

# Standard Specification for Tungsten Plate, Sheet, and Foil

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## 1. Scope

- 1.1 This specification covers unalloyed tungsten plate, sheet, and foil.
- 1.2 The values stated in inch-pound units are to be regarded as the standard.

## 2. Terminology

### 2.1 Definitions of Terms Specific to This Standard:

- 2.1.1 *foil*—any product less than 0.005 in. (0.13 mm) in thickness.
- 2.1.2 *plate*—any product  $\frac{3}{16}$  in. (4.75 mm) or more in thickness.
- 2.1.3 *sheet*—any product 0.187 in. (4.75 mm) or less in thickness, to a minimum of 0.005 in. (0.13 mm) in thickness.

## 3. Ordering Information

- 3.1 Orders for material under this specification shall include the following information:
- 3.1.1 Material identification and temper designation,
- 3.1.2 Product form (Section 2),
- 3.1.3 Chemical requirements (Table 1),
- 3.1.4 Tolerances (Section 6, Table 2, and Fig. 1),
- 3.1.5 Workmanship and quality level requirements (Section 7),
- 3.1.6 Packaging (Section 13),
- 3.1.7 Marking (Section 12),
- 3.1.8 Certification and reports (Section 11), and
- 3.1.9 Disposition of rejected material (Section 10).

## 4. Materials and Manufacture

4.1 The various tungsten flat products covered by this specification shall be produced using common rolling, forging, or extrusion equipment, as normally found in primary mill product plants. The ingot metal is consolidated employing either the powder metallurgy or vacuum-arc-casting process.

## 5. Chemical Composition

5.1 The tungsten ingots or billets for conversion to finished products covered by this specification shall conform to the

**TABLE 1 Chemical Composition/Check Analysis**

Element	Composition, max, %	Permissible Variations in Check Analysis, %
C	0.010	$\leq 0.002$
O	0.010	+ 10 % relative
N	0.010	+ 0.0005
Fe	0.010	+ 0.001
Ni	0.010	+ 0.001
Si	0.010	+ 0.001

requirements of the chemical composition prescribed in Table 1.

### 5.2 Check Analysis:

5.2.1 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.

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

5.2.3 The manufacturer shall not ship material that is outside the limits specified in Table 1, with the exception of oxygen and nitrogen, whose percentage may vary with the method of manufacture.

5.2.4 Check analysis limits shall be as specified in Table 1.

## 6. Permissible Variations in Dimensions

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

6.2 The width tolerances shall be as agreed upon between the manufacturer and the purchaser. In general, shearing tolerance will be  $\pm \frac{1}{16}$  in. (61.6 mm) and slitting tolerance will be  $\pm \frac{1}{32}$  in. (60.8 mm).

6.3 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  $\pm \frac{1}{16}$  in.,  $-0$ /ft (1.6 mm/m) of length.

6.4 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
$\frac{3}{16}$ – $\frac{5}{8}$ (4.75–15.9)	5

6.4.1 Determine flatness deviation (Fig. 1) as follows:

$$\text{Flatness deviation, \% } 5 \sim H/L \leq 3 \text{ } 100$$

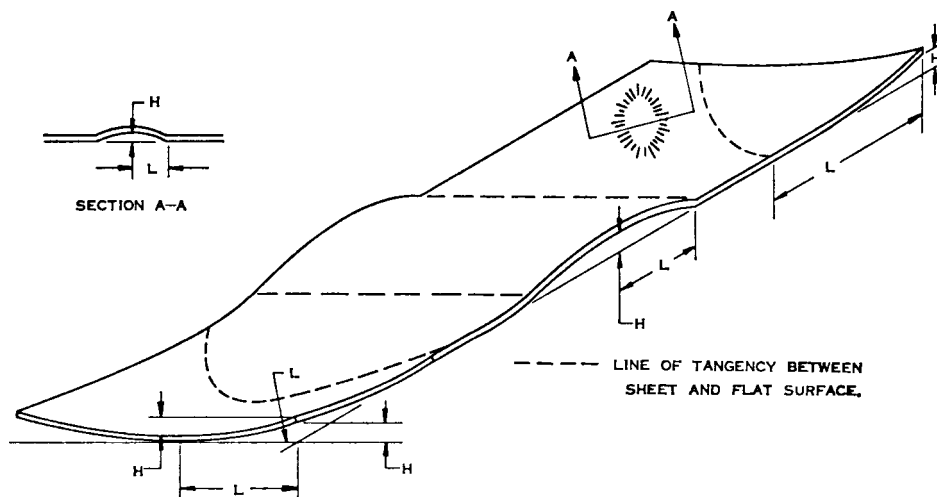
<sup>1</sup> This specification is under the jurisdiction of ASTM Committee B-10 on Reactive and Refractory Metals and Alloys and is the direct responsibility of Subcommittee B10.04 on Molybdenum and Tungsten.

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**TABLE 2 Permissible Thickness Variations**

Specified Width, in. (mm)	Specified Thickness, in. (mm)	Thickness Tolerance, <sup>A</sup> in. (mm)
12 (305) and under	0.005–0.010 (0.13–0.25), incl	60.001 (60.0254)
	over 0.010–0.020 (0.25–0.51), incl	60.002 (60.0508)
	over 0.020 (0.51)	610 %
Over 12–24 (305–610), incl	over 0.010–0.025 (0.25–0.64), incl	60.0025 (60.0635)
	over 0.025 (0.64)	610 %

<sup>A</sup>Tolerances for foil shall be as agreed upon between the producer and the purchaser.



Flatness Deviation, %  $5 (H/L) \times 100$

*H* 5 maximum distance between flat surface and lower surface of sheet.

*L* 5 minimum distance between highest point on sheet and point of contact with flat surface.

**FIG. 1 Plate and Sheet Flatness Tolerances**

where:

*H* 5 maximum vertical distance between a flat reference surface and the lower surface of the flat product, and

*L* 5 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.

## 7. Workmanship, Finish, and Appearance

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

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

7.3 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.

## 8. Sampling

8.1 Care shall be exercised to ensure that the sample selected for testing is representative of the material and form and is not contaminated by the sampling procedure.

## 9. Methods of Chemical Analysis

9.1 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. Where such methods are not available, methods of analysis as mutually agreed upon by the manufacturer and the purchaser shall be employed.

## 10. Rejection

10.1 Material not conforming to this specification or to authorized modifications shall be subject to rejection. Unless otherwise specified, rejected material may be returned to the manufacturer at the manufacturer's expense unless the purchaser receives, within 4 weeks of notice of rejection, other instructions for disposition.

## 11. Certification

11.1 If requested, the manufacturer shall supply at least three copies of a report of the chemical analysis of each heat or powder metallurgy product from the powder lot represented in the shipment, and reports of the result of tests of each size of each heat or powder lot to determine properties.

11.2 The report shall include the purchase order number, heat or powder lot number, this specification number, type and temper condition, nominal thickness, and quantity and number of items covered by the shipment.

## 12. Product Marking

12.1 Unless otherwise specified, each plate or sheet shall be legibly and conspicuously marked or tagged with the number

of this specification, material type and temper condition, heat or lot number, manufacturer's identification, and the nominal thickness gage in inches. All markings must withstand ordinary handling and shall be capable of removal with standard cleaning solvents.

12.2 Coiled sheet and foil shall be similarly marked at the outside end of each coil.

### 13. Packaging and Package Marking

13.1 Unless otherwise specified, material purchased under

this specification must be packaged by box or other suitable protective containers and shall be so marked as to indicate the nature of any special handling required.

### 14. Keywords

14.1 foil; plate; sheet; tungsten

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