# IEEE Standard Method for Measuring the Effectiveness of Electromagnetic Shielding Enclosures

## IEEE Electromagnetic Compatibility Society

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Standards Development Committee

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**Abstract:** Uniform measurement procedures and techniques are provided for determining the effectiveness of electromagnetic shielding enclosures at frequencies from 9 kHz to 18 GHz (extendable to 50 Hz and 100 GHz, respectively) for enclosures having all dimension greater than or equal to 2.0 m. The types of enclosures covered include, but are not limited to, single-shield or double-shield structures of various construction, such as bolted demountable, welded, or integral with a building; and made of materials such as steel plate, copper or aluminum sheet, screening, hardware cloth, metal foil, or shielding fabrics.
**Keywords:** electromagnetic shielding, screened rooms, shielded enclosures, shielded rooms, shielding, shielding effectiveness

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## Introduction

This introduction is not part of IEEE Std 299-2006, IEEE Standard Method for Measuring the Effectiveness of Electromagnetic Shielding Enclosures.

This document provides a standard set of methods and procedures for determining the shielding effectiveness (SE) of shielding enclosures. The enclosures of concern include those used for testing groups of equipment, vehicles, computing systems, and smaller units whose electromagnetic (EM) emission and susceptibility require determination without disturbance from other sources. This standard incorporates the basic concepts of MIL-STD-285,[a] the SE measurement reference for many years, which was cancelled by the U.S. Department of Defense in 1997. Those concepts have been expanded upon to increase the applicability of the measurement techniques to enclosures having a wide variety of applications and constructed from a large number of materials with varying methods of fabrication and assembly.

The basic premise of MIL-STD-285 is still in position: the shield effect is to provide an insertion loss to outside influence. IEEE Std 299-2006 offers testing based upon the performance specifications of the shield, rather than a fixed set of parameters that may not be applicable to the shield in question. The specific test procedures and frequency ranges are selected as appropriate for the enclosure being tested. The most important factor considered during the development of this revision was the concept that measurement of EM SE is a requirement not unique to walk-in sized enclosures. There are no widely accepted standards in use to describe test methods and techniques for measuring SE of physically small enclosures. The Standards Development Committee of the IEEE Electromagnetic Compatibility Society directed the current Working Group to plan for developing new parts of IEEE Std 299 for addressing the testing of these smaller enclosures. Thus, this document will continue to provide a standardized test method for EM shielded enclosures having all dimensions greater than or equal to 2 m. New parts of IEEE Std 299 will be developed soon to address these smaller enclosures.

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[a] MIL publications are available from Customer Service, Defense Printing Service, 700 Robbins Ave., Bldg. 4D, Philadelphia, PA 19111-5094, USA.

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## Participants

The many contributions to this standard by the members of the P299 Working Group are gratefully acknowledged. The support of the Vice Chairs, Norman Wehling (retired) and Dr. Croisant, was invaluable, as were the editing efforts of Mark Bushnell and improvements to the figures by Joseph Weibler. Professor Sarto was also extremely helpful in clarifying many of the concepts and equations.

Special appreciation is extended to Don Sweeney who served and liaison from the EMC Society Standards Development Committee and "Angel" for the project.

At the time this standard was completed, the P299 Working Group had the following membership:

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# IEEE Standard Method for Measuring the Effectiveness of Electromagnetic Shielding Enclosures

## 1. Overview

### 1.1 Scope

This standard provides uniform measurement procedures for determining the effectiveness of electromagnetic (EM) shielding enclosures at frequencies from 9 kHz to 18 GHz (extendable down to 50 Hz and up to 100 GHz).

The owner of the shielding enclosure shall provide the frequencies at which the shield will be tested, and the shielding effectiveness (SE) limits for pass/fail. This standard suggests a range of test frequencies that would provide very high confidence in the effectiveness of the shield. This standard dose not define SE limits for pass or fail.

### 1.2 Purpose

The purpose of this standard is to provide the following:

a) A standard procedure for the measurement of the effectiveness of shielded enclosures, in a broad range of radio frequencies (RFs), including a minimum set of recommended frequencies

b) Identical procedures applicable to frequencies other than the standard set

c) An optional measurement technique to detect the nonlinear behavior of high-permeability ferromagnetic enclosures (see Annex C)

### 1.3 Application

The measurement procedures provided in this standard apply to any enclosure having a smallest linear dimension greater than or equal to 2.0 m. Separate methods, to be provided in the future, shall be used for enclosures with any dimension smaller than 2.0 m.

In the case of enclosures that are to be used in anechoic or semianechoic applications, this procedure shall apply prior to the installation of any RF absorber materials.