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Space systems — Thermal control coatings for spacecraft — Atomic oxygen protective coatings on polyimide film

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 14, *Space systems and operations*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document describes technical information for the selection and application of atomic oxygen protective coatings as required to confirm conformity with the requirements for the protection of polyimide film.

Satellites in low Earth orbit are bombarded by high-energy radiation particles and gas particles such as atomic oxygen (AO). In particular, AO corrodes certain materials, thereby weakening a spacecraft's exterior and potentially damaging its instruments. Polymers are significantly eroded.

Polyimide films are widely used as multilayer insulation materials on a spacecraft's exterior, which is exposed directly to the space environment. Despite these interesting properties, polyimide shows poor resistance to AO. Therefore, polyimide is often coated with an additional protective coating for resistance to AO. Such films have unique characteristics that are relevant for different applications. This document summarizes the coating properties, as well as a comparison or consideration of the pros and cons for selection.

This document provides a property map of the types of AO protective coatings available to spacecraft designers and thermal control film manufacturers. It enhances coating selection, indicates selection guidelines, and improves the reliability of spacecraft.

Requirements for coating properties and quality control are also defined, so as to eliminate defective products, improve the quality and function of films, accelerate the exchange and distribution of coating techniques, invite new providers to the market, introduce competition, and enhance international trade.

Space systems — Thermal control coatings for spacecraft — Atomic oxygen protective coatings on polyimide film

1 Scope

This document defines the general requirements for atomic oxygen (AO) protective coatings that are applied on polyimide thermal control films. It also describes the different properties of coated polyimide films such as indium tin oxide (ITO), SiO_x, germanium, and silicone, property measurement test methods, and selection guidelines.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 16378, *Space systems — Measurements of thermo-optical properties of thermal control materials*

ISO 27025:2010, *Space systems — Programme management — Quality assurance requirements*

ASTM D257, *Standard Test Methods for DC Resistance or Conductance of Insulating Materials*

ASTM E595, *Standard Test Method for Total Mass Loss and Collected Volatile Condensable Materials from Outgassing in a Vacuum Environment*

ASTM E1559, *Standard Test Method for Contamination Outgassing Characteristics of Spacecraft Materials*

ECSS-ST-Q70-02, Thermal vacuum outgassing test for the screening of space materials

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1.1
atomic oxygen
oxygen molecules separated by ultraviolet light from the sun, which are main atmospheric constituents in the range of about 200 km to 700 km

Note 1 to entry: As a spacecraft orbits the Earth at high speed, atomic oxygen can collide with the spacecraft's surface at high speed and degrade the surface material.

3.1.2
coating
continuous layer formed from a single or multiple application of a *coating material* (3.1.3) to a *substrate* (3.1.8)

[SOURCE: ISO 4618:2014, 2.50.1, modified — "continuous" has been added at the beginning.]