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Standard Specification for Sintered Ceramic Ferrite Permanent Magnets[1]

This standard is issued under the fixed designation A1054; 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 technically important, commercially available, magnetically hard sintered ceramic ferrite permanent magnets.

1.2 Ceramic ferrite magnets have residual magnetic induction Br from 2000 G (0.2 T) up to about 5000 G (0.5 T) and intrinsic coercive field strength H_{ci} (H_{cJ}) from 2000 Oe (160 kA/m) up to about 5000 Oe (400 kA/m). Their specific magnetic hysteresis behavior (demagnetization curve) can be characterized using Test Method A977/A977M.

1.3 The values stated in customary (cgs-emu and inch-pound) units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units which are provided for information only and are not considered standard.

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.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

A340 Terminology of Symbols and Definitions Relating to Magnetic Testing

A977/A977M Test Method for Magnetic Properties of High-Coercivity Permanent Magnet Materials Using Hysteresigraphs

2.2 *Other Standards:*

MMPA Standard No. 0100-00 Standard Specifications for Permanent Magnet Materials[3]

IEC 60404-8-1, Magnetic Materials Part 8: Specifications for individual materials Section 1 – Standard specifications for magnetically hard materials[4]

International Air Transport Association (IATA) Dangerous Goods Regulations, Packing Instruction 902[5]

3. Terminology

3.1 The terms and symbols used in this specification are defined in Terminology A340.

4. Classification

4.1 The classification of ceramic ferrite permanent magnets is given in Tables 1 and 2, with cross-reference to MMPA Standard No. 0100-00 and IEC 60404-8-1 standards.

5. Ordering Information

5.1 Orders for parts conforming to this specification shall include the following information:

5.1.1 Reference to this standard and year of issue/revision.

5.1.2 Reference to an applicable part drawing.

5.1.3 Magnetic property requirements if they are more stringent that the minimum values listed in the tables.

5.1.4 Quantity required.

5.1.5 The required magnetization state of the provided material (unmagnetized, fully magnetized, magnetized and thermally stabilized, magnetized and partially demagnetized or "calibrated"). This information should appear on the part drawing whenever possible.

5.1.6 Certification of magnetic property evaluation.

5.1.7 Marking and packaging requirements.

5.1.8 Exceptions to this specification or special requirements such as plating, coating, or functional testing as mutually agreed upon by the producer and user.

6. Chemical Composition

6.1 The general chemical composition of ceramic ferrite magnets is $MO \cdot 6Fe_2O_3$ with M being barium, strontium, or some combination of the two. New ferrite grades may also

[1] This specification is under the jurisdiction of ASTM Committee A06 on Magnetic Properties and is the direct responsibility of Subcommittee A06.02 on Material Specifications.

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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] Available from The International Magnetics Association (IMA), 8 South Michigan Avenue, Suite 1000, Chicago, IL 60603.

[4] Available from IEC (International Electrotechnical Commission) Central Office 3, rue de Varembé, P.O. Box 131, CH - 1211, GENEVA 20 Switzerland.

[5] Available from IATA, 800 Place Victoria, PO Box 113, Montréal, Quebec, H4Z 1M1.

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TABLE 1 Classification and Minimum Magnetic Property Requirements for Isotropic Sintered Ceramic Ferrite Magnets

Material					Magnetic Properties				
ASTM Designation[A]	MMPA Brief Designation	Original MMPA Class	IEC Brief Designation	IEC Code Reference	Maximum Energy Product, MGOe (kJ/m ^{3})	Remanent Induction Br, gauss (mT)	Normal Coercive Field Strength, Hc (HcB) oersted (kA/m)	Intrinsic Coercive Field Strength, H_{ci} (H_{cJ}) oersted (kA/m)	Relative Recoil Permeability, μrec G/Oe
CE-I-01	1.03/3	Ceramic 1	...	S1-0-1	1.05 (8.4)	2300 (230)	1860 (148)	3250 (259)	1.2

[A] Designations are XX-Y-ZZZ where:

XX = material type (CE = ceramic ferrite),
Y = processing and orientation (I = isotropic (non-oriented), A = anistropic (oriented)), and
ZZZ = numeric grade designation.

TABLE 2 Classification and Minimum Magnetic Property Requirements for Anisotropic Sintered Ceramic Ferrite Magnets

Material					Magnetic Properties				
ASTM Designation[A]	MMPA Brief Designation	Original MMPA Class	IEC Brief Designation	IEC Code Reference	Maximum Energy Product, MGOe (kJ/m ^{3})	Remanent Induction Br, gauss (mT)	Normal Coercive Field Strength, Hc (HcB) oersted (kA/m)	Intrinsic Coercive Field Strength, H_{ci} (H_{cJ}) oersted (kA/m)	Relative Recoil Permeability μrec G/Oe
CE-A-02	...	Ceramic 2	...	...	1.8 (14.3)	2900 (290)	2400 (191)	3000 (239)	1.1
CE-A-05	3.4/2.5	Ceramic 5	Hard ferrite 26/18	S1-1-6	3.40 (27.1)	3800 (380)	2400 (191)	2500 (199)	1.1
CE-A-06	...	Ceramic 6	...	...	2.45 (19.5)	3200 (320)	2820 (225)	3300 (263)	1.1
CE-A-07	2.7/4.0	Ceramic 7	Hard ferrite 20/28	S1-1-2	2.75 (21.9)	3400 (340)	3250 (259)	4000 (318)	1.1
CE-A-08A	3.5/3.1	Ceramic 8A	Hard ferrite 25/12	S1-1-5	3.50 (27.9)	3850 (385)	2950 (235)	3050 (243)	1.1
CE-A-08B	...	Ceramic 8B	...	...	4.12 (32.8)	4200 (420)	2913 (232)	2960 (236)	1.1
CE-A-10	...	Ceramic 10	...	...	3.82 (30.4)	4000 (400)	3510 (280)	3617 (288)	1.1
CE-A-11	...	Ceramic 11	...	...	4.32 (34.4)	4300 (430)	2512 (200)	2560 (204)	1.1
CE-A-21	3.4/3.9	...	...	...	3.40 (27.1)	3800 (380)	3400 (271)	3900 (310)	1.1
CE-A-22	4.0/2.9	...	...	...	4.00 (31.8)	4100 (410)	2800 (223)	2900 (231)	1.1
CE-A-23	3.2/4.8	...	...	...	3.20 (25.5)	3700 (370)	3500 (279)	4800 (382)	1.1
CE-A-24	3.8/4.0	...	...	...	3.80 (30.3)	4000 (400)	3560 (290)	4000 (318)	1.1

[A] Designations are XX-Y-ZZZ where:

XX = material type (CE = ceramic ferrite),
Y = processing and orientation (I = isotropic (non-oriented), A = anistropic (oriented)), and
ZZZ = numeric grade designation.

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https://standards.iteh.ai/catalog/standards/sist/93826b90-9865-406c-aceb-136de6bc3701/astm-a1054-14

include some rare earth elements. Chemical compositions listed in the tables are typical and are not guaranteed.

7. Physical and Mechanical Properties

7.1 Typical thermal properties are listed in Appendix X1.

7.2 Typical physical properties are listed in Appendix X2.

7.3 Physical density values are given for information purposes only and are not guaranteed.

7.4 Ceramic magnets are used for their magnetic characteristics. The end-use application should not rely on them for structural purposes due to low tensile and flexural strength. These materials are very brittle, and they chip and break easily.

8. Magnetic Property Requirements

8.1 Magnetic properties are listed in Tables 1 and 2.

8.2 The values of essential magnetic properties listed in the table are specified minimum values at +68F (+20C), determined after magnetizing to full saturation.

8.3 The specified values of magnetic properties are valid only for magnet test specimens with a uniform cross-section along the axis of magnetization. Properties for anisotropic (magnetically oriented) magnets are measured along the axis of preferred orientation.

8.4 Because of the nature of permanent magnet production, magnetic testing of each lot is strongly recommended, especially for applications where the magnet performance is closely specified. Such magnetic property evaluations shall be conducted in the manner described below. Where the magnet shape is not suitable for magnetic testing, a sample shall be cut from the magnet using appropriate slicing and grinding techniques, paying attention to any magnetic orientation within the magnet.

8.4.1 The magnetic properties shall be determined in accordance with Test Method A977/A977M, or by using a suitable, mutually agreed upon magnetometer.

8.4.2 When magnets are being purchased in the fully magnetized condition, the testing shall determine the magnetic properties from the as-received magnetization state, followed