Designation: ~~B550/B550M – 07 (Reapproved 2012)~~ B550/B550M – 07 (Reapproved 2019)

Standard Specification for Zirconium and Zirconium Alloy Bar and Wire[1]

This standard is issued under the fixed designation B550/B550M; 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 three grades of zirconium and zirconium alloy bar and wire.

1.2 Unless a single unit is used, for example corrosion mass gain in mg/dm^2, the values stated in either inch-pound or SI units are to be regarded separately as standard. The values stated in each system are not exact equivalents; therefore each system must be used independently of the other. SI values cannot be mixed with inch-pound values.

1.3 The following precautionary caveat pertains only to the test methods portions 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~~ safety, health, and ~~health~~environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *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:*[3]

E8 Test Methods for Tension Testing of Metallic Materials [Metric] E0008_E0008M

E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *annealed, n*—denotes material that exhibits a recrystallized grain structure.

3.2 *Lot Definitions:*

3.2.1 *bar and wire, n*—a lot shall consist of a material of the same size, shape, condition, and finish produced from the same ingot or powder blend by the same reduction schedule and the same heat treatment parameters. Unless otherwise agreed between manufacturer and purchaser, a lot shall be limited to the product of an 8 h period for final continuous anneal, or to a single furnace load for final batch anneal.

3.2.2 *Forms:*

3.2.2.1 *bar, n*—a hot rolled, forged, or cold worked semifinished solid section product whose cross sectional area is equal to or less than 16 in.^{2} [10 323 mm^2]; rectangular bar must be less than or equal to 10 in. [254 mm] in width and greater than 0.1875 in. [4.8 mm] in thickness.

3.2.2.2 *wire, n*—rounds, flats, or special shapes less than or equal to 0.1875 in. [4.8 mm] in thickness or major dimension.

4. Classification

4.1 The bar or wire is to be furnished in three grades as follows:

4.1.1 *Grade R60702*—Unalloyed zirconium.

4.1.2 *Grade R60704*—Zirconium-tin.

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[1] This specification is under the jurisdiction of ASTM Committee B10 on Reactive and Refractory Metals and Alloys and is the direct responsibility of Subcommittee B10.02 on Zirconium and Hafnium.

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[2] For ASME Boiler and Pressure Vessel Code applications, see related Specification SB-550 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.

4.1.3 *Grade R60705*—Zirconium-niobium.

5. Ordering Information

5.1 Orders for material under this specification should include the following information:
5.1.1 Quantity (weight or number of pieces),
5.1.2 Name of material (zirconium bar or wire) (Table 1),
5.1.3 Grade number (see 4.1),
5.1.4 Standard designation and year of issue, for example ASTM Specification B550/B550M- 07, and
5.1.5 Additions to the specification as required.

NOTE 1—A typical ordering description is as follows: 1000 lb [500 kg] zirconium cold drawn bar, 0.35 in. [10 mm] in diameter by 10 ft [3 m] in length, ASTM B550 - 01, Grade R60702.

6. Materials and Manufacture

6.1 Bar and wire covered by this specification shall be formed with conventional fabrication methods and equipment found in primary ferrous and nonferrous metal plants.

6.2 The products covered include the sections and sizes shown in Table 1.

6.3 Bar and wire will be supplied in the conditions prescribed in Table 2.

7. Chemical Composition

7.1 The material shall conform to the requirements as to chemical composition prescribed in Table 3.

7.2 The manufacturer's ingot analysis shall be considered the chemical analysis for bar and wire, except for hydrogen and nitrogen, which shall be determined on the finished product.

7.3 When requested by the purchaser and stated in the purchase order, a product analysis for any elements listed in Table 3 shall be made on the finished product.

7.3.1 The manufacturer's analysis shall be considered as verified if the check analysis confirms the manufacturer's reported values within the tolerances prescribed in Table 4.

8. Mechanical Properties

8.1 The annealed material shall conform to the requirements for mechanical properties, at room temperature, as prescribed in Table 5. Wire supplied for welding applications shall be furnished with a temper suitable for uniform feeding in semiautomatic or automatic welding equipment.

9. Permissible Variations in Dimensions

9.1 Unless otherwise specified, all bar or wire shall conform to the permissible variations in dimensions prescribed in Tables 6-14, as follows:
9.1.1 Table 6, Dimensional Tolerances for Hot-Finished Rounds, Squares, Octagons, and Hexagons.
9.1.2 Table 7, Dimensional Tolerances in Hot-Rolled Flat Bars.
9.1.3 Table 8, Permissible Variations in Sectional Dimensions for Cold-Finished Bars in Rounds, Hexagons, Octagons, and Squares.
9.1.4 Table 9, Permissible Variations in Width and Thickness for Cold-Finished Bars in Flats.
9.1.5 Table 10, Permissible Variations in Sectional Dimensions for Wire.

TABLE 1 Product Sections and Size

Product	Section	Size
Bars:	Hot-finished round, squares, octagons, and hexagons	¼ in. [6.4 mm] and over in diameter or size
	Hot-finished flats	¼ in. [6.4 mm] to 10 in. [250 mm], incl, in width, and ⅛ in. [3.2 mm] and over in thickness
	Cold-finished rounds, squares, octagons, hexagons, and shapes	Over ½ in. [13 mm] in diameter or size[A]
	Cold-finished flats	⅜ in. [9.5 mm] and over in width,[B] and ⅛ in. [3.2 mm] and over in thickness[C]
Wire:	Cold-finished rounds, squares, octagons, hexagons, and shapes	½ in. [13 mm] and under in diameter or size
	Cold-finished flats	1/16 in. [1.6 mm] to under ⅜ in. [9.5 mm] in width, and 0.010 in. [.25 mm] to under 3/16 in. [4.8 mm] in thickness

[A] Sizes ½ in. [13 mm] and under are wire when in coils, and cut wire when finished in straight lengths.
[B] Widths less than ⅜ in. [9.5 mm] and thicknesses less than 3/16 in. [4.8 mm] are generally described as flat wire.
[C] Thickness ⅛ in. [3.2 mm] to under 3/16 in. [4.8 mm] can be cold-rolled strip as well as bar.

TABLE 2 Condition

Form	Condition
Bars	hot finished
	hot finished and annealed
	cold finished
	cold finished and annealed
Wire	cold finished
	cold finished and annealed

9.1.6 Table 11, Permissible Variations in Thickness and Width for Cold-Finished Flat Wire.
9.1.7 Table 12, Permissible Variations in Length for Hot-Finished or Cold-Finished Bars.
9.1.8 Table 13, Permissible Variations in Length for Round and Shape, Straightened and Cut Wire, and Exact Length Resheared Wire.
9.1.9 Table 14, Permissible Variations in Straightness for Hot- or Cold-Finished Bars.

10. Workmanship, Finish, and Appearance

10.1 Bars in the hot-finished condition which will conform to the tolerances prescribed in Tables 6 and 7, shall be furnished with one of the following finishes as designated on the purchase order:
10.1.1 Not descaled,
10.1.2 Mechanically descaled,
10.1.3 Mechanically descaled and pickled, and
10.1.4 Turned (round bars only).

10.2 Bars and wire in cold-finished condition that will conform to the tolerances prescribed in Tables 8-12, shall be furnished with one of the following finishes as designated on the purchase order.
10.2.1 Cold drawn or cold rolled, or swaged,
10.2.2 Turned (round bars only),
10.2.3 Centerless ground (round bars only), and
10.2.4 Polished (round bars only).

10.3 Bars or wire shall be free of cracks, seams, slivers, blisters, burrs, and other injurious imperfections in accordance with standards of acceptability agreed upon between the manufacturer and the purchaser.

11. Significance of Numerical Limits

11.1 For the purpose of determining compliance with the specified limits for requirements of the properties listed in the following table, an observed value or a calculated value shall be rounded as indicated in accordance with the rounding methods of Practice E29.

Property	Rounded Unit for Observed or Calculated Value
Chemical composition and tolerances (when expressed as decimals)	nearest unit in the last right-hand place of figures of the specified limit
Tensile strength and yield strength	nearest 1000 psi (10 MPa)
Elongation	nearest 1 %

12. Number of Tests and Retests

12.1 One longitudinal tension test shall be made from each lot of bar and rod, see 13.1.

12.2 One chemistry test for hydrogen and nitrogen content shall be made from each lot of finished product, see 13.2.

12.3 *Retests:*
12.3.1 If any sample or specimen exhibits obvious surface contamination or improper preparation disqualifying it as a truly representative sample, it shall be discarded and a new sample or specimen substituted.
12.3.2 If the results of any tests of any lot do not conform to the requirements specified, retests shall be made on additional samples from the same lot, each of which shall conform to the requirements specified.

13. Test Methods

13.1 *Tension Tests*—The tension test shall be conducted in accordance with Test Methods E8. Determine the yield strength by the offset (0.2 %) method. Determine the tensile properties using a strain rate of 0.003 to 0.007 in./in. [mm/mm]/min through the yield strength. After the yield strength has been exceeded, the cross-head speed may be increased to approximately 0.05 in./in. [mm/mm]/min to failure.

13.2 *Chemical Tests*—The chemical analyses shall be conducted by the standard techniques normally used by the manufacturer.