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Storage requirements for satellite

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Storage requirements for satellite

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FOREWORD

The standard is translated from the Chinese version of Standard on GB/T 29082-2012 released by Standardization Administration of China (SAC) under the management of State General Administration of Quality Supervision and Inspection and Quarantine. TC 425 is responsible for the translation. In case of any doubt about the contents of English version, the Chinese original shall be considered authoritative.

This standard is drafted in accordance with rules given in GB/T 1.1-2009.

This standard is proposed by China Aerospace Science and Technology Corporation.

This standard is under the jurisdiction of National Technical Committee on Space Technology and Operation of Standardization Administration of China (SAC/TC 425).

INTRODUCTION

This standard belongs to the National Standard System of China Space. The National Standard System of China Space is applicable to the formulation, revision, and management of national standards in the field of space, covering three sectors of space management, space technology, and space application and services and serving as the basis for guiding spacecraft and launch vehicle project management, engineering, space launch services, and in-orbit satellite applications.

With the development of general satellite platform technology, on-satellite equipment, components and even subsystems are promoting the commodity-off-the-shelf (COTS) product implementation gradually. Some backup idea of on-satellite equipment had been changed from one-to-one backup for single satellite into one-to-more or more-to-more backup for several satellites. At the same time, on-satellite products are developing gradually to a batch production due to the requirements of satellite networking. Therefore, there will be more and more products facing the problem of long-period storage. In addition, in case of a sudden disaster or emergency event, it is required to launch satellites stored on ground into orbit so as to replace, supplement or perform relevant missions in the shortest time. The requirements of strategy storage need to store satellite products urgently in safety and reliability. Therefore, it is necessary to formulate the specification for satellite storage requirements in order to regulate and guide the ground storage of satellite products, improve the product ability to maintain specified product functions under specified storage conditions in specified period, and minimize any adverse effect (or loss) caused by improper storage of satellite products.

This standard is a set of comprehensive and systematical technology specification for satellite storage to explore effective services for current and future product on the basis of reviewing and summarizing the experiences, lessons and achievements of each satellite storage in China.

Due to the diversity and complexity of satellite, it is not necessary to encourage copying the requirements in the standard completely into the contract of product research and development but tailoring the standard according to specific characteristics of research and development product. It is suitable to select proper items from the standard and carry out proper applications according to the requirements in these items, strictly implement or relax these requirements, introduce them formally into contract or research/development files, become the necessary requirements in implementation, and serve the products more economically and effectively.

Storage requirements for satellite

1 Scope

This standard specifies the technical and management requirements for satellite storage.

This standard is applicable to ground storage of satellite, general electronic equipment, electrical equipment, optical equipment, solar battery array, moving parts, multi-layer insulation components and other products in satellite development.

2 Terms and definitions

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

2.1

parallel storage specimen

a specimen stored simultaneously with products to synchronously acquire product key characteristic parameters which are sensitive to storage environment and storage lifetime during the storage of optical device, solar battery array, moving parts and other products.

3 General Requirements

3.1 The agency proposing product research and development tasks shall specify product storage requirements in the product research and development assignment. The manufacturer and the user shall store products according to the requirements.

3.2 The storage mode of satellite may be divided into two types such as placing satellites directly in plant for storage (plant storage for short) and placing satellites in special packaging box for storage (packaging box storage for short).The satellite that is stored for more than three months shall be placed in packaging box.

3.3 Generally, there are four types of equipment storage modes as follows:

a) Storage by packaging box filled with nitrogen: products are placed in special packaging box for storage, and box is filled with high purity nitrogen (qualified product) and maintained with a positive pressure;

b) Storage by packaging bag filled with nitrogen: products are packaged with anti-static plastic bag, air in bag is replaced with high purity nitrogen (qualified product) and sealed and placed in a special packaging box;

c) Storage by vacuum packaging bag: products are packaged with anti-static plastic bag, sealed after vacuum pumping, and placed in a special packaging box;

d) Storage with desiccant: after being packaged with anti-static plastic bag, products are placed into a special packaging box, and desiccant is put into it according to the requirements.

A storage mode of equipment products shall be selected properly according to product characteristics. Generally, the storage modes in 3.3 a) ~3.3 c) shall be used.

3.4 Silica gel or molecular sieve desiccant that the moisture content is no more than 4% is placed in anti-static plastic bag and packaging box. Desiccant is rapped with gauze. The humidity indicator paper is used in packaging bag. After 24 hours, check and confirm the packaging bag meets the relative humidity requirements, and then go to the storage procedure.

3.5 Parallel storage specimens are selected generally from the same batch of products or components. The retest requirements of parallel storage specimens during the storage period shall be determined by product designers according to product characteristics and environment characteristics.

3.6 Set up proper environment conditions according to different products and their storage modes.

3.7 Complete periodical inspection and retest according to the requirements during the product storage period.

3.8 Complete corresponding tests according to the requirements during the product storage period.

3.9 There shall not be any effect of electromagnetic field or radiation material in warehouse or plant. There shall not be any corrosive liquid or gas.

4 Detailed requirements

4.1 Management requirements

4.1.1 During the product design period, overall considerations of product storage requirements as well as necessary tools, equipment, apparatuses etc. shall be taken.

4.1.2 The product manufacturer shall make storage plans according to storage requirements.

4.1.3 For flammable, explosive, poisonous, corrosive and radioactive products, effective measures shall be taken to ensure the safety and prevent the environment from being polluted.

4.1.4 Management requirements of quality record and transferring during product storage shall be established.

4.1.5 In product storage, marks shall be made, including the starting time for storage and the planned storage period.

4.1.6 Warehouse management systems shall be established. Qualified warehouse keepers shall check warehouse conditions periodically and make records.

4.1.7 For stored products, product storage inventory, maintenance, inspection, and testing as well as recording product storage situations shall be carried out periodically as required. Product which exceeds the storage period shall be isolated timely.

4.1.8 Test personnel shall record power-on time, power-on test result and other situations of product with electrical performance requirements in the product quality instruction.

4.1.9 Designers shall analyze and compare testing data to accumulate product reliability and stability data.

4.1.10 The information exchange during the process of product storage shall be strengthened to detect and correct potential quality problems timely.

4.1.11 Product storage requirements shall be one of the contents in product final review.

4.2 Storage requirements for satellite

4.2.1 Preparation before storage

4.2.1.1 Before storing the satellite, the storage outline (or storage technical requirements) shall be developed according to product characteristics, to specify requirements of configuration, storage environment, inspection, retest during the storage period and test, etc.

4.2.1.2 Generally, energy storage power supply, pyrotechnics, solar battery array, multi-layer insulation components, optical device, moving parts and other special products with special requirements shall be stored separately, and other products shall be stored with the satellite.

4.2.1.3 Generally, there shall be parallel storage specimen for key components of moving parts (such as expansion mechanism) stored with satellite.

4.2.1.4 Before storing the satellite, analyze and find equipment, non-metal material and others possibly exceeding the effective period in products accompanied with the satellite, and take corresponding reliability assurance measures.

4.2.2 Requirements for storage environment

4.2.2.1 Requirements for plant storage environment

Unless otherwise specified, the general requirements are shown as follows:

a) Temperature: 15℃~25℃;

b) Relative humidity: 35%~60%;

c) Cleanliness: better than level 8;

d) Gas pressure: positive.

4.2.2.2 Environment requirements for packaging box storage

4.2.2.2.1 Satellite is placed into a dedicated packaging box for storage, and the box is filled with qualified high purity nitrogen. Unless otherwise specified, the general requirements for environment of satellite in box shall be shown as follows:

a) Temperature: 15℃~25℃;

b) Relative humidity: 35%~60%;

c) Gas pressure: 500Pa~1500Pa higher than local atmospheric pressure. The packaging box shall be refilled timely when gas pressure is not 500Pa higher than local atmospheric pressure.

4.2.2.2.2 Packaging box shall be placed in a dedicated warehouse or plant, the environment requirements are shown as follows:

a) Temperature: 15℃~25℃;

b) Relative humidity shall be no more than 75%;

c) Cleanliness: clean.

4.2.3 Requirements for storage area

Requirements for storage area are shown as follows:

a) Set up a storage area with fences and warning signs around the storage position. The distance between fence and satellite or satellite packaging box shall be 2 meters at least;
b) When stored in packaging box, satellite shall be bonded with grounding stud on the dedicated packaging box of satellite through grounding wires. The dedicated packaging box of satellite shall be grounded through satellite grounding stud in plant;
c) When stored in plant, satellite shall be bonded with plant satellite grounding stud through grounding wires;
d) When satellite stored in plant, relevant personnel shall touch anti-static bar, wear anti-static clothing before going into the storage area and register the IN/OUT time.

4.2.4 Requirements for inspection and retest during the storage period

4.2.4.1 During the storage period, the environment temperature and relative humidity in plant/warehouse and the temperature, relative humidity and pressure data indicated on specified packaging box of satellite shall be checked and recorded for one time respectively in the morning and evening. If the environment conditions do not meet the specified requirements, report immediately and regulate timely.

4.2.4.2 During the storage period, retest satellite and parallel storage specimen regularly. During the retest, the environment of plant shall meet the requirements in 4.2.2.1. The interval between 2 retests shall be no more than 6 months generally.

4.2.5 Requirements for testing and test after storage

After the expiration of storage, the following operations shall be carried out:

a) Assemble equipment stored separately on satellite;
b) Carry out electric tests of satellite;
c) According to the assembly/disassembly degree and effect of products on satellite, determine whether the workmanship vibration test of satellite is implemented. The level of workmanship vibration test is 1/2 or 1/4 that of acceptance vibration test generally;
d) Continuous electrification burn-in tests shall be done under normal pressure and temperature for 72 hours;
e) If the storage period is more than 18 months, acceptance thermal vacuum tests shall be done.

4.3 Requirements for storage and retest of general electronics and electrical equipment

4.3.1 Requirements for storage environment

4.3.1.1 For product storage specified in 3.3 a)~3.3 c), the environmental requirements of warehouse for packaging box during the storage period are shown as follows:

a) Temperature: 10℃~30℃;
b) Relative humidity shall be no more than 60%;
c) Cleanliness: clean.

4.3.1.2 For product storage specified in 3.3 d), the environmental requirements of warehouse for

packaging box during the storage period are shown as follows:

a) Temperature: 15℃~25℃;

b) Relative humidity shall be no more than 60%;

c) Cleanliness: clean.

4.3.2 Requirements for retest during the storage period

4.3.2.1 For product storage specified in 3.3 a)~3.3 c), appearance inspection and electrification retest shall be carried out by opening the container every 6 months during the storage period. Both master and backup modules in the same housing shall be electrified at the same time. For equipment that master and backup modules cannot be electrified at the same time, the electrification time of master and backup modules shall be no less than 24 hours respectively. During the electrification period, test the main performance parameters of product. Test items shall generally include electrical performance test items specified by product acceptance requirements.

4.3.2.2 For product storage specified in 3.3 d), open the packaging box to carry out appearance inspection and electrification retest every three months during the storage period. Electrify and test continuously for one time every 6 months. The requirements for electrification time and test are the same as those in 4.3.2.1.

4.3.2.3 Unless otherwise specified, general requirements for test environment in electrification retest or continuous electrification inspection are shown as follows:

a) Temperature: 15℃~25℃;

b) Relative humidity: 35%~60%;

c) Cleanliness: better than level 8.

4.3.3 Requirements for test during the storage period

Acceptance thermal vacuum tests shall be done if the storage period (18 months) expires and shall be done every 18 months.

4.4 Requirements for storage of optical devices

4.4.1 Storage method

4.4.1.1 Optical devices are generally stored in the mode specified in 3.3 a).

4.4.1.2 Before packing, the optical surface shall be checked and cleaned. After cleaning, the optical surface shall be protected with protective film or dust cover according to product specifications.

4.4.1.3 Unless otherwise specified, both cleaning and packaging shall be implemented in a clean room with the cleanness higher than Level 7.

4.4.2 Requirements for retest during the storage period

During the storage period, open the packaging box to inspect appearance and retest optical devices and parallel storage specimens every 6 months. Generally, the continuous electrification time of optical devices shall be no less than 24 hours. Both master and backup servers in the same housing shall be

electrified at the same time. For any equipment that master and backup servers cannot be electrified at the same time, the electrification time of master and backup servers shall not be less than 24 hours respectively. During the electrification period, the main performance index of product shall be detected. The detection shall be implemented according to test items specified in the device storage scheme.

4.4.3 Requirements for test during the storage period

The optical devices that the storage period (18 months) expires shall be implemented with thermal vacuum acceptance tests. And the thermal vacuum acceptance test shall be repeated every 18 months.

4.5 Requirements for storage and retest of solar battery array

4.5.1 The solar battery array shall be stored in the mode specified in 3.3 a). During the storage period, requirements for warehouse environment of packaging box are shown as follows:

a) Temperature: 10℃~30℃;

b) Relative humidity shall be no more than 75%;

c) Cleanliness: clean.

4.5.2 During the storage period, open the packaging box to carry out appearance inspection and retest for parallel storage specimens every 6 months.

4.5.3 If solar battery array is stored separately for over a year, the expansion performance test shall be carried out before being assembled on satellite.

4.6 Requirements for storage of moving parts

4.6.1 Development of storage plan

When developing the storage plan of moving parts, the following items shall be considered:

a) Consider comprehensively the lubrication mode, operating mode, materials, and other factors;

b) Analyze the bearing capacity of ground gravity on friction pairs and its influences, and take effective measures;

c) For products with solid lubrication, take protections such as nitrogen filling, etc. during the storage period to prevent them from corrosion;

d) For products lubricated with grease or lubricant oil, take into account the compatibility between lubricating materials and friction pair materials.

4.6.2 Storage modes

Generally moving parts shall be stored in the modes specified in 3.3 a)~3.3 c).

4.6.3 Requirements for retest during the storage period

4.6.3.1 Inspect appearance of moving parts every 6 months, and carry out the following performance retest of these parts under normal temperature and pressure:

a) Carry out power on/off tests for 3 times at least to check the start/stop performance of moving parts;

b) Carry out the continuous operation tests for 6 hours at least, to test and check the operating

situation of moving parts, and then compare with previous tests and inspection situations.

4.6.3.2 Inspect appearance and retest parallel storage specimens every 6 months.

4.7 Requirements for storage of multi-layer insulation components

4.7.1 If multi-layer insulation components are not used for more than 15 days, store them in the mode specified in 3.3 a). If they are used in 15 days, put them temporarily into plastic bag, replace the air in bag with high purity nitrogen (qualified product), and place it on material bracket after sealing.

4.7.2 When placing multi-layer insulation components, keep them level generally. Large multi-layer insulation components may be folded in one dimension and shall not be folded in 2 or more dimensions.

4.7.3 For finished product of secondary surface mirror thermal-control coating in thin film of mask with conductive properties, roll and package it with a drum (the diameter is no less than 100 mm) to store but without folding.

4.8 Requirements for storage of other products

4.8.1 The storage of pyrotechnic device, energy storage power supply and other products shall be implemented according to relevant standards, national regulations, and specific product technology conditions.

4.8.2 The storage of products imported from abroad shall be implemented according to corresponding technical specifications.