



Standard Specification for Titanium Sponge¹

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1. Scope

1.1 This specification covers the purchase of virgin titanium sponge metal. This virgin metal is commonly designated as titanium sponge because it is most commonly porous and sponge-like 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

[E10 Test Method for Brinell Hardness of Metallic Materials](#)

[E1409 Test Method for Determination of Oxygen and Nitrogen in Titanium and Titanium Alloys by the Inert Gas Fusion Technique](#)

[E1447 Test Method for Determination of Hydrogen in Titanium and Titanium Alloys by Inert Gas Fusion Thermal Conductivity/Infrared Detection Method](#)

[E1941 Test Method for Determination of Carbon in Refractory and Reactive Metals and Their Alloys by Combustion Analysis](#)

[E2371 Test Method for Analysis of Titanium and Titanium Alloys by Atomic Emission Plasma Spectrometry \(Withdrawn 2013\)](#)³

3. Terminology

3.1 *Lot Definitions*:

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

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.

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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 The last approved version of this historical standard is referenced on www.astm.org.

4. Materials and Manufacture

4.1 Titanium sponge is usually prepared by reduction of titanium tetrachloride and gets its sponge-like character from the processes involved in production. This spongy characteristic, 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.

4.2 This specification is not limited to metal prepared by reduction of the tetrachloride.

4.3 Particle size requirements shall be a matter of agreement between the manufacturer and the purchaser.

5. Chemical Composition

5.1 The titanium sponge metal purchased to 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 [7.1.2](#). 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 [E10](#), 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, but shall be such that the analysis is representative of the sponge lot. The following is one acceptable industrial practice:

7.1.1 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).

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.

7.1.2 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 from each button for the required chemical analysis (Table 1). The 0.5-lb (227-g) sample shall be used for the metal, chloride, hydrogen, and moisture (water) 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. Certification

9.1 A producer's or supplier's certification shall be furnished to the purchaser. The certification will state the manufacturing method employed and the grade of titanium sponge produced (as per Table 1). In addition, the certification will state that the sampling and testing was performed in accordance with this specification and has been found to meet the requirements therein. A report of the results, including Brinell Hardness if required, shall be furnished with the certification.

10. Methods of Chemical Analysis

10.1 The methods of analysis shall be in accordance with Test Methods E1409, E1447, E1941, or E2371 or by other methods as agreed upon between the manufacturer and the

purchaser. Moisture content shall be determined by any current acceptable industrial practice.

10.2 Where test methods do not exist, the supplier will determine the technique(s) unless otherwise required by the purchaser.

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

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