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Salt fog test methods for manned spacecraft materials

载人航天器用材料盐雾试验方法

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Foreword

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 is under the jurisdiction of the National Manned Spaceflight Standardization Technical Committee (SAC/TC570). This document was drafted by: China Academy of Space Technology, University of Science and Technology Beijing, Beijing Spacecraft Overall Design Department, and Beijing Space Technology. Information Institute, Guangdong Corrosion Science and Technology Innovation Research Institute, and Zhongkexin Engineering Consulting (Beijing) Co., Ltd. The main drafters of this document are: Wang Xiangke, Wang Xudong, Xing Yan, Liu Gang, Yu Xiangtian, Qi Yue, Li Yan, Huang Jinying, Wang Xu, Liu Dan, and Wang Yang. Wu Bing, Niu Hu, Liu Jingyu, Wang Yanan, Li Miao, Li Jin, An Jing, Huo Jiajing, Li Jiang. Salt spray test methods for materials used in manned spacecraft

1. Scope This document specifies the purpose, test items, test requirements, test conditions and procedures, and test evaluation for salt spray environment testing of materials used in manned spacecraft. Price and test report. This document applies to the identification and evaluation of materials used in manned spacecraft that undergo salt spray testing during spacecraft transportation, loading, unloading, temporary storage, and launch. The effects of corrosive environments encountered during operation on materials. Other materials used in spacecraft should refer to this guide.

3. Terms and Definitions This document does not contain any terms or definitions that need

to be defined.

4. Experimental Objective Laboratory salt spray tests provide data support for evaluating the corrosion resistance of materials used in manned spacecraft.

5. Test Items Based on the corrosive environmental conditions that materials used in manned spacecraft may experience throughout their entire life cycle, the salt spray test project is divided into exposure to... Coastal (atmospheric) environmental salt spray test, exposure to indoor/uncontrolled environmental salt spray test, and exposure to temperature and humidity controlled environmental salt spray test Three categories were tested.

a) Salt spray test for exposure to coastal (atmospheric) environment. used to test the effects of direct contact with the outdoor coastal (atmospheric) environment without protection. Corrosion resistance of materials under contact conditions, such as materials for products launched at sea and outdoors at the Wenchang Satellite Launch Center.

b) Exposure to indoor/uncontrolled environmental salt spray test. used to test indoor environmental conditions without temperature and humidity control in coastal areas. The corrosion resistance of materials, such as those used in products manufactured in the Wenchang Satellite Launch Center's uncontrolled temperature and humidity workshop.

c) Salt spray test under temperature and humidity controlled environment. used to test materials under temperature and humidity controlled indoor environmental conditions in coastal areas. The corrosion resistance of materials, such as those used in products manufactured in temperature and humidity controlled workshops and fairings at the Wenchang Satellite Launch Center.

6.1 Determination of Test Items

6.1.1 Salt spray testing of materials should be conducted according to the environmental conditions experienced by the materials throughout their entire life cycle. Project. When spacecraft materials need to undergo multiple types of salt spray tests, the sequence of corrosive environments the materials experience during the mission should be determined. The order of salt spray test items.

6.1.2 The three types of test items are ranked from highest to lowest according to the severity of the test conditions. exposure to coastal (atmospheric) salt spray test Salt spray test in indoor/uncontrolled humidity environment, and salt spray test in temperature and humidity controlled environment. If the specimen can pass the stringent requirements... For high-severity testing projects, low-severity testing projects may be omitted.

6.2 Specimen Requirements

6.2.1 The type, quantity, shape, and size of the test specimens shall be selected according to the relevant specifications for the tested material. If no specifications exist, the testing

party and the commissioning party shall determine the appropriate selection. The agreement was reached through consultation between the parties.

6.2.2 The surface of the specimen should be free of contaminants that could cause the surface water film to break, such as oil, grease, or dirt (dust), and should be free of scratches and oxidation discoloration. defect.

6.2.3 The specimen should be thoroughly cleaned before the test. The cleaning method depends on the properties of the specimen material. The surface of the specimen and its contaminants should not be cleaned using [specific cleaning methods]. Abrasives or solvents that may corrode the surface of the specimen.

6.3 Requirements for Test Equipment The requirements for the test equipment are as follows:

- a) The salt spray chamber should have the capability to perform combined tests of salt spray, humidification, and drying.
- b) The materials used in the manufacture of the testing equipment, salt spray chamber, temperature control device, spraying device, salt spray collector, etc., shall comply with GB/T 10125. Regulation.
- c) The temperature and humidity chamber should meet the following requirements. 1) The constant temperature and humidity chamber can conduct constant humidity and heat tests for no less than 30 days, during which the temperature can be controlled at $(30 \pm 2)^{\circ}\text{C}$ and the relative humidity... It can be controlled within $(60 \pm 10)\%$; 2) Use temperature and humidity sensors placed in the workspace to monitor the temperature and relative humidity inside the test chamber; 3) Condensate should be continuously drained from the test chamber; the chamber should not be used again without purification. 4) The resistivity of the water used as the moisture source in the constant temperature and humidity chamber should not be less than $500 \Omega \cdot \text{m}$; 5) The temperature and humidity in the workspace should be uniform and consistent with the conditions near the monitoring sensors; 6) The electrical load on the test specimen should not significantly affect the conditions inside the test chamber; 7) Condensation on the walls and top of the constant temperature and humidity chamber should not drip onto the test specimens.

6.4 Laboratory Environmental Requirements Laboratory environments generally meet the following requirements.

- a) Temperature. $15^{\circ}\text{C} \sim 35^{\circ}\text{C}$;
- b) Relative humidity. $20\% \sim 80\%$;
- c) Atmospheric pressure. $78 \text{ kPa} \sim 103 \text{ kPa}$.

7.1 Salt spray test for exposure to coastal (atmospheric) environment

7.1.1 Test Conditions The experimental conditions are as follows:

a) The concentration (mass fraction) of the NaCl solution used in the experiment was $(5\pm 1)\%$, and the preparation method was as follows: 1) NaCl of chemical purity or higher should be used for preparation; 2) The pH value of the precipitated NaCl solution collected in the salt spray chamber should be maintained at 6.5~

7.2 at a temperature of $(35\pm 2)^{\circ}\text{C}$; 3) The pH value should be adjusted using chemically pure or higher-purity hydrochloric acid or sodium hydroxide; 4) pH value can be measured by electrochemical or colorimetric methods.

b) Salt spray deposition rate is 1 mL/(80 cm²·h) to 3 mL/(80 cm²·h).

7.1.2 Test Procedure The experimental steps are as follows:

a) Before the test, the appearance of the specimen should be checked and photographed.

b) Inject the NaCl solution that meets the requirements of 7.1.1a) into the salt spray chamber, ensuring that the NaCl solution remains at the lowest possible level in the salt spray chamber throughout the experiment. Above the small scale line.

c) Place the test specimens face up in the salt spray chamber, with the test surface at an angle of 15° to 30° to the vertical, ensuring that the specimens do not obstruct each other. For non- The specimens for the test should closely resemble the above-mentioned specifications.

d) Adjust the temperature inside the salt spray chamber to $(35\pm 2)^{\circ}\text{C}$ and keep it at that temperature for at least 2 hours.

e) Spray salt spray for 24 hours, during which the temperature inside the salt spray chamber is $(35\pm 2)^{\circ}\text{C}$.

f) The salt spray chamber automatically switches to a drying state and maintains this state for 24 hours. During this period, the temperature inside the salt spray chamber is $(35\pm 2)^{\circ}\text{C}$, completing one cycle.

f) until a total of 2 cycles are completed. The cycle period of the test can be adjusted according to the actual conditions of the test material or product. Sure.

7.2 Salt spray test in indoor/uncontrolled environment

7.2.1 Test Conditions The test conditions are as follows:

a) The concentration (mass fraction) of the NaCl solution used in the experiment was $(0.8\pm 0.1)\%$, prepared using the same method as 7.1.1a);

b) Salt spray deposition rate is 1 mL/(80 cm²·h) to 3 mL/(80 cm²·h).

7.2.2 Test Procedure The experimental steps are as follows: