Designation: B883 – 05

Standard Specification for Metal Injection Molding (MIM) Ferrous Materials[1]

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1. Scope

1.1 This specification covers ferrous metal injection molded materials fabricated by mixing elemental or pre-alloyed 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 pre-alloyed 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.

1.2.1.6 MIM-430L , ferritic stainless steel produced from pre-alloyed powder or an admixture of powders.

1.3 Chemical composition limits are specified in Table 1.

1.4 Property values stated in inch-pound units are to be regarded as the standard. Conversions to SI units may be approximate.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

B243 Terminology of Powder Metallurgy

B311 Test Method for Density of Powder Metallurgy (PM) Materials Containing Less Than Two Percent Porosity

B328 Test Method for Density, Oil Content, and Interconnected Porosity of Sintered Metal Structural Parts and Oil-Impregnated Bearings[3]

B933 Test Method for Microindentation Hardness of Powder Metallurgy (PM) Materials

E8 Test Methods for Tension Testing of Metallic Materials

E18 Test Methods for Rockwell Hardness of Metallic Materials

E350 Test Methods for Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrical Steel, Ingot Iron, and Wrought Iron

E415 Test Method for Atomic Emission Vacuum Spectrometric Analysis of Carbon and Low-Alloy Steel

E1019 Test Methods for Determination of Carbon, Sulfur, Nitrogen, and Oxygen in Steel, Iron, Nickel, and Cobalt Alloys by Various Combustion and Fusion Techniques

E1086 Test Method for Atomic Emission Vacuum Spectrometric Analysis of Stainless Steel by Point-to-Plane Excitation Technique

E1621 Guide for X-Ray Emission Spectrometric Analysis

F1089 Test Method for Corrosion of Surgical Instruments

2.2 *MPIF Standards:*[4]

MPIF Standard 35, Material Standards for Metal Injection Molded Parts

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

MPIF Standard 51, Determination of Microhardness of Powder Metallurgy Materials

MPIF Standard 59, Determination of Charpy Impact Energy of Unnotched Metal Injection Molded Test Specimens

MPIF Standard 62, Determination of the Corrosion Resistance of MIM Grades of Stainless Steel Immersed in 2 % Sulfuric Acid Solution

MPIF Standard 63, Density Determination of MIM Components (Gas Pycnometer)

3. Terminology

3.1 *Definitions*:

3.1.1 Definitions of powder metallurgy terms can be found in Terminology B243. Additional descriptive information is

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

[4] Available from Metal Powder Industries Federation (MPIF), 105 College Road East, Princeton, NJ 08540–6692, USA.

TABLE 1 Chemical Composition Requirements For Metal Injection Molded Materials

Material Designation		Fe	Ni	Cr	Co	Mo	C	Cu	Si	Mn	Nb + Ta	V	Other
MIM-2200	Min.	Bal.	1.5	-	-	-	-	-	-	-	-	-	-
	Max.	Bal.	2.5	-	-	0.5	0.1	-	1.0	-	-	-	1.0
MIM-2700	Min.	Bal.	6.5	-	-	-	-	-	-	-	-	-	-
	Max.	Bal.	8.5	-	-	0.5	0.1	-	1.0	-	-	-	1.0
MIM-4605	Min.	Bal.	1.5	-	-	0.2	0.4	-	-	-	-	-	-
	Max.	Bal.	2.5	-	-	0.5	0.6	-	1.0	-	-	-	1.0
MIM-316L	Min.	Bal.	10	16	-	2	-	-	-	-	-	-	-
	Max.	Bal.	14	18	-	3	0.03	-	1.0	2.0	-	-	1.0
MIM-430L	Min.	Bal.	-	16	-	-	-	-	-	-	-	-	-
	Max.	Bal.	-	18	-	-	0.05	-	1.0	1.5	-	-	1.0
MIM-17-4PH	Min.	Bal.	3	15.5	-	-	-	3	-	-	0.15	-	-
	Max.	Bal.	5	17.5	-	-	0.07	5	1.0	1.0	0.45	-	1.0

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 Table 1),

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

4.1.4 Functional or mechanical property testing (see 7.3-7.7 and Tables 2-5),

4.1.5 Corrosion resistance testing (see 8.1-8.1.4 and Table 6),

4.1.6 Purchaser or purchaser's representative desire to witness the inspection and testing of material prior to shipment (see 10.2),

4.1.7 Requirement for certification of material and a report of test results (see 12.1),

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

4.1.9 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 Table 1.

6. Chemical Composition

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

6.2 Chemical analysis for the elements copper, chromium, molybdenum, and nickel shall be determined in accordance

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

Material Designation	Minimum Mandatory Values Tensile Properties			Typical Values Tensile Properties			Density	Typical Values Hardness		Unnotched Charpy Impact Energy[B]
	Ultimate Strength	Yield Strength	Elongation in 1 in.	Ultimate Strength	Yield Strength	Elongation in 1 in.		Macro (apparent)	Micro (converted)	ft-lbf
	10^3 psi	10^3 psi	%	10^3 psi	10^3 psi	%	g/cm^3	Rockwell		
MIM-2200 (as-sintered)	37	16	20.0	42	18	40.0	7.6	45 HRB	. . .	100
MIM-2700 (as-sintered)	55	30	20.0	60	37	26.0	7.6	69 HRB	. . .	130
MIM-4605 (as-sintered)	55	25	11.0	64	30	15.0	7.5	62 HRB	. . .	50
MIM-4605[C] (quenched and tempered)	215	190	≤1.0	240	215	2.0	7.5	48 HRC	55 HRC	40

[A] Reprinted by permission from MPIF Standard 35, "Materials Standard for Metal Injection Molded Parts", 2000, Metal Powder Industries Federation, 105 College Road East, Princeton, NJ 08540-6692.

[B] MPIF Standard 59 specimens are 0.197 × 0.394 × 2.155 in. The results were not normalized to 0.394 × 0.394 × 2.165 in. since this would have resulted in higher impact energy values.

[C] These data were measured on test bars tempered for 1 h at 350°F.