



Standard Test Method for Measuring the Electromagnetic Shielding Effectiveness of Planar Materials¹

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1. Scope

1.1 This test method provides a procedure for measuring the electromagnetic (EM) shielding effectiveness (SE) of a planar material due to a plane-wave, far-field EM wave. From the measured data, near-field SE values may be calculated for magnetic (H) sources for electrically thin specimens.^{2,3} Electric (E) field SE values may also be calculated from this same far-field data, but their validity and applicability have not been established.

1.2 The measurement method is valid over a frequency range of 30 MHz to 1.5 GHz. These limits are not exact, but are based on decreasing displacement current due to decreased capacitive coupling at lower frequencies and on overmoding (excitation of modes other than the transverse electromagnetic mode (TEM)) at higher frequencies for the size of specimen holder described in this test method. Any number of discrete frequencies may be selected within this range. For electrically thin, isotropic materials with frequency-independent electrical properties of conductivity, permittivity and permeability, measurements may be needed at only a few frequencies as the far-field SE values will be independent of frequency. If the material is not electrically thin or if any of the parameters vary with frequency, measurements should be made at many frequencies within the band of interest.

1.3 This test method is not applicable to cables or connectors.

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:

D 1711 Terminology Relating to Electrical Insulation⁴

3. Terminology

3.1 *Definitions*—For definitions of terms used in this test method refer to Terminology D 1711.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *dynamic range (DR)*—the difference between the maximum and minimum signals measurable by the system.

3.2.1.1 *Discussion*—Measurement of materials with good SE require extra care in order to avoid contamination of extremely low power or voltage values by unwanted signals from leakage paths.

3.2.2 *electrically thin*—the thickness of the specimen is much, much ($<1/100$) less than the electrical wavelength within the specimen.

3.2.3 *far field*—that region where E and H are orthogonal to each other and also to the direction of propagation of energy.

3.2.4 *near field*—that region where E and H are not related by simple rules.

3.2.4.1 *Discussion*—The transition region between near field and far field is not abrupt, but occurs approximately $\lambda/2\pi$ from a dipole source, where λ is the free-space wave length of the frequency of the source. This concept of regions is further blurred by reradiating due to scattering by reflecting materials or objects that may be distant from the source. The interior of metallic structures often contains a mixture of near-field regions.

3.2.5 *shielding effectiveness (SE)*—the ratio of power received with and without a material present for the same incident power.

3.2.5.1 *Discussion*—It is usually expressed in decibels by the following equation:

$$SE = 10 \log \frac{P_1}{P_2} \text{ (decibels, dB)} \quad (1)$$

where:

¹ This test method is under the jurisdiction of ASTM Committee D-9 on Electrical and Electronic Insulating Materials and is the direct responsibility of Subcommittee D09.12 on Electrical Tests.

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² Wilson, P. F., and Ma, M. T., "A Study of Techniques for Measuring the Electromagnetic Shielding Effectiveness of Materials," NBS Technical Note 1095, May 1986.

³ Adams, J. W., and Vanzura, E. J., "Shielding Effectiveness Measurements of Plastics," NBSIR 85-3035, January 1986.

⁴ *Annual Book of ASTM Standards*, Vol 10.01.