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## Standard Specification for SEAMLESS FERRITIC-AUSTENITIC ALLOY STEEL TUBES<sup>1</sup>

This standard is issued under the fixed designation A 669; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

### 1. Scope

1.1 This specification<sup>2</sup> covers seamless ferritic-austenitic steel tubes for heat exchanger and general service. The steel is intended for use in general corrosion-resistant applications with particular emphasis on resistance to stress-corrosion cracking. This material may develop embrittlement if used at temperatures above 615°F (325°C).

1.2 The tubing sizes and thicknesses usually furnished to this specification are ¼ to 6 in. (6.4 to 152.4 mm), incl, in outside diameter and 0.020 to 1.10 in. (0.51 to 27.9 mm), in average wall thickness. Tubing having other dimensions may be furnished, provided such tubes comply with all other requirements of this specification.

1.3 The steel has a microstructure consisting of about 50% pools of austenite in a ferrite matrix.

1.4 Tubes furnished to this specification must be able to be expanded into tube sheets by the conventional methods.

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

### 2. Applicable Documents

#### 2.1 ASTM Standard:

A 450 Specification for General Requirements for Carbon, Ferritic Alloy, and Austenitic Alloy Steel Tubes<sup>3</sup>

### 3. General Requirements for Delivery

3.1 Material furnished under this specification shall conform to the applicable requirements of the current edition of Specification A 450, unless otherwise provided herein.

### 4. Ordering Information

4.1 Orders for material under this specifica-

tion shall include the following, as required, to describe the desired material adequately:

- 4.1.1 Quantity (feet or number of lengths),
- 4.1.2 Dimensions (outside diameter and average wall and length, cut or random),
- 4.1.3 Name of material (seamless tubes),
- 4.1.4 Specification number,
- 4.1.5 Condition (hot or cold finished),
- 4.1.6 Special requirements,
- 4.1.7 Optional requirement (see 9.4), and
- 4.1.8 Certification (see 23.2 of Specification A 450).

### 5. Materials and Manufacture

5.1 The steel shall be made by the electric-furnace process or other primary processes approved by the purchaser. The primary melting may incorporate separate degassing or refining, and may be followed by secondary melting using electroslag remelting or vacuum-arc remelting. If secondary melting is employed, the heat shall be defined as all of the ingots remelted from a single primary heat.

5.2 Tubes shall be made by the seamless process and shall be either hot finished or cold worked as specified.

5.3 All tubes shall be furnished in the heat-treated condition. The heat treatment shall be performed at a temperature of 1850 ± 50°F (1010 ± 28°C) with subsequent quenching in water or rapidly cooling by other means.

<sup>1</sup> 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 A01.10 on Tubing.

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<sup>2</sup> For ASME Boiler and Pressure Code application see related Specification SA-669 in Section III of that Code.

<sup>3</sup> Annual Book of ASTM Standards, Vol 01.01.

5.4 The tubes shall be pickled free from scale. When bright annealing in accordance with 5.3 is performed, pickling is not required.

## 6. Chemical Requirements

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

## 7. Heat Analysis

7.1 An analysis of each heat of steel shall be made by the steel manufacturer to determine the percentages of the elements specified. If secondary melting processes are employed, the heat analysis shall be obtained from one remelted ingot or the product of one remelted ingot of each primary melt. The chemical composition thus determined, or that determined from a product analysis made by the tubular product manufacturer, shall be reported to the purchaser or his representative and shall conform to the requirements specified.

## 8. Product Analysis

8.1 An analysis of either one billet or one tube shall be made from each heat. The chemical composition thus determined shall conform to the requirements specified.

8.2 If the original test for product analysis fails, retests of two additional billets or tubes 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 (Note 1) shall be rejected or, at the option of the producer, each billet or tube may be individually tested for acceptance. Billets or tubes that do not meet the requirements of the specification shall be rejected.

NOTE 1—For flaring requirements, the term *lot* is as prescribed in Table 3.

NOTE 2—For tension and hardness test requirements, the term *lot* applies to all tubes prior to cutting, of the same nominal diameter and wall thickness which 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 which are heat treated in the same furnace charge. When the final heat treatment is in a continuous furnace, a lot shall include all tubes of the same size and heat, heat treated in the same furnace at the same temperature, time at heat and furnace speed.

## 9. Mechanical Requirements

9.1 *Tension Test*—One tension test shall be made on a specimen for lots of not more than 50 tubes. Tension tests shall be made on specimens from two tubes for lots of more than 50 tubes (Note 2). Results of tests shall conform to the tensile properties prescribed in Table 2.

9.2 *Hardness Test*—Brinell or Rockwell hardness tests shall be made on specimens from two tubes from each lot (Note 2). Results of tests shall conform to the hardness requirements of Table 2.

9.3 One flaring test shall be made on a specimen from one end of one tube from each lot of finished tubes. The minimum expansion of the inside diameter shall be 10%.

9.4 Each tube shall be subjected to the hydrostatic test, as modified in 9.4.1. When specified by the purchaser, a nondestructive electric test, in accordance with Specification A 450, may be used instead of or in addition to the hydrostatic test.

9.4.1 The hydrostatic test pressure shall be twice that calculated in accordance with 10.1 of Specification A 450.

## 10. Permissible Variations in Dimensions

10.1 Variations in outside diameter, wall thickness, and length from those specified shall not exceed the amounts prescribed in Table 4.

## 11. Workmanship

11.1 Tubes shall have a workmanlike finish and shall not deviate in straightness by more than 0.030 in. in 3 ft (0.84 mm/m) of length.

## 12. Marking

12.1 In addition to the marking prescribed in Specification A 450, the marking shall include whether the tube is hot- or cold-finished.