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Discussion on seawater test method of Internet of things communication equipment

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Abstract: Based on the practical application environment, this paper puts forward a seawater test method for the Internet of Things communication equipment applied in the Marine environment. The verification through the test and the suggestions and suggestions for the problems found in the test. Finally, the advantages of the seawater test are introduced and compared with the salt spray test.

Keywords: sea water test; marine environment; test steps; salt spray test

1. Introduction

At present, with the increasing of Marine development and continuous investment in Marine communication equipment, the influence of seawater and Marine environment on communication equipment has become an urgent topic of research. There are some differences between the immersion test of seawater and that of laboratory due to the influence of external conditions such as wind wave and sea water velocity. Therefore, it is of great significance to study the influence of seawater immersion on communication equipment and its accessories, and to work out a set of seawater immersion test methods according to the test situation to improve the environmental adaptability and reliability of communication equipment, as well as to understand the influence of seawater on communication equipment during operations such as armed swimming and sea training.

2. Seawater test procedure

Seawater will cause corrosion to metal materials and their products. It is of important research significance to study the influence of this property on the new generation of field Internet of Things communication equipment and its accessories, improve the environmental adaptability and reliability of Internet of Things communication equipment, and understand the possible impact of such actions as armed swimming and sea training.

1) Test contents

a) Seawater impregnation of knapsack Internet of Things communication equipment and accessories;

b) The antenna and base of the Internet of Things communication equipment on the vehicle are impregnated with seawater (only the parts exposed outside the vehicle body are considered here).

2) Test site.

The tropical coastal area of Hainan. The typical sea area is the South China Sea, where the average surface temperature is 10-35 ℃ and the maximum surface salinity is 37‰.

3) Environmental monitoring projects

During the test, external environmental factors such as solar radiation intensity, air humidity, wind speed, precipitation (time, amount), sea water (surface temperature, maximum surface salinity, ocean wave, surface velocity of ocean current) and so on were recorded.

4) Test time

The time is generally chosen between May and October, from 11 p.m. to 4 p.m., when the temperature in Hainan is the highest value of the year, which is conducive to better triggering faults.

5) Immersion depth

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The coverage depth of the backpack Internet of Things communication equipment and its accessories is 0.2m ~ 0.3m. This value takes into account the application conditions of armed swimming and landing operations, and the depth does not take into account the accident of the Internet of things communication equipment falling into the sea.

The vehicle antenna and base are covered to a depth of 1m. This figure takes into account the application conditions of tanks and armoured vehicles in deep water and the impact of waves on this.

6) Impregnation time

The wading time of backpack and handheld is 30mins, and the wading time of vehicle is 1h. In order to test how long the product will fail after immersion in seawater, multiple groups of iot communication devices will be dipped for different times, and multiple observations will be made to count the test time until the product fails partially or completely.

7) Working state of the specimen

Since the expected actual application environment is unknown, static (Internet of Things communication equipment works without power supply) and dynamic (Internet of Things communication equipment works with power supply supply) tests can be considered. Before the test, whether this method will cause harm to Internet of Things communication equipment or human body should be considered.

8) Sample quantity

In order to analyze the test effect, it is suggested to select the same batch of Internet of Things communication equipment for the test sample, the number should be no less than 3, one of which is used as the sealing sample.

9) Test preparation

a) Equipment installation.

The backpack type Internet of Things communication equipment and its accessories are installed on the back frame, and the vehicle antenna and antenna base are fixed on the test bracket. During the test, the samples can be placed in the offshore position through the test support (this method may be affected by the tide and the immersion depth may change), or can be suspended under the floating row by ropes.

b) Test records.

Prepare records of environmental monitoring, electrical performance indicators and functional appearance.

The contents of the environmental monitoring record form include: time, date, solar radiation intensity, seawater surface air humidity, seawater temperature, salinity, flow rate, tester's signature and auditor's signature.

Electrical performance indicators include: measurement of main indicators of Internet of Things communication equipment and accessories.

The functional appearance record sheet includes: the integrity and functional realization of the surface of the Internet of Things communication equipment and accessories.

c) Pretreatment

Before wading into water, cover the waterproof or dust-proof caps that come with the interfaces of Internet of Things communication devices and batteries.

10) Test implementation

a) Initial detection

Before installing the equipment to the test bracket, test and record the items required in the test records.

b) Test process

Step 1: Install the Internet of Things communication equipment on the test bracket and put it on the beach for 1 hour to make the surface temperature of the Internet of Things communication equipment and seawater temperature to form a certain temperature difference. Then put the test samples into the sea and record the environmental indicators;

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Step 2: Under the condition of ensuring personal safety, the Internet of Things communication equipment should be turned on for communication test (for the sake of safety, this item can be omitted).

Step 3: Keep the Internet of Things communication equipment off. After placing the Internet of Things communication equipment and its antenna in seawater for 1h, take the Internet of Things communication equipment out of the seawater. One of the Internet of Things communication equipment shall be washed with fresh water immediately, while the other one shall not be washed with fresh water.

11) Result analysis

After the test, it is necessary to evaluate the short-term and long-term effects of seawater on the Internet of Things communication equipment and its accessories, and consider whether to conduct the failure rule test based on the test data and actual task analysis.

3. Analysis of experimental results and suggestions

Figure 1 Seawater immersion test of the back-negative equipment

Figure 2 SeaWater maceration experiment for vehicle-mounted equipment

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Figure 3, Figure 4 seawater maceration experiment of battery of carrying equipment1

1)Test conclusion

a) The host of the Internet of Things communication equipment is not flooded, and the indicators and functions are normal after the test.

b) There was water at the battery interface of short and ultrashort wave. After the test sample was placed for one day, the positive terminal interface of an ultrashort wave Internet of Things communication device (impregnated for 2 hours) showed slight corrosion, and the band knob switch showed corrosion.

c) Corrosion occurs in the contact surface between the antenna segment and the antenna segment of all whip antennas.

d) The charging interfaces of two 12V NIMH battery packs are corroded.

2)Suggestions

a) When considering the waterproof requirements of the equipment, in addition to the waterproof requirements for the equipment itself, the waterproof performance of the supporting equipment should also be taken into account. For example, the Internet of Things communication equipment is mainly waterproof, but in practical application, in the case of water crossing, the Internet of Things communication equipment supporting equipment, such as batteries, antennas and other equipment also need to be waterproof. Therefore, it is recommended that the equipment with waterproof requirements should also consider the same environmental conditions as the main engine when selecting its accessories.

b) According to the test results, due to the corrosive nature of seawater, it is necessary to timely clean the equipment after soaking in seawater to remove the salt on the surface of the equipment.

c) It is suggested that in the design and development stage of the product, for the equipment applied in the Marine environment, the impregnation protection of the equipment should be considered, so that the equipment can be well waterproof protection under the condition of armed swimming.

4. Advantages of seawater experiment and differences with salt spray experiment

Seawater test is a kind of natural environment test, the purpose is to test the equipment in the natural environmental conditions of the ocean adaptability. Compared with environmental tests conducted in the laboratory, natural environmental tests have the following advantages:

1) Compared with the environmental test in the environmental laboratory, the recommended method is the natural environment test. Only when the natural environment test cannot meet the requirements can the simulation test in the environmental laboratory be considered. The simulation test of environmental laboratory can only simulate the environment and indicators under natural

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environmental conditions as far as possible, but it can not completely replace the natural environment test. The test principle and test method of environmental laboratory are derived from the natural environment test, and the test conditions and grades should be selected according to the use scenario of the equipment and the measurement value of the specific environment. Only when the natural environment test conditions are not available or it is not convenient to carry out the simulation test of environmental laboratory is recommended.

2) Some indicators of seawater test cannot be simulated in the environmental laboratory, such as seawater composition, flow rate, temperature and impact effect of seawater on equipment in the test, which cannot be simulated in the environmental laboratory. Therefore, the simulation test in the environmental laboratory cannot completely replace the natural environment test, which will lead to the phenomenon that some environmental laboratories pass the assessment but will fail in the actual use environment.

3) The test conditions of environmental laboratory are regulated by national standards and military standards, and the test conditions are relatively fixed. However, due to the different geographical locations of Marine climate in different places, the different composition of sea water, the different flow rate of sea water and other factors, it is impossible to use a unified standard to completely simulate the Marine climate conditions in different areas. And the standards that have been developed are based on measurements taken years ago that, over time, do not necessarily capture the current situation. Therefore, the natural environment test data conducted according to different use scenarios of the equipment are more reliable, can better reflect the problems exposed by the use of the equipment in this environment, and have more value for promotion and application.

Compared with the standard salt spray experiment, the two have the following differences:

1) Different experimental environment: Compared with the salt spray experiment, the test method proposed in this paper belongs to the category of natural environment test, and compared with the salt spray and other environmental tests conducted in environmental laboratories, it belongs to two different test methods.

2) Different purposes of the experiment: the test method introduced in this paper is to investigate the capability of the equipment to prevent seawater immersion and to evaluate the short - and long-term effects of seawater on the communication equipment and its accessories. The salt spray test is to see the protective ability of the equipment's constituent materials to salt spray, and the experimental purpose and examination content of the two are different.

3) Different experimental methods: Since the salt spray test is carried out in the laboratory, the temperature of the test chamber can be controlled and adjusted to the desired temperature (such as 35 degrees). However, in the seawater test proposed in this paper, it is impossible to control the seawater temperature, velocity, salt and other indicators, so the above indicators can only be truthfully recorded before and during the test, and the influence of the above indicators on the experimental results can be compared.

5. Conclusion

This paper introduces the purpose and significance of seawater test, the specific implementation methods and steps, through the test found the problems and give the relevant opinions and suggestions. With the increasing efforts of ocean development, more and more Internet of Things devices are playing an increasingly important role in ocean detection, ocean perception and information transmission. Therefore, it has become an urgent task to study the test methods and organize the implementation of environmental tests under natural conditions such as oceans.

References

[1] Qiangying Zhang , Chi Zhang GB/T2421-2007. General Rules for Environmental Testing of Electrical and Electronic Products. Beijing: Standards Press of China, 2007.12

ISSN:2790-1688 DOI: 10.56028/aetr.3.1.351
[2] Commission of Science, Technology and Industry for National Defense GJB150A-2009. Environmental Test Methods for Military Equipment. Beijing: Published by Standardization Institute of Ministry of Electronics Industry, 2009.12

[3] General Equipment Department of PLA GJB367A-2001 General Specification for Military Communication Equipment Beijing: Standards Press of China, 2001.05

[4] Guowei He , Reliability Test Technology [M], Beijing: National Defense Press 2003.03