



Standard Test Method for Saturation Magnetization or Induction of Nonmetallic Magnetic Materials¹

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^{ε1} NOTE—Updated 6.3 and 6.3.2 editorially in October 2011.

1. Scope

1.1 This test method covers the measurement of saturation magnetization of magnetic materials using a vibrating sample magnetometer.

1.2 Explanation of symbols and abbreviated definitions appear in the text of this test method. The official symbols and definitions are listed in Terminology A340.

1.3 The values stated in either customary (absolute (or practical) cgs-emu) units or SI units are to be regarded separately as standard. Within the text, the SI units are shown in brackets. The values stated in each system are not exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with this method.

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

¹ This test method is under the jurisdiction of ASTM Committee A06 on Magnetic Properties and is the direct responsibility of Subcommittee A06.01 on Test Methods.

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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. Summary of Test Method

3.1 The magnetic induction B , magnetic field strength H , and magnetization M in a material are related by the following equation (1):³

$$B = H + 4\pi M \text{ (cgs units)}$$

$$B = \mu_o(H + M) \text{ [SI units]}$$

3.1.1 In this test method, cgs units are given in parentheses () and SI units in square brackets [].

3.2 The magnetization M is the magnetic moment per unit volume of material. In a ferromagnetic or ferrimagnetic material, M increases with the applied magnetic field H , but at sufficiently high values of H , M approaches a constant maximum value called the *saturation magnetization* M_s (emu/cm³) or [A/m]. The corresponding value of $B - H = 4\pi M_s$ (gauss) or $B - \mu_o H = \mu_o M_s$ [tesla] is called the *saturation induction*. It is sometimes given the label B_s .

3.3 If a sphere of isotropic magnetic material is placed in a uniform magnetic field, the sphere becomes uniformly magnetized in a direction parallel to the applied field. The magnetic field in the space outside the sphere is exactly that of a magnetic dipole located at the center of the sphere and oriented parallel to the magnetization of the sphere. The strength of this magnetic dipole is equal to the total magnetic moment of the sphere, which is given by:

$$m = Mv(\text{emu}) \text{ or } [A \cdot m^2]$$

where:

v = is the volume of the sphere, (cm³) or [m³].

Section 4 describes an apparatus that provides an indication or reading proportional to the strength of this dipole field and therefore proportional to the magnetization M of the sample. If the proportionality constant between this reading and the magnetic moment can be established, and if the volume of the

³ The boldface numbers in parentheses refer to a list of references at the back of this standard.