



Standard Practice for Combined, Simulated Space Environment Testing of Thermal Control Materials with Electromagnetic and Particulate Radiation¹

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INTRODUCTION

Spacecraft thermal control coatings may be affected by exposure to the space environment to the extent that their radiative properties change and the coatings no longer control temperatures within desired limits. For some coatings, this degradation of properties occurs rapidly; others may take a long time to degrade. For the latter materials, accelerated testing is required to permit approximate determination of their properties for extended flights. The complexity of the degradation phenomena and the inability to characterize materials in terms of purity and atomic or molecular defects make laboratory exposures necessary.

It is recognized that there are various techniques of investigation that can be used in space environment testing. These range in complexity from exposure to ultraviolet radiation in the wavelength range from 50 to 400 nm, with properties measured before and after testing, to combined environmental testing using both particle and electromagnetic radiation and in situ measurements of radiative properties. Although flight testing of thermal control coatings is preferred, ground-based simulations, which use reliable test methods, are necessary for materials development. These various approaches to testing must be considered with respect to the design requirements, mission space environment, and cost.

1. Scope

1.1 This practice describes procedures for providing exposure of thermal control materials to a simulated space environment comprising the major features of vacuum, electromagnetic radiation, charged particle radiation, and temperature control.

1.2 Broad recommendations relating to spectral reflectance measurements are made.

1.3 Test parameters and other information that should be reported as an aid in interpreting test results are delineated.

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:

E 275 Practice for Describing and Measuring Performance

of Ultraviolet, Visible, and Near Infrared Spectrophotometers²

E 296 Practice for Ionization Gage Application to Space Simulators³

E 349 Terminology Relating to Space Simulation³

E 434 Test Method for Calorimetric Determination of Hemispherical Emittance and the Ratio of Solar Absorptance to Hemispherical Emittance Using Solar Simulation³

E 490 Solar Constant and Air Mass Zero Solar Spectral Irradiance Tables³

E 491 Practice for Solar Simulation for Thermal Balance Testing of Spacecraft³

E 903 Test Method for Solar Absorptance, Reflectance, and Transmittance of Materials Using Integrating Spheres⁴

3. Terminology

3.1 Definitions:

3.1.1 *absorbed dose*—the amount of energy transferred from ionizing radiation to a unit mass of irradiated material.

3.1.2 *absorbed dose versus depth*—the profile of absorbed energy versus depth into material.

¹ This practice is under the jurisdiction of ASTM Committee E-21 on Space Simulation and Applications of Space Technology and is the direct responsibility of Subcommittee E21.04 on Space Simulation and Thermal Radiation.

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² *Annual Book of ASTM Standards*, Vol 03.06.

³ *Annual Book of ASTM Standards*, Vol 15.03.

⁴ *Annual Book of ASTM Standards*, Vol 12.02.

