Designation: B 823 – 01

Standard Specification for Materials for Nonferrous Powder Metallurgy (P/M) Structural Parts[1]

This standard is issued under the fixed designation B 823; 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 a variety of nonferrous powder metallurgy (P/M) structural materials and includes a classification system, or material designation code. With the classification system, this specification includes chemical composition and minimum tensile yield strength.

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

NOTE 1—Paragraphs 6.1 and 8.1 govern material classification by the designation code. The classification system is explained in the Appendix.

2. Referenced Documents

2.1 *ASTM Standards:*

B 243 Terminology of Powder Metallurgy[2]

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

2.2 *Other Standard:*

MPIF Standard 35, Materials Standard for P/M Structural Parts[3]

3. Terminology

3.1 *Definitions*—Definitions of powder metallurgy terms can be found in Terminology B 243. Additional descriptive information is available in the Related Materials section of Vol 02.05 of the *Annual Book of ASTM Standards*.

4. Ordering Information

4.1 Materials for parts covered by this specification shall be ordered by materials designation code.

4.2 Orders for parts under this specification may include the following information:

4.2.1 Certification, if required (see Section 10),

4.2.2 Test methods and mechanical properties other than strength (see 8.2 and 8.3),

4.2.3 Density (see 7.1),

4.2.4 Porosity and oil content (see 7.2), and

4.2.5 Special packaging, if required.

5. Materials and Manufacture

5.1 Structural parts shall be made by pressing and sintering metal powders. Parts may also be made by repressing and resintering sintered parts, if necessary, to produce finished parts in conformance with the requirements of this specification.

6. Chemical Composition

6.1 The material shall conform to the requirements provided in Table 1.

6.2 Chemical analysis, if required, shall be performed by any method agreed upon by the manufacturer and the purchaser.

7. Physical Properties

7.1 *Density*:

7.1.1 The buyer and the seller may agree upon a minimum average density for the part and minimum densities for specific regions of the part.

7.1.2 Density shall be determined in accordance with Test Method B 328.

7.2 *Porosity*:

7.2.1 The buyer and the seller may agree upon a minimum volume oil content for parts that are to be self-lubricating.

7.2.2 The buyer and the seller may agree upon a functional test for porosity in parts that are to be self-lubricating, or for permeability where fluid flow must be restricted.

8. Mechanical Properties

8.1 The minimum guaranteed tensile yield strength, as shown in Table 2, is a numerical suffix to the material designation code and is read as 10^3 psi. The code is adopted from MPIF Standard 35. All tensile yield strengths are defined as the 0.2 % offset yield strengths.

8.2 The purchaser and manufacturer should agree upon the method to be used to verify the minimum strength characteristics of the finished parts. Since it is usually impossible to machine tensile test specimens from these parts, alternative strength tests are advisable. An example would be measuring

[1] This test method is under the jurisdiction of ASTM Committee B09 on Metal Powders and Metal Powder Products and is the direct responsibility of Subcommittee B09.05 on Structural Parts.

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

[3] Available from Metal Powder Industries Federation, 105 College Road East, Princeton, NJ 08540.

TABLE 1 Chemical Requirements

Material Designation	Chemical Composition, %[A]					
	Cu	Zn	Pb	Sn	Ni	
CZ-1000	88.0	remainder	. . .	. . .	. . .	min
	91.0	remainder	. . .	. . .	. . .	max
CZP-1002	88.0	remainder	1.0	. . .	. . .	min
	91.0	remainder	2.0	. . .	. . .	max
CZ-2000	77.0	remainder	. . .	. . .	. . .	min
	80.0	remainder	. . .	. . .	. . .	max
CZP-2002	77.0	remainder	1.0	. . .	. . .	min
	80.0	remainder	2.0	. . .	. . .	max
CZ-3000	68.5	remainder	. . .	. . .	. . .	min
	71.5	remainder	. . .	. . .	. . .	max
CZP-3002	68.5	remainder	1.0	. . .	. . .	min
	71.5	remainder	2.0	. . .	. . .	max
CNZ-1818	62.5	remainder	. . .	. . .	16.5	min
	65.5	remainder	. . .	. . .	19.5	max
CNZP-1816	62.5	remainder	1.0	. . .	16.5	min
	65.5	remainder	2.0	. . .	19.5	max
CT-1000	87.5	remainder	. . .	9.5	. . .	min
	90.5	remainder	. . .	10.5	. . .	max

[A] Other elements: the total by difference equals 2.0 % maximum, which may include other minor elements added for specific purposes.

TABLE 2 Minimum Yield Strength for Nonferrous Alloys

Material Designation Code	Minimum Yield Strength, 10^3 psi
CZ-1000-9	9
-10	10
-11	11
CZP-1002-7	7
CZ-2000-11	11
-12	12
CZP-2002-11	11
-12	12
CZ-3000-14	14
-16	16
CZP-3002-13	13
-14	14
CNZ-1818-17	17
CNZP-1816-13	13
CT-1000-13 (repressed)	13

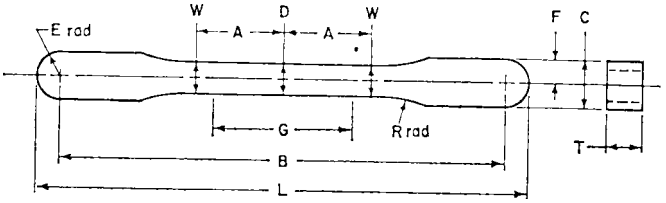
the force needed to break teeth off a gear with the gear properly fixtured.

8.3 The tensile yield strength of the part may be measured indirectly by testing flat tensile bars (See Fig. 1) molded from the same mixed powder lot at the density of the critical region of the parts and then processed along with the parts.

8.4 Transverse rupture strength values can also be related to tensile yield strengths by correlation. While nonferrous P/M materials are technically too ductile for this simple beam test, the test values are reproducible and useful.

9. Sampling

9.1 *Lot*—Unless otherwise specified, a lot shall consist of parts of the same form and dimensions made from powders of the same composition, molded and processed under the same conditions, and submitted for inspection at one time.



Pressing Area = 1.00 in.^{2}

Note—Dimensions specified, except G and T are those of the die.

Dimensions

	in.	mm
A—Half length of reduced section	⅝	15.88
B—Grip length	3.187± 0.001	80.95 ± 0.03
C—Width of grip section	0.343 ± 0.001	8.71 ± 0.03
D—Width at center	0.225 ± 0.001	5.72 ± 0.03
E—End radius	0.171 ± 0.001	4.34 ± 0.03
F—Half width of grip section	0.171 ± 0.001	4.34 ± 0.03
G—Gage length	1.000 ± 0.003	25.40 ± 0.08
L—Overall length	3.529 ± 0.001	89.64 ± 0.03
R—Radius of fillet	1	25.4
T—Compact to this thickness	0.140 to 0.250	3.56 to 6.35
W—Width at end of reduced section	0.235 ± 0.001	5.97 ± 0.03

FIG. 1 Standard Flat Unmachined Tension Test Specimen for Powder Metallurgy Products

9.2 *Chemical Analysis*—When requested on the purchase order, at least one sample for chemical analysis shall be taken from each lot. The analysis shall be performed by a mutually agreed upon method.

9.3 *Mechanical Tests*—The manufacturer and the purchaser shall agree upon a representative number of specimens for mechanical tests.

10. Rejection and Rehearing

10.1 Parts failing to conform to the requirements of this specification may be rejected. Rejection should be reported to the producer or supplier promptly and in writing.

11. Certification

11.1 When specified in the purchase order or contract, a certification from the producer shall be furnished to the purchaser which states that the parts were manufactured, sampled, tested, and inspected in accordance with this specification and have been found to meet its requirements. When specified in the purchase order or contract, a report of the test results shall be furnished.

12. Keywords

12.1 brass; bronze; nickel silver; nonferrous powder metallurgy; nonferrous structural parts; powder metallurgy (P/M); structural parts

APPENDIX

(Nonmandatory Information)

X1. USE OF THIS SPECIFICATION

X1.1 *P/M Material Code Designation:*

X1.1.1 The P/M material code designation, or identifying code for structural P/M parts, defines a specific material as to chemistry and minimum strength, expressed in 10^3 psi (6.895 MPa (6.895 N/mm^2)). For example, CZ-1000-9 is a P/M copper zinc material containing nominal 90 % copper and 10 % zinc. It has a minimum yield strength of 9×10^3 psi (9000 psi) in the as-sintered condition.

X1.1.2 The system offers a convenient means of designating both the chemistry and minimum strength value of any standard P/M material. For each standard material, the density is given as one of the typical values and is no longer a requirement of the specification.

X1.1.3 Code designations in this specification and revisions thereof apply only to P/M materials for which specifications have been adopted. In order to avoid confusion, the P/M material designation coding system is intended for use only with such materials, and it should not be used to create nonstandard materials. The explanatory notes, property values, and other contents of this specification have no application to any other materials.

X1.1.4 In the coding system, the prefix letters denote the general type of material. For example, the prefix CZ represents copper (C) and zinc (Z), which is known as brass. The prefix letter codes are as follows:

X1.1.4.1 C = copper (Cu),
X1.1.4.2 CT = bronze (Cu-Sn),
X1.1.4.3 CNZ = nickel silver (Cu-Ni-Zn),
X1.1.4.4 CZ = brass (Cu-Zn),
X1.1.4.5 N = nickel (Ni),
X1.1.4.6 P = lead (Pb), and
X1.1.4.7 T = tin (Sn).

X1.2 *Prefix and Four-Digit Code*—The four digits following the prefix letter code refer to the composition of the material. In nonferrous materials, the first two numbers in the four-digit series designate the percent of the major alloying constituent; the last two numbers of the four digit series designate the percent of the minor alloying constituent. For improved machinability, lead is sometimes the third alloying element in a nonferrous alloy system. Lead will then be indicated only by the letter "P" in the prefix. The percent of lead or any other minor alloying element that happens to be excluded from the four-digit nomenclature is represented in the "chemical composition" information that appears with each standard material. For an illustration of P/M nonferrous material designation coding, see Fig. X1.1.

X1.3 *Suffix Digit Code*—The two-digit suffix represents the minimum strength value, expressed in 10^3 psi (6.895 MPa (6.895 N/mm^2)), that the user can expect from the P/M material possessing that chemistry. The minimum tensile yield strength for these materials in the as-sintered condition is given in Table X1.1.

X1.4 *Data Source*—Information used in compiling this specification was contributed by the membership of ASTM Committee B09 on Metal Powders and Metal Powder Products and the Standards Committee of the Powder Metallurgy Parts Association of MPIF. These technical data are on file at MPIF Headquarters, Princeton, NJ and are reproduced in this specification with the permission of the Metal Powder Industries Federation.

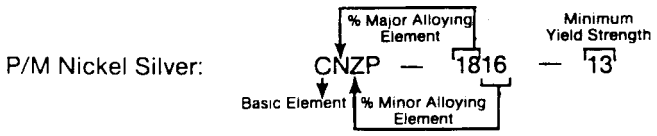


FIG. X1.1 Illustration of Powder Metallurgy Nonferrous Material Designation Coding

TABLE X1.1 Nonferrous Alloys: Brass, Bronze, and Nickel Silver

NOTE 1— 10^3 psi = 6.895 MPa (6.895 N/mm^2).
NOTE 2—1 in. = 25.4 mm.
NOTE 3—1 ft-lb = 1.356 J.

Powder Metallurgy Material Properties

Minimum Values[A]		Typical Values[B]									
		Tensile Properties									Hardness
Material Designation Code	Minimum Strength, Yield,[A] 10^3 psi	Ultimate Strength, 10^3 psi	Yield Strength, 0.2 %, 10^3 psi	Elongation, in 1 in., %	Young's Modulus, 10^6 psi	Poisson's Ratio	Transverse Rupture Strength, 10^3 psi	Unnotched Charpy Impact Energy, ft-lb	Density, g/cm^3	Compressive Yield Strength, 0.1 %, 10^3 psi	Apparent (Direct), Rockwell
CZ-1000-9	9	18.0	9.5	9.0	11.5	0.31	39	15.0	7.60	12	65HRH
-10	10	20.0	11.0	10.5	13.0	0.31	46	24.0	7.90	12	72
-11	11	23.0	12.0	12.0	14.5	0.31	52	31.0	8.10	12	80
CZP-1002-7	7	20.0	8.5	10.0	13.0	0.31	45	24.0	7.90	10	66HRH
CZ-2000-11	11	23.0	13.5	9.0	[C]	[C]	52	27.0	7.6	[C]	73
CZ-2000-12	12	35.0	17.0	18.0	[C]	[C]	70	45.0	8.0	[C]	82
CZP-2002-11	11	23.0	13.5	9.0	12.5	0.31	52	27.0	7.60	12	73HRH
-12	12	35.0	17.0	18.0	14.5	0.31	70	45.0	8.00	14	82
CZ-3000-14	14	28.0	16.0	14.0	12.0	0.31	62	23.0	7.60	18	84HRH
-16	16	34.0	19.0	17.0	13.0	0.31	86	38.0	8.00	19	92
CZP-3002-13	13	27.0	15.0	14.0	12.0	0.31	57	12.0	7.60	12	80HRH
-14	14	31.5	16.5	16.0	13.0	0.31	71	25.0	8.00	15	88
CNZ-1818-17	17	34.0	20.0	11.0	13.5	0.31	73	24.0	7.90	24	90HRH
CNZP-1816-13	13	26.0	15.0	10.0	13.5	0.31	50	22.0	7.90	18	86HRH
CT-1000-13 (repressed)	13	22.0	16.0	4.0	8.5	0.31	45	4.0	7.20	20	82HRH

[A] Suffix numbers represent minimum strength values in 10^3 psi.
[B] Mechanical property data derived from laboratory-prepared test specimens sintered under commercial manufacturing conditions.
[C] Additional data in preparation will appear in subsequent editions of this specification.