



Designation: B 338 – 99

Standard Specification for Seamless and Welded Titanium and Titanium Alloy Tubes for Condensers and Heat Exchangers¹

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This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 This specification covers the requirements for 20 grades of titanium and titanium alloy tubing intended for surface condensers, evaporators, and heat exchangers, as follows:²

- 1.1.1 *Grade 1*—Unalloyed titanium,
- 1.1.2 *Grade 2*—Unalloyed titanium,
- 1.1.3 *Grade 3*—Unalloyed titanium,
- 1.1.4 *Grade 7*—Unalloyed titanium plus 0.12 to 0.25 % palladium,
- 1.1.5 *Grade 9*—Titanium alloy (3 % aluminum, 2.5 % vanadium),
- 1.1.6 *Grade 11*—Unalloyed titanium plus 0.12 to 0.25 % palladium,
- 1.1.7 *Grade 12*—Titanium alloy (0.3 % molybdenum, 0.8 % nickel),
- 1.1.8 *Grade 13*—Titanium alloy (0.5 % nickel, 0.05 % ruthenium),
- 1.1.9 *Grade 14*—Titanium alloy (0.5 % nickel, 0.05 % ruthenium),
- 1.1.10 *Grade 15*—Titanium alloy (0.5 % nickel, 0.05 % ruthenium),
- 1.1.11 *Grade 16*—Unalloyed titanium plus 0.04 to 0.08 % palladium,
- 1.1.12 *Grade 17*—Unalloyed titanium plus 0.04 to 0.08 % palladium,
- 1.1.13 *Grade 18*—Titanium alloy (3 % aluminum, 2.5 % vanadium) plus 0.04 to 0.08 % palladium,
- 1.1.14 *Grade 26*—Unalloyed titanium plus 0.08 to 0.14 % ruthenium,
- 1.1.15 *Grade 27*—Unalloyed titanium plus 0.08 to 0.14 % ruthenium,
- 1.1.16 *Grade 28*—Titanium alloy (3 % aluminum, 2.5 % vanadium) plus 0.08 to 0.14 % ruthenium,
- 1.1.17 *Grade 30*—Titanium alloy (0.3 % cobalt, 0.05 % palladium),
- 1.1.18 *Grade 31*—Titanium alloy (0.3 % cobalt, 0.05 % palladium),
- 1.1.19 *Grade 33*—Titanium alloy (0.4% nickel, 0.015% palladium, 0.025% ruthenium, 0.15% chromium), and
- 1.1.20 *Grade 34*—Titanium alloy (0.4% nickel, 0.015% palladium, 0.025% ruthenium, 0.15% chromium).

1.2 Tubing covered by this specification shall be heat treated by at least a stress relief as defined in 5.3.

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

2. Referenced Documents

2.1 ASTM Standards:

A 370 Test Methods and Definitions for Mechanical Testing of Steel Products³

E 8 Test Methods for Tension Testing of Metallic Materials⁴

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications⁵

E 120 Test Methods for Chemical Analysis of Titanium and Titanium Alloys⁶

E 1409 Test Method for Determination of Oxygen in Titanium and Titanium Alloys by the Inert Gas Fusion Technique⁷

E 1447 Test Method for Determination of Hydrogen in Titanium and Titanium Alloys by the Inert Gas Fusion Thermal Conductivity Method⁷

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *lot (seamless tube)*, *n*—tubing of the same nominal size and wall thickness manufactured and heat-treated using the same process and equipment, made from the same production heat, and given the same finishing operation. For continuous anneal the lot shall be limited to the product of an 8 h period. For batch anneal, the lot shall be limited to a single furnace load.

3.1.2 *lot (welded/cold worked tube)*, *n*—a number of pieces

¹ This specification is under the jurisdiction of ASTM Committee B-10 on Reactive and Refractory Metals and Alloys and is the direct responsibility of Subcommittee B10.01 on Titanium.

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² For ASME Boiler and Pressure Vessel Code applications, see related Specification SB-338 in Section II of that Code.

³ Annual Book of ASTM Standards, Vol 01.03.

⁴ Annual Book of ASTM Standards, Vol 03.01.

⁵ Annual Book of ASTM Standards, Vol 14.02.

⁶ Annual Book of ASTM Standards, Vol 03.05.

⁷ Annual Book of ASTM Standards, Vol 03.06.