



## Standard Practice for Solar Simulation for Thermal Balance Testing of Spacecraft<sup>1</sup>

This standard is issued under the fixed designation E 491; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

### 1. Scope

#### 1.1 Purpose:

1.1.1 The primary purpose of this practice is to provide guidance for making adequate thermal balance tests of spacecraft and components where solar simulation has been determined to be the applicable method. Careful adherence to this document should ensure the adequate simulation of the radiation environment of space for thermal tests of space vehicles.

1.1.2 A corollary purpose is to provide the proper test environment for systems-integration tests of space vehicles. An accurate space-simulation test for thermal balance generally will provide a good environment for operating all electrical and mechanical systems in their various mission modes to determine interferences within the complete system. Although adherence to this practice will provide the correct thermal environment for this type of test, there is no discussion of the extensive electronic equipment and procedures required to support systems-integration testing.

1.2 *Nonapplicability*—This practice does not apply to or provide incomplete coverage of the following types of tests:

1.2.1 Launch phase or atmospheric reentry of space vehicles,

1.2.2 Landers on planet surfaces,

1.2.3 Degradation of thermal coatings,

1.2.4 Increased friction in space of mechanical devices, sometimes called “cold welding,”

1.2.5 Sun sensors,

1.2.6 Man in space,

1.2.7 Energy conversion devices, and

1.2.8 Tests of components for leaks, outgassing, radiation damage, or bulk thermal properties.

#### 1.3 Range of Application:

1.3.1 The extreme diversification of space-craft, design philosophies, and analytical effort makes the preparation of a brief, concise document impossible. Because of this, various spacecraft parameters are classified and related to the important characteristic of space simulators in a chart in 7.6.

1.3.2 The ultimate result of the thermal balance test is to prove the thermal design to the satisfaction of the thermal

designers. Flexibility must be provided to them to trade off additional analytical effort for simulator shortcomings. The combination of a comprehensive thermal-analytical model, modern computers, and a competent team of analysts greatly reduces the requirements for accuracy of space simulation.

1.4 *Utility*—This recommended practice will be useful during space vehicle test phases from the development through flight acceptance test. It should provide guidance for space simulation testing early in the design phase of thermal control models of subsystems and spacecraft. Flight spacecraft frequently are tested before launch. Occasionally, tests are made in a space chamber after a sister spacecraft is launched as an aid in analyzing anomalies that occur in space.

1.5 *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 259 Practice for Preparation of Pressed Powder White Reflectance Factor Transfer Standards for Hemispherical and Bi-Directional Geometries<sup>2</sup>

E 296 Practices for Ionization Gage Application to Space Simulators<sup>3</sup>

E 297 Methods for Calibrating Ionization Vacuum Gage Tubes<sup>4</sup>

E 349 Terminology Relating to Space Simulation<sup>3</sup>

#### 2.2 ISO Standard:

ISO 1000-1973 SI Units and Recommendations for the Use of Their Multiples and of Certain Other Units<sup>4</sup>

#### 2.3 American National Standards:<sup>5</sup>

ANSI Y10.18-1967 Letter Symbols for Illuminating Engineering

ANSI Z7.1-1967 Standard Nomenclature and Definitions for Illuminating Engineering

ANSI Y10.19-1969 Letter Symbols for Units Used in Science and Technology

<sup>1</sup> 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 Test Methods.

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<sup>2</sup> *Annual Book of ASTM Standards*, Vol 06.01.

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 15.03.

<sup>4</sup> Discontinued, see 1984 *Annual Book of ASTM Standards*, Vol 15.03.

<sup>5</sup> Available from the American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.