

ICS 49.020
CCS V 25



**NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

GB/T 46174-2025

**Space environment - General requirements for space
environmental effect simulation tests of aerospace electronic
components**

空间环境 宇航用电子元器件空间环境效应模拟试验通用要求

Issued on: October 5, 2025

Implemented on: October 5, 2025

**Issued by: State Administration for Market Regulation;
Standardization Administration of the PRC**

Table of Contents

1	Scope	
2	Normative references	
3	Terms and Definitions	
4	Abbreviations	
5	Space Environment Effects of Aerospace Components	
6	General Rules for Ground Simulation Tests of Space Environment Effects	
7	Ground simulation test procedure for space environment effects	6
7.1	Basic Procedure for Ground Simulation Test of Space Environment Effects	6
7.2	Space Environment and Effects Analysis	6
7.3	Test Protocol Development	6
7.4	Test Implementation	7
7.5	Experimental Data Analysis and Processing	
8	Requirements for Ground Simulation Tests of Space Environmental Effects	7
8.1	Ground-based simulation experiment of total ionization dose effect	7
8.2	Ground-based simulation experiment of single-event effects	8
8.3	Ground simulation test of displacement damage effect	8
8.4	Static Electricity Sensitivity Ground Simulation Test	9
8.5	Vacuum Exhaust Ground Simulation Test	9
8.6	Vacuum cold welding simulation test	10
8.7	Low-pressure discharge ground simulation test	10
8.8	Ground Simulation Experiment of Vacuum Micro-Discharge	11
8.9	Electrical performance characterization under extreme temperatures	11
8.10	Temperature cycling and thermal shock simulation tests	11
8.11	Simulation Experiment of Atomic Oxygen Erosion Effect	12
8.12	Magnetic Test	13
8.13	Simulation Experiment of Ultraviolet Radiation Effects	
8.14	Simulation Experiment of Physical Impacts such as Space Debris	13
8.15	Simulation Experiment of Pollution Effects of Moon Dust, etc.	14
11	Rapid temperature change double-boiler method	
17	Appendix B (Informative) Classification of Device Radiation Sensitivity	
18	Ionizing radiation (total dose)	

1 Scope

GB/T 46174-2025 is the Chinese national standard covering testing a component against the space environment on the ground - the total ionising dose, the displacement damage and the single event effects, the beam and dose rate used for each, the bias and monitoring during irradiation, and the pass criteria. First edition, under the Chinese Academy of Sciences, and already in force. Issued on 5 October 2025, it has been in force since 5 October 2025.

This document establishes the space environment effects of aerospace electronic components (hereinafter referred to as "components") and ground simulation tests of space environment effects. The principles and testing procedures stipulate the testing requirements. This document applies to ground-based simulation tests of the space environment effects on electrical, electronic, electromagnetic, electromechanical, and optoelectronic components used in aerospace applications.

2 Normative references

The contents of the following documents, through normative references within the text, constitute essential provisions of this document. Dated citations are not included. For references to documents, only the version corresponding to that date applies to this document; for undated references, the latest version (including all amendments) applies. This document.

GB/T 4937.2 Mechanical and climatic testing methods for semiconductor devices - Part

3 Terms and Definitions

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

3.1 electronic components A basic unit in electronic circuits or electronic devices that performs electrical, electronic, electromagnetic, electromechanical, and optoelectronic functions. This basic unit can consist of multiple... It is composed of several parts and cannot be disassembled unless it is damaged. [Source: GB/T 32054-2015, 3.7]

8.15 Simulation Experiment of Pollution Effects of Moon Dust, etc. 14

8.16 Ground Simulation Experiment of Synergistic Effects of Multi-Factor Environment in Space

14 Appendix A (Informative) Main Spatial Environment 15 A.1 Space Radiation Environment 15 A.2 Space Plasma 16 A.3 Vacuum 16 A.4 Atmospheric Composition 17 A.5 Temperature 17 A.6 Spatial Magnetic Field

11 Rapid temperature change double-boiler method

GB/T 4937.18-2018 Mechanical and climatic testing methods for semiconductor devices - Part

17 Appendix B (Informative) Classification of Device Radiation Sensitivity

18 Appendix C (Informative) Electrostatic Sensitivity of Typical Electrostatic Sensitive Devices 22 C.1 Classification of Static Electricity Sensitivity 22 C.2 Electrostatic Sensitivity of Typical Electrostatic Sensitive Devices

22 Appendix D (Normative) Single-event effect test methods 23 D.1 Experimental Objective 23 D.2 Irradiation Source 23 D.3 Experimental Procedure for Heavy Ion or Proton Single-Particle Effects 23 D.4 Test Method for Single-Event Effect of Pulsed Laser

24 Appendix E (Informative) Vacuum Cold Welding Test Method 25 E.1 Experimental Objective 25 E.2 Test Apparatus 25 E.3 Test Procedure

25 Appendix F (Informative) Vacuum Micro-discharge Test Methods 26 F.1 Experimental Objective 26 F.2 Test Apparatus 26 F.3 Test Procedure

26 Appendix G (Informative) Test Methods for Electrical Performance Characterization under Extreme Temperature Conditions 27 G.1 Experimental Objective 27 G.2 Test Apparatus 27 G.3 Test Procedure

27 Appendix H (Informative) Test Methods for Pollution such as Lunar Dust 28 H.1 Experimental Objective 28 H.2 Test Apparatus 28 H.3 Test Procedure

28 References 29

This document complies with the provisions of GB/T 1.1-2020 "Standardization Work Guidelines Part

1. Structure and Drafting Rules of Standardization Documents". Drafting. Please note that some content in this document may involve patents. The issuing organization of this document assumes no responsibility for identifying patents. This document was proposed by the Chinese Academy of Sciences. This document is under the jurisdiction of the National Technical Committee on Standardization of Aerospace Technology and Its Applications (SAC/TC425). This document was drafted by: China Academy of Space Technology, Beijing Institute of Satellite Environmental Engineering, and Beijing Spacecraft Overall Design Department. Shenzhen Star-Ground Twin Technology Co., Ltd., Shandong Aerospace Electronic Technology Research Institute, Shanghai Space Technology Basic Research Institute, National Space Science Center of the Chinese Academy of Sciences Space Science Center, the 24th Research Institute of China Electronics Technology Group

Corporation, China Aerospace Science and Technology Corporation Commercial Satellite Co., Ltd., Harbin Institute of Technology University of Technology and Jiangsu Aolei Optoelectronics Co., Ltd. The main drafters of this document are. Yu Qingkui, Shen Zicai, Sun Yi, Wang Yue, Wu Bing, Lü He, Yu Hang, Yao Shuai, Wang Tianqi, Ni Weixing, and Wang Yang. Wang Bo, Li Changhong, Wang Qianyuan, Liu Jianli, Liu Chaoming, Wang Shijin, Zhang Guang. Space environment aerospace electronic components space environment General requirements for effect simulation experiments

18 Ionizing radiation (total dose)

GB/T 32452 Terminology for Spacecraft Space Environment

GB/T 34517 Evaluation Method for Vacuum Outgassing of Non-metallic Materials for Spacecraft

GB/T 39343 Single-event experiment design and procedure for aerospace processor devices

GB/T 41543-2022 General Specification for Simulation Test of Space Environment Effects on Space Materials

GB/T 42969-2023 Test methods for displacement damage of electronic components

GB/T 43967 Test methods for single-event pulsed lasers of semiconductor devices for space environment and aerospace applications

GB/T 44181 Method for predicting on-orbit single-event upset rate of semiconductor devices for space environment and aerospace applications

ISO 21494 Magnetic testing for space systems

IEC 60749.25 Mechanical and climatic testing methods for semiconductor devices - Part

25.Temperature cycling