WHITE PAPER

Mixed Flowing Gas Corrosion Testing

NTS

Accelerated Aging with Mixed Flowing Gases

How can you accurately predict the condition and performance of your product several years into the future? With a mixed flowing gas (MFG) test, you can accelerate the aging process of your product to assess the effects of long-term exposure to atmospheric pollutants. As a result, you can use the MFG test to determine how your product will age over the next 10 or 20 years—and you can make this assessment over the course of a handful of days.

THE MFG CORROSION TEST

The MFG corrosion test is used to accelerate aging for electronic products and components. To conduct the MFG test, engineers use a combination of temperature, relative humidity, gaseous pollutants, and a variety of relevant variables to simulate the environment to which a product is exposed over time. The test setup typically involves a climatic chamber along with a gas delivery system.

The corrosion is due to atmospheric exposure—and it can be predicted based on the type, volume, and duration of gases excreted in the chamber. The exact mix of gases and other variables are dependent up client requirements. The most common test conditions for MFG, however, include a temperature of 30°C and a relative humidity of 70% or a temperature of 25°C and a relative humidity of 75%. The most common gases excreted into the chamber consist of a combination of nitrogen dioxide (NO_2), sulfur dioxide (SO_2), hydrogen sulfide (H_2S), and chorine (Cl_2).

To ensure the integrity of the test, engineers use copper or gold-pated coupons in conjunction with the test article. When the test article is placed into the chamber, the corresponding copper coupons are placed along side it. Regardless of the test duration, the copper coupons are often weighed on a micro balance after four days of exposure when testing according to IEC 60068-2-60 or five days when testing to GR-63-CORE. By measuring the rate of corrosion on the coupons, engineers are able to determine how the test product will age over time with a greater degree of accuracy.

A full day is usually required for the initial setup and the exposure duration is typically 14 days, depending on the industry and product type. Additional common setups include 10 day exposures for various electronics—and and in some cases 21 days. Each day the test runs, engineers are able to extrapolate exposure in terms of years. A test that runs for 10 days can simulate product aging of 15 years, for example.

INDUSTRY STANDARDS

Accelerated aging is important for a variety of industries, including automotive, telecommunications, aerospace, defense, industrial, medical, and consumer electronics. With a wide range of industries that require MFG testing, different customers might require testing to different standards. The most common standards to which customers test to assess the effects of atmospheric pollutants include the following:

- **IEC 60068-2-60**
  According the International Electrotechnical Commission (IEC), the standard "determines the corrosive influence of operating and storage indoor environments on electrotechnical products components, equipment and materials, particularly contacts and connections, considered separately, integrated into a subassembly or assembled as a complete equipment."

- **Telcordia GR-63-CORE**
  The Telecordia General Requirement for 63-Core pertains to the physical protection for Network Equipment-Building System Requirements (NEBS).

- **ASTM B845-97**
  ASTM International describes the standard as evaluating "devices containing electrical contacts such as slip rings, separable connectors, electromechanical relays or switch contacts."

- **EIA-364-65B**
  The Electronic Components Industry Association (EIA) this standard as establishing "establishes the test procedure for producing environmentally related corrosive atmospheres to determine the reaction of plated or unplated surfaces when exposed to different concentrations of flowing gas mixtures."

The test standard a customer uses is dependent upon a variety of factors, including the type of product, performance criteria, product durability, and the industry in which the product is used. The industry plays an important role for meeting specific standards and for complementing MFG testing with related tests. As an example, MFG testing on telecommunications equipment represent only one of a variety of reliability tests, which include EMC/EMC, temperature, altitude, earthquake, and others to assess the integrity, durability, and performance with the highest degree of technical accuracy.

USE CASES

As referenced above, MFG testing is relevant in a variety of industries. As a result, there are a wide range of use cases available for MFG testing. Since the testing accelerates corrosion in electronics, any product that contains electric components that are expected to be exposed to atmospheric gases can benefit from MFG testing. Common products include smart phones, laptops, fiber optics, medical devices, and a wide range of other products. At the same time, however MFG testing has far-reaching implications. At NTS, for example, engineers have performed MFG testing on everything from Tesla Model S battery packs to a SpaceX Starlink antennae.

TAKE ACTION

When planning for testing, it is important to ensure that only the areas of the device that are normally exposed to atmospheric phenomenon. A common mistake is unnecessary testing for areas of a device that are unlikely to be exposed to the environment that leads to corrosion. In addition, it is important to schedule testing in accordance with your product delivery time line. As a result, starting a conversation with a test engineer earlier in the process can be beneficial. As the worldwide leader in testing, inspection, and certification, take a moment to speak with a trusted expert at NTS.

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