

Salt Fog Testing

It is over seventy years since the specifications of the neutral salt fog test were first defined by ASTM B117 in 1939. American Society of Testing and Materials method B117 is the standard salt fog environmental test used for accelerated corrosion testing of materials. ASTM B117 is the universal international salt fog test method and the conditions of the test have been widely written into many national standards and industry codes. The conditions of the B117 test method produce an environment containing a salt fog that reacts with exposed specimens. The salt fog method is commonly called salt spray or salt mist testing, however these names are a misnomer as the environment that exists in the test chamber is a strictly controlled salt fog. ASTM B117 formalised the details of the salt fog test in a reproducible format. Salt fog testing had existed in various forms from 1914, however the parameters of the ad-hoc test methods and procedures varied significantly and it was difficult to compare the results of salt fog testing from the variety of methods used by laboratories.

The salt fog chamber is a device to expose samples to an environment of droplets of warm saline solution for a continuous test period. The samples are contacted by chloride ions, oxygen and water. Add elevated temperature to these three components and you have a seriously corrosive environment for any metal surface. ASTM B117 defines the essential parameters of the neutral salt fog test as follows.

- 5% sodium chloride solution
- Solution pH 6.5 to 7.2
- Specific gravity 1.0255 to 1.0400 g/cm³
- Salt < 0.3% impurities
- Chamber and solution atomisation temperature 35°C
- Fog collection rate 1 to 2 ml/hr/80mm²
- Fog homogeneity
- Details of permissible solution contamination
- Details of chamber conditions and sample exposure

The ASTM B117 salt fog test method is suitable for metallic samples, with and without metallic and/or non-metallic surface coatings, films and treatments. The test method does not define the exposure times for specimens. The test method does not define the process of assessing the exposed samples for corrosion and coating damage. Exposure times and sample assessment are set out in applicable product specifications.

Salt fog testing is used extensively for automotive, building, structural and externally exposed components. The method is primarily used to evaluate the relative corrosion resistance of coated or treated surfaces. Product specification exposure and assessment conditions may be specific to the component or generic specifications. The product specifications defining the test exposure time and sample assessment are often Original Equipment Manufacturing (OEM) protocols based on extensive testing, in particular testing of components and materials under a range of external environmental conditions. Exposure times can range from as little as 8 hours up to in some cases 10,000 hours.



Surface corrosion and zinc oxidation on galvanised steel after exposure to 1000 hours of salt fog.



Corrosion of untreated steel ball. Salt fog exposure 240 hours.

Painted steel component after exposure to 100 hours of salt fog. Coating has failed in grooves.



Condition of test panel after exposure to salt fog for 1000 hours. Steel coated with zinc. Note edge preparation.



Corrosion damage on stainless steel, painted steel and galvanized steel surfaces after exposure to 500 hours of salt fog.



Corrosion failure on steel component coated with inorganic zinc. Total salt fog exposure 240 hrs.

Exposure times are specific to coating thickness and surface treatment type.

The question is often asked "What is the acceleration of salt fog testing against exposure in the natural environment?" Exposure time in the salt fog chamber cannot be converted to an accelerated exposure time in the field. There is no comparison or correlation between time in the test

chamber and real time in the field. Field conditions vary widely from dry desert atmospheres with no salt exposure and minimal moisture contact, to constant wet marine conditions. In fact it is possible that some marine conditions on exposed surf beaches are equivalent to salt fog testing on a 1:1 basis.

In general the product specifications, in particular OEM specifications, rely

on historical trials that identify a salt fog exposure time that assesses whether the component will survive in the external environment for an acceptable period of time. A cynic might say an acceptable period of time is warranty plus one day, however the pragmatist will realise that the wide range of possible external operating conditions will mean that some components are used in very aggressive conditions and others operate in moderate or mild environments. The responsibility of the component manufacturer is to find or develop a product specification that offers acceptable results after a reasonable exposure period.

Salt fog testing is not an exact replication of natural environment exposure. The continual wetting of the test surface may not allow passive films to form. For this reason cycle corrosion testing has been developed to more closely represent natural exposure. Cyclic testing includes periods of salt fog, dry and humidity. The basic neutral salt fog test B117 can also be modified by changing the chemistry of the salt solutions. The most common modifications to the method are G85 acetic acid salt spray test (ASS) and B368 acetic acid with copper chloride salt spray test (CASS). The modified methods are primarily used for the rapid testing of chromium plating.

Great care should be taken in handling specimens supplied for salt fog testing. It is no use expecting an acceptable result by grabbing a hand full of components from a production bin, dropping them in an air mail bag, and sending the samples to the test laboratory. The condition of the surface of the samples prior to testing is critical to the ultimate outcome of the test. Separating and individually wrapping specimens is recommended.

Salt fog testing to ASTM B117 is a common corrosion test method because it is cheap, quick, well standardized and repeatable. Salt fog test is widely used in industry for the evaluation of corrosion resistance of coated and treated surfaces on components. The qualification is that there is a poor correlation between the exposure in salt fog chamber and the external operation of a coating. As you are all aware surface corrosion reactions are a complicated process and are influenced by many external factors.

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