tube end to the first tool impression, shall not be less than that specified, but may exceed the specified value by ½ in. (12.7 mm).