



Designation: ~~B777-99~~ Designation: **B 777 - 07**

## Standard Specification for Tungsten Base, High-Density Metal<sup>1</sup>

This standard is issued under the fixed designation B 777; 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.

### 1. Scope

1.1 This specification covers the requirements for four classes of machinable, high-density tungsten base metal produced by ~~consolidation of consolidating metal powder mixtures of which mixtures,~~ the composition of which is mainly tungsten. This material specification may be used for bare parts or ~~be used~~ for parts that may be coated with other materials for protection against corrosion and abrasion.

1.2 *Intended Use*—Parts made from this material are intended for uses such as weights or counter-balances in static or dynamic balancing, high-speed rotating inertia members, radiation shielding, hypervelocity impact, and vibration-damping applications.

1.3 *Special Applications*—For particular applications, properties or requirements other than those specified in Sections 5, 6, and 7 of this specification may be important. These alloys may contain elements which make them magnetic. Where freedom from magnetic response is required, this should be specified in the purchase order. Class 4 is not available in a non-magnetic grade. For purposes of this specification, non-magnetic ~~characteristics are~~ material is defined as material having a maximum magnetic permeability of 1.05 (see Test Method B 193). Also for special applications involving large sections, methods for determining internal quality, such as mechanical tests on specimens from these larger sections or suitable nondestructive tests may be applied. If required, these additional tests shall be specified in the purchase order.

1.4 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

### 2. Referenced Documents

2.1 *ASTM Standards: A600 Specification for Tool Steel High Speed*<sup>2</sup>

A 600 Specification for Tool Steel High Speed

B 193 Test Method for Resistivity of Electrical Conductor Materials

B 311 Test Method for Density Determination for Powder Metallurgy (P/M) Materials Containing Less than ~~Than~~ Two Percent Porosity

D 3951 Practice for Commercial Packaging

E 3 ~~Test Methods~~ Guide for Preparation of Metallographic Specimens

E 8 Test Methods for Tension Testing of Metallic Materials

E 18 ~~Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials~~<sup>6</sup>

Test Methods for Rockwell Hardness of Metallic Materials

E 407 Practice for Microetching Metals and Alloys

2.2 *Federal Standard:*

Fed. Std. No. 151 Metals, Test Methods<sup>3</sup>

### 3. Classification

3.1 The tungsten base metal shall be of the following classes (see Table 1 and Table 2), as specified (see 4.1):

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee B-40B10 on Reactive and Refractory Metals and Alloys and is the direct responsibility of Subcommittee B10.04 on Molybdenum and Tungsten.

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<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* Vol 01-05 volume information, refer to the standard's Document Summary page on the ASTM website.

<sup>3</sup> Annual Book of ASTM Standards, Vol 02.03.

<sup>6</sup> Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, http://www.dodssp.daps.mil.

**TABLE 1 Composition, Density and Hardness Properties**

Class	Nominal Tungsten, weight %	Density, g/cc	Hardness <sup>A,B</sup> Rockwell “C” <sub>max</sub>
1	90	16.85–17.25	32
2	92.5	17.15–17.85	33
3	95	17.75–18.35	34
4	97	18.25–18.85	35

<sup>A</sup> When specified by the purchaser, other hardness testing methods may be employed.

<sup>B</sup> For mechanically worked or aged material, the hardness can be as high as R 46.

**TABLE 2 Mechanical Properties, Minimum Values**

Class	Ultimate Tensile Strength		Yield Strength at 0.2 % Off-set		Elongation, <sup>A</sup> %
	ksi	MPa	ksi	MPa	
1	110 <sup>B</sup>	758	75	517	5 <sup>B</sup>
2	110 <sup>B</sup>	758	75	517	5 <sup>B</sup>
3	105 <sup>B</sup>	724	75	517	3 <sup>B</sup>
4	100	689	75	517	2

<sup>A</sup> Determine with an extensometer accurate to 0.5 % elongation or less.

<sup>B</sup> Nonmagnetic composition to Classes 1, 2 and 3 shall be 94 ksi (648 MPa) minimum ultimate tensile strength. Minimum elongation shall be 2 % on Classes 1 and 2 and 1 % on Class 3.

Class	Tungsten, Nominal %
1	90
2	92.5
3	95
4	97

#### 4. Ordering Information

4.1 Orders for tungsten base, high-density metal should specify the following:

4.1.1 Title, designation, and year of issue of this specification, <https://standards.iteh.ai/>

4.1.2 Class, (see 3.1), [iteh.ai/catalog/standards/sist/7ee2896d-b197-49f1-bb45-c4ef677a1187/astm-b777-07](https://standards.iteh.ai/catalog/standards/sist/7ee2896d-b197-49f1-bb45-c4ef677a1187/astm-b777-07)

4.1.3 Machinability requirements, if any (see section 7.3),

4.1.4 Quantity,

4.1.5 Levels of preservation and packing (see 9.1),

4.1.6 Special markings, if required (see 9.2),

4.1.7 Method of hardness testing, if different from Rockwell “C” (see Table 1),

4.1.8 Freedom of parts from magnetic response, if required (see 1.3), and

4.1.9 Dimensions and tolerances.

#### 5. Materials and Manufacture

5.1 *Materials*—The raw materials shall be a mixture of loose metal powders consisting mainly of tungsten and a metallic powder binder such as copper, nickel or iron, ~~that, which,~~ by sintering, will produce materials meeting the requirements of this specification.

#### 6. Chemical Composition

6.1 The specified class shall have the nominal tungsten content in Table 1.

#### 7. Physical and Mechanical Properties

7.1 *Composition, Physical and Mechanical Properties*—The sintered material shall have properties conforming to Table 1 and Table 2 as determined on standard sintered test bars (see Test Methods E 8).

7.2 *Microstructure*—The microstructure of each sample shall be a uniform distribution of tungsten particles in a binder metal matrix when viewed at a magnification of 200 times. The location may be specified (see 8.4.5).

7.3 *Machinability*—When specified (see 4.1), the machinability of the basic parts or of a suitable test specimen shall be such that it shall pass the test specified in 8.4.6.

7.4 *Identification*—Each lot and associated test bars shall be clearly marked with a lot serial number (see 8.3.1).