Designation: B 817 – 98

Standard Specification for Powder Metallurgy (P/M) Titanium Alloy Structural Components [1]

This standard is issued under the fixed designation B 817; 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 powder metallurgy (P/M) structural components fabricated from commercially pure (CP) titanium powder mixed with master alloy powder and minor elemental powders in appropriate quantity to yield combined material chemistries comparable to ingot metallurgy (I/M) alloys Titanium 6A1-4V and Titanium 6A1-6V-2Sn.

1.2 This specification covers the following materials:

1.2.1 Two types depending on alloy composition as detailed in Table 1.

1.2.1.1 Type I is comparable to I/M Ti-6A1-4V.

1.2.1.2 Type II is comparable to I/M Ti-6A1-6V-2Sn.

1.2.2 Two grades of each type that result from the specific titanium powder used are as follows:

1.2.2.1 Grade 1 is made from sponge fines with residual levels of chlorine and sodium.

1.2.2.2 Grade 2 is made from hydride/dehydride (HDH) or other process titanium with significantly lower chlorine and sodium content.

1.2.3 Two classes as a function of density (see Table 2) are as follows:

1.2.3.1 Class A density ratio is 94 % minimum.

1.2.3.2 Class B density ratio is 99 % minimum.

NOTE 1—**Warning:** CP titanium powder may be pyrophoric; its use may involve an explosion hazard.

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

1.4 *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. Specific precautionary statements are given in Note 1.*

2. Referenced Documents

2.1 *ASTM Standards:*

B 243 Terminology of Powder Metallurgy[2]

B 311 Test Method for Density Determination for Powder Metallurgy (P/M) Materials Containing Less Than Two Percent Porosity[2]

B 328 Test Methods for Density, Oil Content, and Interconnected Porosity of Sintered Powder Metal Structural Parts and Oil-Impregnated Bearings[2]

E 8 Test Methods for Tension Testing of Metallic Materials[3]

3. Terminology

3.1 *Definitions*—Definitions of powder metallurgy terms can be found in Terminology B 243.

3.2 *Descriptions of Terms Specific to This Standard*—Additional descriptive information is available in the Related Material section of Volume 02.05 of the *Annual Book of ASTM Standards.*

4. Ordering Information

4.1 Orders for components under this specification shall include the following information:

4.1.1 Dimensions (see Section 9),

4.1.2 Chemical composition (see Section 6 and Table 1),

4.1.3 Density (see 7.1 and Table 2),

4.1.4 Mechanical properties (see Section 8 and Table X1.1), and

4.1.5 Certification (see Section 13).

5. Materials and Manufacture

5.1 Structural components shall be fabricated by cold compacting a mixture of CP titanium, master alloy, and other elemental powders into suitable shapes. The compacts shall be vacuum sintered and hot isostatically pressed, if necessary, to provide parts conforming to the requirements of this specification.

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[1] This specification is under the jurisdiction of ASTM Committee B-9 on Metal Powders and Metal Powder Productsand is the direct responsibility of Subcommittee B09.11on Near Full Density Powder Metallurgy Materials.

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[2] *Annual Book of ASTM Standards*, Vol 02.05.

[3] *Annual Book of ASTM Standards*, Vol 03.01.

TABLE 1 Chemical Requirements

Element	Composition, Weight %			
	Grade 1		Grade 2	
	Type I	Type II	Type I	Type II
Aluminum	5.50/6.75	5.0/6.0	5.50/6.75	5.0/6.0
Vanadium	3.50/4.50	5.0/6.0	3.50/4.50	5.0/6.0
Tin	N/A[A]	1.5/2.5	N/A[A]	1.5/2.5
Iron	0.40 max	0.35/1.0	0.40 max	0.35/1.0
Copper	N/A[A]	0.35/1.0	N/A[A]	0.35/1.0
Oxygen, max	0.30	0.30	0.30	0.30
Hydrogen, max	0.015	0.015	0.015	0.015
Nitrogen, max	0.04	0.04	0.04	0.04
Carbon, max	0.10	0.10	0.10	0.10
Sodium, max	0.20	0.20	TBD[B]	TBD[B]
Chlorine, max	0.20	0.20	TBD[B]	TBD[B]
Silicon, max	0.10	0.10	0.10	0.10
Residual elements each, max	0.10	0.10	0.10	0.10
Residual elements total, max	0.40	0.40	0.40	0.40
Titanium	remainder	remainder	remainder	remainder

[A] Not applicable.
[B] Various chloride levels may be available between the standard 0.20 max and the wrought equivalent of 0.001 max. The acceptable level for specific product applications shall be agreed upon between the purchaser and supplier and specified on the purchase order.

TABLE 2 Density Requirements

Class	Density Ratio min, %
A	94
B	99

6. Chemical Composition

6.1 Chemical composition shall conform to the requirements of Table 1.

6.2 Chemical analysis shall be made in accordance with methods prescribed in Volume 03.05 of the *Annual Book of ASTM Standards*, or any other standard method mutually agreed upon between the manufacturer and the purchaser.

7. Physical Properties

7.1 *Density*:

7.1.1 Density ratio shall exceed minimum limits prescribed in Table 2. The purchaser and the producer shall mutually agree on pore free density values.

7.1.2 Density shall be determined in accordance with Test Method B 328 for Class A materials.

7.1.3 Density shall be determined in accordance with Test Method B 311 for Class B materials.

8. Mechanical Properties

8.1 Whenever feasible tests shall be performed on material removed from actual components. The test requirements shall be determined after consideration of actual component function.

8.2 The required mechanical properties and a sampling plan shall be agreed upon between the manufacturer and the purchaser. All shipments of components subsequent to the establishment of testing conditions shall conform to the agreed limits.

9. Dimensions and Tolerances

9.1 Dimensions and tolerances of the structural components shall be indicated on drawings accompanying the purchase order or contract.

10. Sampling

10.1 *Lot*—Unless otherwise specified, a lot shall consist of components fabricated from powder of the same mix lot; compacted, sintered (and hot isostatically pressed, if required) under the same conditions.

10.2 *Chemical Analysis*—If required by purchase agreement, at least one sample for chemical analysis shall be taken from each lot. A representative sample of chips may be obtained by dry-milling, drilling or crushing at least two pieces without lubrication using clean, dry tools.

10.3 *Mechanical Testing*—If required by purchase agreement, the manufacturer and purchaser shall mutually agree on the representative number of specimens for mechanical testing, from each lot.

11. Inspection

11.1 Unless otherwise specified, inspection of components supplied on contract shall be made by the purchaser.

12. Rejection and Rehearing

12.1 Components that fail to conform to the requirements of this specification may be rejected. Rejection shall be reported to the producer or supplier promptly and in writing. In case of dissatisfaction with test results, the producer or supplier may make a claim for a rehearing.

13. Certification

13.1 When specified in the purchase order or contract, a producer's certification of compliance document shall be furnished to the purchaser, verifying that the components manufactured were sampled, tested and inspected in accordance with this specification and have met the requirements. When specified in the purchase order or contract, a report of test results shall be furnished.

13.2 Certification by an independent, third party indicating conformance to the requirements of this specification may be considered upon the request of the purchaser.

13.3 The purchase order or contract must specify whether or not the certification includes a report of chemical analysis.

14. Keywords

14.1 compaction; cold isostatic pressing (CIP); ELCL titanium; HDH titanium powder; hot isostatic pressing (HIP); powder metallurgy;"sponge fines" titanium powder; structural components; Ti-6A1-4V; Ti-6A1-6V-2Sn; titanium; titanium alloys; vacuum sinter

APPENDIX

(Nonmandatory Information)

X1. MECHANICAL PROPERTY DATA

TABLE X1.1 Typical Properties

Type	Grade	Class	0.2 % Offset				Elongation in 1 in. (25 mm) %	Reduction in Area, %
			Tensile Strength		Yield Strength			
			10^3 psi	(MPa)	10^3 psi	(MPa)		
I	1	A	111	(765)	101	(696)	4	5
I	1	B	123	(848)	108	(745)	8	14
II	1	A	131	(903)	113	(779)	3	4
II	1	B	139	(958)	131	(903)	6	8
I	2	A	131	(903)	118	(814)	8	18
I	2	B	139	(958)	125	(862)	13	29
II	2	A	. . .	. . .	. . .	. . .	. . .	. . .
II	2	B	139	(958)	128	(883)	13	13

X1.1 Typical data for the mechanical properties of elementally mixed titanium alloy specimens are given in Table X1.1. These data do not constitute a part of this specification. They indicate, to the purchaser, the mechanical properties that may be expected from tension specimens conforming to the specified density and chemical requirements. It should be understood that the values represent specimens cut from commercial parts. Refer to Method E 8, Fig. 20.

NOTE X1.1—Refer to Refs. **(1-10)**[4] for supplemental material property information.

[4] The boldface numbers in parentheses refer to a list of references at the end of the text.

REFERENCES

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