



Designation: F288 – 96 (Reapproved 2019)

# Standard Specification for Tungsten Wire for Electron Devices and Lamps<sup>1</sup>

This standard is issued under the fixed designation F288; 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.

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

## 1. Scope

1.1 This specification covers three types of drawn wire suitable for fabrication into parts for electron tubes, lamps, and other devices; and one type of rod for metal-to-glass sealing (grid wire is excepted):

1.1.1 *Type 1A*—Commercially pure nonsag wire (Note 2 and Note 3).

1.1.2 *Type 1B*—Commercially pure rod suitable for metal-to-glass sealing.

1.1.3 *Type 2A*—Thoriated filament wire containing 1 % thoria.

1.1.4 *Type 2B*—Thoriated filament wire containing 2 % thoria.

1.2 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.3 Types 1A and 1B are designated as UNS R07005. Type 2A is designated as UNS R07911. Type 2B is designated as UNS R07912.

1.4 The following precautionary caveat pertains only to the Chemical Analysis, 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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

NOTE 1—A dimensional measurement method for testing nonsag tungsten wire above 0.030 in. (0.76 mm) in diameter is provided in Test Method F269.

NOTE 2—Acceptance of nonsag wire characteristics for particular applications of size shall be by agreement between producer and consumer based on either a flashed microstructure as shown by photomicrographs, or on dimensional measurement limits determined in accordance with Test Method F269.

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee F01 on Electronics and is the direct responsibility of Subcommittee F01.03 on Metallic Materials, Wire Bonding, and Flip Chip.

Current edition approved April 1, 2019. Published April 2019. Originally approved in 1954. Last previous edition approved in 2014 as F288 – 96 (2014). DOI: 10.1520/F0288-96R19.

1.5 *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*:<sup>2</sup>

F16 Test Methods for Measuring Diameter or Thickness of Wire and Ribbon for Electronic Devices and Lamps

F204 Test Method for Surface Flaws in Tungsten Seal Rod and Wire

F205 Test Method for Measuring Diameter of Fine Wire by Weighing

F219 Test Methods of Testing Fine Round and Flat Wire for Electron Devices and Lamps

F269 Test Method for Sag of Tungsten Wire

2.2 *Military Standards*:

MIL-STD-105 Sampling Procedures and Tables for Inspection by Attributes<sup>3</sup>

MIL-STD-129 Marking for Shipment and Storage<sup>3</sup>

## 3. Terminology

3.1 *Definition of Terms Specific to This Standard*:

3.1.1 *wire*—The term wire as used in this specification applies to all drawn material that is spooled or coiled, and to short cut lengths 0.020 in. (0.51 mm) or less in diameter.

3.1.2 *nonsag or doped tungsten wire*—This term designates a wire which, when recrystallized, shows elongated interlocking grains.

3.1.3 *rod*—The term rod as used in this specification applies to centerless ground material 0.020 in. (0.51 mm) or larger in diameter, in short cut lengths or random cut lengths.

<sup>2</sup> 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.

<sup>3</sup> Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

#### 4. Ordering Information

4.1 Orders for wire and rod furnished to this specification shall include the following information:

- 4.1.1 Length in metres, or quantity of short cut lengths,
- 4.1.2 Type and UNS No. (Section 1),
- 4.1.3 Straightness (Section 10),
- 4.1.4 Finish (Section 8),
- 4.1.5 Weight or size (Section 7) and tolerance, and
- 4.1.6 Specification number.

NOTE 3—A typical ordering description for straight chemically cleaned wire is as follows: xxxx metres, tungsten wire, Type 1A UNS R07005, straightened, Finish 2; 280.8 mg/200 mm ( $\pm 3\%$ ), to ASTM F288 – XX.

#### 5. Chemical Composition

5.1 The wire and rod shall conform to the chemical requirements specified in Table 1. The sample for analysis shall be representative of the lot submitted. Lot size, sample size, and sampling method shall be as agreed upon by the supplier and purchaser.

#### 6. Physical Properties

6.1 *Tensile Strength*—The tensile strength of a 10-in. (250-mm) gage length of wire in grams per milligram per 200 mm shall be within the limits specified in Table 2 when tested in accordance with 13.1.

6.2 *General Ductility Requirements* —The ductility of Types 1A, 2A, and 2B wire shall be sufficient to meet the following requirements:

6.2.1 *Wire up to 75 mg/200 mm, Inclusive* —Six 1-m lengths shall be tested in accordance with 13.2. The wire shall not break more than two times in the six tests. Where required, a lower limit may be negotiated between purchaser and seller.

6.2.2 *Wire over 75 mg/200 mm*—Thirty successive close-wound turns completely around mandrels shall be free of splitting or cracking when tested in accordance with 13.2.2 and examined at a magnification of 30 $\times$ .

6.2.3 *Special Ductility Requirements* —Wire for certain applications may require a special ductility as agreed upon between the purchaser and the seller.

6.3 *Surface Defects*— Type 1B rod shall not show faults when tested in accordance with 13.5.

#### 7. Dimensions, Weights, and Permissible Variations

7.1 Dimensional tolerances for Type 1A (nonsag) wire for use as incandescent filaments shall conform to the requirements specified in Table 3.

NOTE 4—Tolerances are industry standards; closer tolerances may be obtained in certain instances, usually at a premium.

**TABLE 1 Chemical Requirements<sup>A</sup>**

Type, UNS number	Thoria, weight %	Tungsten, weight %
1A and 1B (R07005)	....	99.95 min
2A (R07911)	0.8 min, 1.2 max	balance
2B (R07912)	1.7 min, 2.2 max	balance

<sup>A</sup> For all Types:  
Other elements (each)—100 ppm max.  
Total other elements—500 ppm max.

7.2 Out-of-roundness of wire or rod over 0.020 in. (0.51 mm) in diameter shall be within 5 % of the maximum diameter, when measured by a method agreed upon by supplier and purchaser. A referee method for this test is contained in Procedure B of Test Methods F16.

#### 7.3 Weight/Diameter Conversion Formulas:

7.3.1 The weight of Type 1A wire and Type 1B rod (density 19.17), is as follows:

$$\text{wt in mg/200 mm} = (\text{diameter in mils})^2 \times 1.943, \text{ or} \\ (\text{diameter in mm})^2 \times 3011$$

7.3.2 The weight of Type 2A wire (density 18.80), is as follows:

$$\text{wt in mg/200 mm} = (\text{diameter in mils})^2 \times 1.905, \text{ or} \\ (\text{diameter in mm})^2 \times 2953$$

7.3.3 The weight of Type 2B wire (density 18.50), is as follows:

$$\text{wt in mg/200 mm} = (\text{diameter in mils})^2 \times 1.875, \text{ or} \\ (\text{diameter in mm})^2 \times 2906$$

#### 8. Workmanship, Finish, and Appearance

8.1 Furnish the wire in the following finishes:

- 8.1.1 *Finish 1*—Black, as-drawn,
- 8.1.2 *Finish 2*—Chemically cleaned,
- 8.1.3 *Finish 3*—Chemically cleaned and stress-relieved.
- 8.1.4 *Finish 4*—Reducing atmosphere cleaned and annealed,
- 8.1.5 *Finish 5*—Etched, and
- 8.1.6 *Finish 6*—Electropolished.

8.2 The rod shall be furnished in the following finish:

- 8.2.1 *Finish 7*—Centerless ground.

#### 9. General Requirements

9.1 The material shall be smooth, free of twists, bends, kinks, curls, and as free of dents, swaging marks, scratches, die marks, laps, seams, splits, slivers, inclusions, bumps, pits, grooves, cracks, and other physical defects when examined at a magnification of 30 $\times$  as best commercial practice will permit.

9.2 Unless black finish is specified, all types of wire shall have a clean finish, free of graphite, grease, oil, and lubricants. All finishes shall be as free of dirt, oxide, stains, scale, and other surface defects, as best commercial practice permits. Wire for hooks, supports, springs, anchors, and mesh shall have a bright smooth surface free of cracks, holes, or craters when examined at a magnification of 10 $\times$ .

9.3 Rod of Type 1B shall have a bright smooth surface and be capable of making acceptable metal-to-glass seals when tested in accordance with Test Method F204.

#### 10. Straightness

10.1 When ordered as straightened, straightness of wire 3.00 mg/200 mm and larger shall be specified as the radius of curvature or camber of a given length of wire as agreed upon between the purchaser and supplier. For wire under 3.00 mg/200 mm, alternative methods for straightness requirements may be used as agreed upon between the purchaser and the supplier.