Designation: B 883 – 97

Standard Specification for Metal Injection Molding (MIM), Ferrous Structural Parts[1]

This standard is issued under the fixed designation B 883; 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 ferrous metal injection molded materials fabricated by mixing elemental or prealloyed metal powders with binders, injecting into a mold, debinding, and sintering, with or without subsequent heat treatment.

1.2 This specification covers the following injection molded materials.

1.2.1 *Compositions*:

1.2.1.1 MIM-2200 Low-alloy steel produced from admixtures of iron powder and other alloying elements such as nickel and molybdenum.

1.2.1.2 MIM-2700 Low-alloy steel produced from admixtures of iron powder, and other alloying elements such as nickel and molybdenum.

1.2.1.3 MIM-4605 Low-alloy steel produced from admixtures of iron powder and other alloying elements such as nickel, molybdenum, and carbon.

1.2.1.4 MIM-316L Austenitic stainless steel produced from prealloyed powder or an admixture of powders.

1.2.1.5 MIM-17-4 PH Precipitation hardening stainless steel produced from prealloyed powder or an admixture of powders.

NOTE 1—Compositional limits and impurity elements may be different from AISI limits. Chemical composition limits are specified in 6.1 and Table 1.

1.3 Property values stated in English system units are the standard. Conversions to SI units may be approximate.

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 Method for Density, Oil Content and Interconnected Porosity of Sintered Metal Structural Parts and Oil Impregnated Bearings[2]

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

E 18 Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials[3]

E 350 Test Method for Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrical Steel, Ingot Iron, and Wrought Iron[4]

E 415 Test Method for Optical Emission Vacuum Spectrometric Analysis of Carbon and Low-Alloy Steel[5]

E 1019 Test Methods for Determination of Carbon, Sulfur, Nitrogen, Oxygen, and Hydrogen in Steel and in Iron, Nickel, and Cobalt Alloys [5]

E 1479 Practice for Describing and Specifying Induction Coupled Plasma Optical Emission Spectrometers[5]

2.2 *Other Test Methods and Standards:*

MPIF Standard 35, Material Standards for Metal Injection Molded Parts[6]

MPIF Standard 50, Method for Preparing and Evaluating Metal Injection Molded Debound and Sintered Tension Test Specimens[6]

MPIF Standard 51, Determination of Microhardness of Powder Metallurgy Materials[6]

3. Terminology

3.1 *Definitions*:

3.1.1 Definitions of powder metallurgy terms can be found in Terminology B 243. Additional descriptive information is available in the Related Material Section of Vol. 02.05 of the Annual Book of ASTM Standards.

4. Ordering Information

4.1 Orders for parts conforming to this specification may include the following:

4.1.1 ASTM Designation,

4.1.2 Alloy composition including carbon content (see 6.1 and Table 1),

4.1.3 Heat Treatment condition and hardness (see Tables 2-5),

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

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

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

[4] *Annual Book of ASTM Standards*, Vol 03.05.

[5] *Annual Book of ASTM Standards*, Vol 03.06.

[6] Available from Metal Powder Industries Federation, 105 College Road East, Princeton, NJ 08540–6692.

TABLE 1 Chemical Requirements For Metal Injection Molded Parts

Material Designation		Fe	Ni	Cr	Mo	C	Cu	Nb + Ta	OTHER
MIM-2200	Min.	Bal.	1.5	-	0.0	0.0	-	-	0.0
	Max.	Bal.	2.5	-	0.5	0.1	-	-	2.0
MIM-2700	Min.	Bal.	6.5	-	0.0	0.0	-	-	0.0
	Max.	Bal.	8.5	-	0.5	0.1	-	-	2.0
MIM-4605	Min.	Bal.	1.5	-	0.2	0.4	-	-	0.0
	Max.	Bal.	2.5	-	0.5	0.6	-	-	2.0
MIM-316L	Min.	Bal.	10.0	16.0	2.0	0.00	-	-	0.0
	Max.	Bal.	14.0	18.0	3.0	0.03	-	-	2.0
MIM-17-4PH	Min.	Bal.	3.0	15.5	-	0.00	3.0	0.15	0.0
	Max.	Bal.	5.0	17.5	-	0.07	5.0	0.45	2.0

TABLE 2 Mandatory and Typical Mechanical Properties of Metal Injection Molded Low-Alloy Steels[A]
English Units

Material Designation	Minimum Mandatory Values Tensile Properties			Typical Values Tensile Properties			Density	Typical Values Hardness	
	Ultimate Strength 10^3 psi	Yield Strength 10^3 psi	Elongation in 1 in. %	Ultimate Strength 10^3 psi	Yield Strength 10^3 psi	Elongation in 1in. %	g/cm^3	Apparent Rockwell	Matrix[B] Rockwell
MIM-2200	37	16	20	42	18	40	7.6	45 HRB	
MIM-2700	55	30	20	60	37	26	7.6	69 HRB	
MIM-4605	55	25	11	64	30	15	7.5	62 HRB	
MIM-4605-HT[C]	215	190	-	240	215	2	7.5	48 HRC	55 HRC

[A]Reprinted by permission from MPIF Standard 35, "Materials Standard for Metal Injection Molded Parts", 1993/1994, Metal Powder Industries Federation, 105 College Road East, Princeton, NJ 08540-6692.
Density determined in accordance with Test Methods B 311 and B 328. Apparent hardness determined in accordance with Test Methods E 18. Tensile properties determined on test bars prepared in accordance with MPIF Standard 50 and tested in accordance with Test Method E 8.
[B]Converted from HK_{100} Microhardness, MPIF Standard 51, Appendix B.
[C]These data were measured on test bars tempered for 1 hour at 350°F.

TABLE 3 Mandatory and Typical Mechanical Properties of Metal Injection Molded Low-Alloy Steels[A]
SI Units

Material Designation	Minimum Mandatory Values Tensile Properties			Typical Values Tensile Properties			Density	Typical Values Hardness	
	Ultimate Strength MPa	Yield Strength MPa	Elongation % in 25.4 mm	Ultimate Strength MPa	Yield Strength MPa	Elongation % in 25.4 mm	g/cm^3	Apparent Rockwell	Matrix[B] Rockwell
MIM-2200	255	110	20	290	125	40	7.6	45 HRB	
MIM-2700	380	205	20	415	255	26	7.6	69 HRB	
MIM-4605	380	170	11	440	205	15	7.5	62 HRB	
MIM-4605-HT[C]	1480	1310	-	1650	1480	2	7.5	48 HRC	55 HRC

[A]Reprinted by permission from MPIF Standard 35, "Materials Standards for Metal Injection Molded Parts", 1993/1994, Metal Powder Industries Federation, 105 College Road East, Princeton, NJ 08540–6692. S.I. values converted from English units in Table 2.
Density determined in accordance with Test Methods B 311 or B 328. Apparent hardness determined in accordance with Test Methods E 18. Tensile properties determined on test bars prepared in accordance with MPIF Standard 50 and tested in accordance with Test Methods E 8.
[B]Converted from HK_{100} Microhardness, MPIF Standard 51, Appendix B.
[C]These data were measured on test bars tempered for 1 hour at 177°C

4.1.4 Functional or mechanical property testing (see 7.1.1-7.1.3, 8.2, Tables 2-5),

4.1.5 Purchaser or purchaser's representative desire to witness the inspection and testing of material prior to shipment (see 9.2),

4.1.6 Requirement for certification of material and a report of test results (see 11.1),

4.1.7 Requirement for full or partial chemical analysis (see Section 6.), and

4.1.8 Other special requirements as mutually agreed

5. Materials and Manufacture

5.1 Parts shall be made by injection molding mixtures of metal powder with binders, debinding, and sintering, with or without subsequent heat treatment. The material shall conform to the designations in 1.2.1 and meet the chemical composition specified in 6.1 and Table 1.

6. Chemical Composition

6.1 Metal injection molded material shall conform to the chemical requirements prescribed in Table 1.