8/11/2009
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CONDITIONS THAT GIVE RISE TO THE NEED FOR ENVIRONMENTAL SIMULATION TESTING

INTRODUCTION

It is widely understood that **environmental simulation testing** is necessary to certify that equipment is capable of withstanding extreme conditions such as found in the desert, in the tropics, aboard marine vessels and aircraft, exposure to solar radiation, high humidity, and extreme hot and cold temperatures.

There exist a great number of commercial and military specifications which cover a wide range of environmental test requirements. However what is often not known or well understood are the actual environmental conditions that give rise to the need for such testing. The following paragraphs present a discussion of some of these environments.

SALT ATMOSPHERE

The oceans are the world's primary source of salt. The salt solutions of the oceans range from 3.5 to 3.9 %. Also winds over the oceans surfaces carry anywhere from 10 to 100 pounds of salt per cubic mile of air. Salts such as sodium chloride, potassium chloride, and calcium and magnesium are highly soluble in water and form strong electrolytes. As a result marine environments are highly corrosive and readily attack many different materials.

To certify that materials can withstand the marine environment salt chambers subject equipment, typically to a 5% salt solution with water temperatures of 95 degrees F.

SAND AND DUST

Extreme sand and dust conditions are found in industrial areas, deserts, and other areas where there has been little or no rainfall. Sand and dust can be extreme problems during blowing wind conditions since it can penetrate even sealed equipment as well as internal portions of aircraft. Blowing sand can be found at elevations as high as 10,000 feet. Sand and dust chambers can develop wind velocities of 300 to 1750 ft/min for dust and 3500 to 5000 ft/min for sand, and can handle various grades of sand such as found in different parts of the world.

SOLAR RADIATION

Organic and synthetic materials are strongly affected by ultraviolet and infrared solar radiation. Rubber deteriorates, plastics darken, polymers lose strength and toughness, and colors fade. The greatest solar radiation occurs in the tropics, but can occur in temperate zones under certain conditions. Also solar heat loads can have an adverse effect on equipment operation. Both full spectrum solar and heat loads can be simulated in the laboratory.

HUMIDITY

Non-metallic materials absorb some moisture, which cause changes in electrical properties. High humidity in combination with other conditions, i.e., salt-air and high temperature, offers significant problems in corrosion control. Relative humidity of up to 100% and temperatures exceeding 85 degrees F require measures to prevent corrosion. Humidity testing is performed by maintaining a relative humidity of 95% while cycling through various temperatures.

FUNGUS

Fungi are a class of microorganisms that feed on organic material such as printed circuit boards, lubricants, and

greases. The ideal growth conditions for fungi are temperatures between 68 and 104 degrees F and relative humidity between 85 and 100%. Fungus chambers incubate fungi by maintaining a typical temperature of 86 degrees F and 90-100% relative humidity.

TEMPERATURE

Extremes of temperature can effect equipment operation. Also rates of corrosion, fungus growth, and moisture condensation vary at different temperatures. Temperature chambers can operate at a range of –80 to 1200 degrees C (-112 to 2192 F), although the typical range is –70 to 177 degrees C (-94 to 351 F).

CONCLUSION

The proper choice of materials and the application of appropriate protective coatings will ensure that corrosion and degradation will be held to a minimum. To ensure that the proper materials and protective coatings have been utilized **environmental simulation testing** should be performed.