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NATIONAL STANDARD OF THE PEOPLE'S REPUBLIC OF CHINA

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Design requirements for atomic oxygen protection of spacecraft

航天器原子氧防护设计要求

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Foreword

This document is in accordance with the provisions of GB/T 1.1-2020 "Guidelines for Standardization Work Part

1.Structure and Drafting Rules of Standardization Documents" Drafting. Please note that some of the contents of this document may involve patents. The issuing agency of this document is not responsible for identifying patents. This document was proposed and managed by the National Aerospace Technology and Application Standardization Technical Committee (SAC/TC425). Drafting organizations of this document. Beijing Satellite Environmental Engineering Research Institute, Beijing Space Vehicle General Design Department, Shandong Xinnuo New Materials Co., Ltd. Division, China Academy of Space Technology, China Aerospace Standardization Institute. The main drafters of this document. Li Tao, Jiang Haifu, Cai Zhenbo, Liu Guoqing, Jiang Lixiang, Qu Shaojie, Zheng Huiqi, Jiao Zilong, Tang Zhenyu, Liu Xiangpeng, Zhai Ruiqiong, Wu Xianpeng, Zheng Wenxia, Xu Dongyan. Spacecraft Atomic Oxygen Protection Design Requirements

1 Scope

China's national design requirements for protecting spacecraft against atomic oxygen. It specifies the general requirements, the design process and the working instructions. Atomic oxygen is the dominant species of the residual atmosphere in low Earth orbit, produced by ultraviolet splitting molecular oxygen, and a spacecraft ploughs through it at eight kilometres a second. At that velocity each impact carries enough energy to break chemical bonds, and the effect on exposed organic materials is erosion: polyimide films, paints, adhesives and composite matrices are progressively eaten away, thinning at rates that matter over years. Silver, used in solar array interconnects, oxidises and crumbles. The remedies are coatings of silica or metal oxides that oxidise once and then protect what is beneath, and geometric design that keeps vulnerable surfaces out of the ram direction. Since the International Space Station and most Earth observation satellites fly in exactly this environment, the requirement is routine rather than exotic.

This document specifies the general requirements, design process and work instructions for the design of atomic oxygen protection for spacecraft. This document is applicable to the protection design of the spacecraft's atomic oxygen oxidation and erosion effect.

2 Normative references

The contents of the following documents constitute the indispensable clauses of this document through normative references in the text. Among them, dated quotations Only the version corresponding to that date is applicable to this document; for undated reference documents, the latest version (including all amendments) is applicable to This document.

GB/T 32452 Spacecraft Space Environment Terminology

3 Terms and definitions

The following terms and definitions defined in GB/T 32452 apply to this document.

3.1 Atomic oxygen effect In the atomic oxygen environment, the material and structural properties change.

3.2 Atomic oxygen incident angle of attack The angle between the incident direction of atomic oxygen and the surface normal of the structured object.

3.3 Windwardside The surface where the angle between the incident direction of the residual atmosphere in the space and the surface normal is between ±90°.

4.1 Basic principles

4.1.1 The principle of comprehensiveness The atomic oxygen protection design should fully cover the exposed products and materials of the spacecraft that are sensitive to the atomic oxygen environment, and the materials should be within the lifetime Meet the functional requirements of orbital atomic oxygen ablation, electricity, mechanics, optics, and heat.

4.1.2 Hierarchical principles In the whole process of spacecraft development, the basic principles should be developed from the three levels of system, sub-system/equipment (such as solar arrays, thermal control components, etc.), and materials. Sub-oxygen protection design.

4.1.3 Economic principles The design of atomic oxygen protection should consider economic cost, avoid over-design, and reduce protection cost.