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Standard Specification for Tungsten Plate, Sheet, and Foil[1]

This standard is issued under the fixed designation B 760; 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

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

~~1.2The values stated in inch-pound units are to be regarded as the standard.~~

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. ~~Terminology~~ Referenced Documents

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 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.~~ ASTM Standards:[2]

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

3. ~~Ordering Information~~

~~3.1Orders for material under this specification shall include the following information:~~

~~3.1.1Material identification and temper designation,~~

~~3.1.2Product form (Section 2~~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),

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~~[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 B10.04 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.

~~3.1.3Chemical requirements (~~
4.1.2 Product form (Section 3),
4.1.3 Chemical requirements (Table 1),
~~3.1.4Tolerances (Section 6~~
4.1.4 Tolerances (Section 9, Table 2, and Fig. 1),
~~3~~4.1.5 Workmanship and quality level requirements (Section ~~7~~10),
~~3.1.6Packaging (Section 13~~
4.1.6 Packaging (Section 14),
~~3.1.7Marking (Section 12~~
4.1.7 Marking (Section 14),
~~3.1.8Certification and reports (Section 11~~
4.1.8 Certification and reports (Section 13), and
~~3.1.9Disposition of rejected material (Section 10~~
4.1.9 Disposition of rejected material (Section 12).

~~4.Materials and Manufacture~~

~~4.1The 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~~

~~5.1The tungsten ingots or billets for conversion to finished products covered by this specification shall conform to the requirements of the chemical composition prescribed in~~ 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.

~~5.2~~

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*:

~~5.2.1Check~~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.

~~5.2.2Check~~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.

~~5.2.3The manufacturer~~ 6.3.3 Check analysis limits shall ~~not ship material that is outside the limits~~be as specified in Table 1~~, with the exception of oxygen and nitrogen, whose percentage may vary with the method of manufacture.~~

~~5.2.4Check analysis limits shall be as specified in~~ .

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

TABLE 1 Chemical Composition/Check Analysis

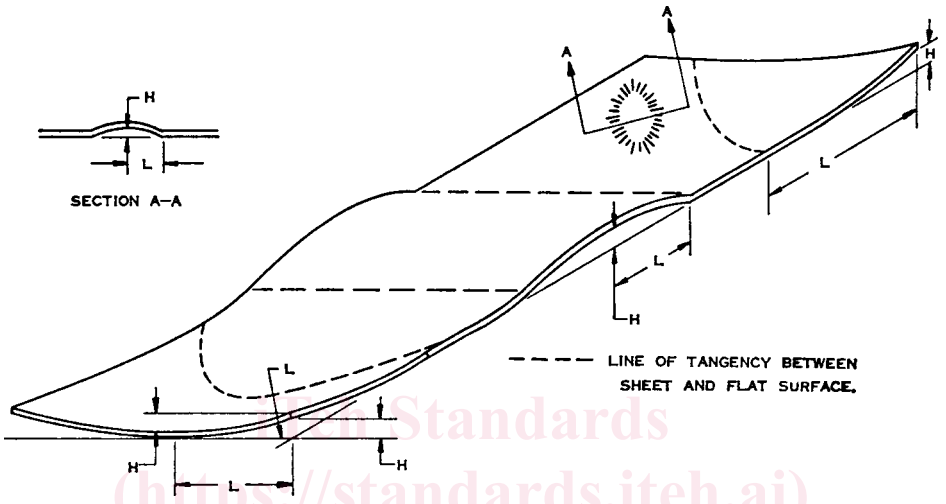
Element	Composition, max, %	Permissible Variations in Check Analysis, %
C	0.010	±0.002
~~O~~	~~0.010~~	~~+ 10 % relative~~
O[A]	0.010	+ 10 % relative
N	0.010	+ 0.0005
Fe	0.010	+ 0.001
Ni	0.010	+ 0.001
Si	0.010	+ 0.001

[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.

TABLE 2 Permissible Thickness Variations

Specified Width, in. (mm)	Specified Thickness, in. (mm)	Thickness Tolerance,[A] in. (mm)
~~12 (305) and under~~	~~0.005–0.010 (0.13–0.25), incl~~	~~±0.001 (±0.0254)~~
12 (305) and under	0.005 to 0.010 (0.13–0.25)	±0.001 (±0.0254)
	~~over 0.010–0.020 (0.25–0.51), incl~~	~~±0.002 (±0.0508)~~
	over 0.010 to 0.020 (0.25–0.51)	±0.002 (±0.0508)
	over 0.020 (0.51)	±10 %
~~Over 12–24 (305–610),~~	~~over 0.010–0.025 (0.25–0.64), incl~~	~~±0.0025 (±0.0635)~~
Over 12 to 24 (305–610), incl	over 0.010 to 0.025 (0.25–0.64)	±0.0025 (±0.0635)
	over 0.025 (0.64)	±10 %

[A] Tolerances for foil shall be as agreed upon between the producer and the purchaser.



Flatness Deviation, % = (*H*/*L*) x 100

H = maximum distance between flat surface and lower surface of sheet.
L = minimum distance between highest point on sheet and point of contact with flat surface.

FIG. 1 Plate and Sheet Flatness Tolerances

~~**6.Permissible Variations in Dimensions**~~

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

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
	cold-rolled, stress-relieved
Foil	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)