



Standard Specification for Tungsten Plate, Sheet, and Foil¹

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1. Scope

1.1 This specification covers wrought unalloyed tungsten plate, sheet, and foil.

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 caveat pertains only to the test method 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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards*:²

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

3. Terminology

3.1 *Lot Definitions*:

3.1.1 *ingot, n*—no definition required.

3.1.2 A manufacturing lot shall consist of a material of the same size, shape, condition, and finish produced from the ingot or powder blend by the same rolling 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.

3.1.3 A chemical analysis lot shall consist of a single powder blend in the case of products manufactured from pressed and sintered powder metallurgy shapes, or a single ingot in the case of products manufactured from ingot.

3.2 *Product Forms*:

3.2.1 *foil, n*—a flat product less than 0.005 in. (0.13 mm) in thickness.

3.2.2 *plate, n*—a flat product 0.188 in. (4.75 mm) or more in thickness.

3.2.3 *sheet, n*—a flat product from .005 in. (0.13 mm) to 0.187 in. (4.75 mm) in thickness.

4. Ordering Information

4.1 Orders for material under this specification shall include the following information:

4.1.1 Material identification and metallurgical condition (Section 7),

4.1.2 Product form (Section 3),

4.1.3 Chemical requirements (Table 1),

4.1.4 Tolerances (Section 9, Table 2, and Fig. 1),

4.1.5 Workmanship and quality level requirements (Section 10),

4.1.6 Packaging (Section 14),

4.1.7 Marking (Section 14),

4.1.8 Certification and reports (Section 13), and

4.1.9 Disposition of rejected material (Section 12).

5. Materials and Manufacture

5.1 The various tungsten flat products covered by this specification shall be formed with the conventional rolling, forging, or extrusion equipment, normally found in primary ferrous and nonferrous plants.

5.2 The ingot metal is consolidated employing either the powder metallurgy or vacuum-arc-casting process.

6. Chemical Composition

6.1 The tungsten ingots or billets for conversion to finished products covered by this specification shall conform to the requirements of the chemical composition prescribed in Table 1.

6.2 *Heat Analysis*:

6.2.1 Heat analysis is an analysis made by the manufacturer of the metal on a representative sample of powder from a single powder blend in the case of material made from pressed and sintered powder billets, or on a representative sample of a cast ingot or intermediate product from that ingot in the case of material made from cast ingot.

6.2.2 Chemical lot analysis shall be as specified in Table 1, with the exception of oxygen which shall be reported for information only, and not be required to meet the requirements of Table 1.

6.3 *Check Analysis*:

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 B10.04 on Molybdenum and Tungsten.

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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.

TABLE 1 Chemical Composition/Check Analysis

Element	Composition, max, %	Permissible Variations in Check Analysis, %
C	0.010	±0.002
O ^A	0.010	+ 10 % relative
N	0.010	+ 0.0005
Fe	0.010	+ 0.001
Ni	0.010	+ 0.001
Si	0.010	+ 0.001

^A If chemical analysis is performed on a sample from the powder blend used to make the finished product, oxygen will be reported for information only.

6.3.1 Check analysis is an analysis made by the purchaser or the manufacturer of the metal after it has been processed into finished mill forms, and is either for the purpose of verifying the composition of a heat or lot, or to determine variations in the composition within a heat or lot.

6.3.2 Check analysis tolerances do not broaden the specified heat analysis requirements but cover variations between laboratories in the measurement of chemical content.

6.3.3 Check analysis limits shall be as specified in **Table 1**.

6.3.4 The manufacturer shall not ship material that is outside the limits specified in **Table 1**.

7. Metallurgical Condition

7.1 Plate, sheet and foil shall be furnished in one of the following conditions as designated on the purchase order:

Form	Metallurgical Condition
Plate	hot-rolled
	hot-rolled, stress-relieved
Sheet	hot-rolled
	hot-rolled, stress-relieved
	cold-rolled
Foil	cold-rolled, stress-relieved
	cold-rolled
	cold-rolled, stress-relieved

7.2 Other conditions can be specified as agreed upon between the purchaser and the manufacturer at the time of purchase.

8. Significance of Numerical Limits

8.1 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 **E 29**.

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 %

9. Permissible Variations in Dimensions

9.1 The thickness tolerances on tungsten products covered by this specification shall be as specified in **Table 2**.

9.2 The width tolerances shall be as agreed upon between the manufacturer and the purchaser. In general, shearing tolerance will be ±1/16 in. (±1.6 mm) and slitting tolerance will be ±1/32 in. (±0.8 mm).

9.3 The length and camber tolerances shall be as agreed upon between the manufacturer and the purchaser. In general, length and camber tolerances will show a maximum deviation of + 1/16 in., - 0/ft (1.6 mm/m) of length.

9.4 Flatness tolerances on tungsten flat products shall be as follows:

Thickness, in.(mm)	Flatness Deviation, max, %
0.005–0.187 (0.13–4.75)	4
0.188–0.625 (4.75–15.9)	5

9.4.1 Determine flatness deviation (**Fig. 1**) as follows:

$$\text{Flatness deviation, \%} = (H/L) \times 100$$

where:

H = maximum vertical distance between a flat reference surface and the lower surface of the flat product, and
L = minimum horizontal distance between the highest point of the flat product where *H* is determined, and the point of contact of the lower surface of the flat product with a flat reference surface.

10. Workmanship, Finish, and Appearance

10.1 Cracks, seams, slivers, blisters, burrs, and other injurious imperfections shall not exceed standards of acceptability agreed upon by the manufacturer and the purchaser.

10.2 Tungsten plate, sheet, and foil shall be free of injurious internal and external imperfections of a nature that will interfere with the purpose for which it was intended.

10.3 Methods of testing for these defects and standards of acceptability shall be as agreed upon between the manufacturer and the purchaser.

10.4 Material may be supplied with as-rolled, as-cleaned, as-machined, or as-ground finish.

10.5 The manufacturer shall be permitted to remove surface imperfections provided such removal does not reduce the dimensions below the minimum permitted by the tolerances for that dimension.

11. Sampling and Test Methods

11.1 Care shall be exercised to ensure that the sample selected for testing is representative of the material and form and that it is not contaminated by the sampling procedure. If there is any question relating to the sampling technique or the analysis of the sample, the methods of sampling and analysis shall be as agreed upon between the purchaser and the manufacturer.

11.2 *Test Methods:*

11.2.1 *Chemistry:*

11.2.1.1 Analyses shall be made using the manufacturer's standard methods.

11.2.1.2 The chemical composition enumerated in this specification shall in case of disagreement, be determined in accordance with the methods approved for referee purposes by ASTM International. Where such methods are not available, methods of analysis as mutually agreed upon by the manufacturer and the purchaser shall be employed.