



Standard Specification for Titanium Sponge¹

This standard is issued under the fixed designation B 299; 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

1.1 This specification covers virgin titanium metal melting stock. This virgin metal is commonly designated as sponge titanium because it is most commonly porous and spongelike in texture, although metal produced electrolytically is granular and is essentially nonporous.

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.

2. Referenced Documents

2.1 ASTM Standards:²

E 10 Test Method for Brinell Hardness of Metallic Materials

E 1409 Test Method for Determination of Oxygen and Nitrogen in Titanium and Titanium Alloys by the Inert Gas Fusion Technique

E 1447 Test Method for Determination of Hydrogen in Titanium and Titanium Alloys by the Inert Gas Fusion Thermal Conductivity/Infrared Detection Method

E 1941 Test Method for Determination of Carbon in Refractory and Reactive Metals and Their Alloys

E 2371 Test Method for Analysis of Titanium and Titanium Alloys by Atomic Emission Plasma Spectrometry

3. Terminology

3.1 Lot Definitions:

3.1.1 *sponge, n*—a lot shall consist of a single blend produced at one time.

4. Materials and Manufacture

4.1 Sponge titanium is usually prepared by reduction of titanium tetrachloride and gets its spongelike character from the processes involved in production. This spongy character-

istic, however, is not considered essential and may be expected to vary greatly with manufacturing methods. For example, virgin titanium produced electrolytically is crystalline or granular in character and is essentially nonporous. The metal is usually supplied in lump or granular form. This specification, however, is not limited to metal prepared by reduction of the tetrachloride.

4.2 Only virgin titanium, free of scrap and intentionally added contaminants, shall be supplied under this specification. It shall be supplied in uniform, well-mixed blends, each of which shall be clearly designated.

5. Chemical Composition

5.1 The titanium metal supplied under this specification shall conform to the chemical composition requirements prescribed in **Table 1**.

6. Hardness

6.1 Brinell hardness testing is optional unless requested by the purchaser. The Brinell Hardness of a lot shall be the average of the hardness determinations on each button prepared as described in **5.1**. The average hardness of each button for the lot shall not exceed the values specified in **Table 1**. Measurement shall be in accordance with Test Method **E 10**, using a 0.394 in. (10-mm) ball, 3307-lbf (1500-kgf) load, and 30-s dwell.

7. Sampling

7.1 The sampling method used shall be a matter of agreement between the manufacturer and the purchaser. The following are acceptable industrial practices:

7.1.1 The blend shall be sampled as required in **7.1.2** and **7.1.3** unless otherwise agreed upon between the manufacturer and the purchaser.

7.1.2 The sample for determining the conformance of the lot to the chemical and physical requirements shall be obtained by sampling the lot to produce a 0.25 % sample but not less than 30 lb (14 kg) providing the lot is crushed to a particle size of 1 in. (25.4 mm) or less in size. The blended evaluation sample shall be split to produce two or more samples 0.1 lb (45 g) or more each, to be melted into buttons, and one sample of at least 0.5 lb (227 g).

7.1.3 The buttons shall be melted in a furnace under an inert-gas atmosphere. The resulting 0.1-lb (45-g) buttons shall be checked for Brinell hardness and samples shall be taken

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 B10.01 on Titanium.

Current edition approved Nov. 1, 2008. Published December 2008. Originally approved in 1955. Last previous edition approved in 2007 as B 299 - 07.

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 Requirements

Element	Weight by % (Dry Basis)				
	GP ^A	EL ^B	SL ^C	ML ^D	MD ^E
Nitrogen, max	0.02	0.008	0.015	0.015	0.015
Carbon, max	0.03	0.02	0.02	0.02	0.02
Sodium, max	^F	0.10	0.19	...	...
Magnesium, max	^F	0.08	...	0.50	0.08
Aluminum, max	0.05	0.03	0.05	0.05	...
Chloride, max	0.20	0.10	0.20	0.20	0.12
Iron, max	0.15	0.05	0.05	0.15	0.12
Silicon, max	0.04	0.04	0.04	0.04	0.04
Hydrogen, max	0.03	0.02	0.05	0.03	0.010
Water, max	0.02	0.02	0.02	0.02	0.02
Oxygen, max	0.15	0.08	0.10	0.10	0.10
Chromium, max	...	...	...	...	0.06 ^G
Nickel, max	...	...	...	...	0.05 ^G
All other impurities (total), max	0.05	0.05	0.05	0.05	0.05
Titanium, balance (nominal)	remainder	remainder	remainder	remainder	remainder
Brinell hardness, max	140	110	120	140	140

^A GP—A general purpose grade, either magnesium or sodium reduced and finished by leaching or inert gas sweep, or both.

^B EL—Electrolytic produced.

^C SL—Sodium reduced and finished by leaching.

^D ML—Magnesium reduced and finished by leaching or inert gas sweep.

^E MD—Magnesium reduced and finished by distillation.

^F Sodium or magnesium, max 0.50 %.

^G The chemical requirements for grade MD sponge have been modified to reflect the use of stainless steel production vessels, which are the norm for this grade of sponge. The use of stainless steel necessarily now incorporates unavoidable chromium and nickel contaminants. These contaminants do not alter the basic property requirements of the sponge. However, it is necessary to incorporate these two unavoidable contaminants into the chemical requirements for this grade, just as the other unavoidable contaminants have been assigned maximum permissible levels.

from each button for the required chemical analysis. The 0.5-lb (227-g) sample shall be used for the metal, chlorine, hydrogen, and moisture analysis.

8. Retests

8.1 If the results of any test lot are not in conformance with the requirements of this specification, the lot may be retested at the option of the manufacturer. The frequency of the retest will double the initial number of tests. If the results of the retest conform to this specification, then the retest values will become the test values for certification. If the results of the retest fail to conform to this specification, the material will be rejected in accordance with Section 9. All test values, original and retest, shall be reported to the purchaser.

9. Report of Analysis

9.1 The manufacturer shall supply at least one copy of the report showing the results of chemical analysis and hardness tests on the material supplied.

10. Methods of Chemical Analysis

10.1 The methods of analysis shall be in accordance with Test Methods E 1409, E 1447, E 1941, or E 2371 or by other methods as agreed upon between the manufacturer and the purchaser. Moisture content shall be determined by any current acceptable industrial practice.

11. Rejection

11.1 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 3 weeks of the notice of rejection, other instructions for disposition.

12. Referee Test and Analysis

12.1 In the event of disagreement between the manufacturer and the purchaser on the conformance of the material to the requirements of this specification, a mutually acceptable referee shall perform the tests in question. The referee's testing shall be used in determining conformance of the material to this specification.

13. Packaging and Package Marking

13.1 The method of packaging shall be agreed upon between the manufacturer and the purchaser. The size and nature of the containers used are generally determined by the time and length of storage and the amount of handling involved. Where a fire hazard or sponge deterioration during prolonged storage are primary considerations, titanium sponge should be packed in air-tight, moisture-proof, sealed metal cans or drums of a type suitable for shipment at the lowest rate by common carrier. Tightly sealed fiber drums are considered adequate where handling is at a minimum and usage is rather prompt.

14. Keywords

14.1 titanium; titanium sponge



ASTM International takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.

This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, at the address shown below.

This standard is copyrighted by ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States. Individual reprints (single or multiple copies) of this standard may be obtained by contacting ASTM at the above address or at 610-832-9585 (phone), 610-832-9555 (fax), or service@astm.org (e-mail); or through the ASTM website (www.astm.org).