



SURFACE VEHICLE RECOMMENDED PRACTICE

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Filiform Corrosion Test Procedure for Painted Aluminum Wheels and Painted Aluminum Wheel Trim

RATIONALE

This document has been updated to improve the procedure based on feedback from users. Clarity and process learning are incorporated. An example data sheet is provided as well as an example master panel to facilitate the use of image analysis to the measurement process.

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1. SCOPE

This test procedure defines a laboratory procedure for generating and evaluating filiform corrosion on painted aluminum wheels and painted aluminum wheel trim.

While this test was developed specifically for the testing of painted aluminum wheels and wheel trim, it may be applicable to other components. The application owner will need to assess if this test generates filiform similar to that found in the relevant usage to ensure it will provide accurate data for the application.

1.1 Purpose

To establish a uniform test method for the wheel and wheel trim industry when assessing the resistance of components to filiform corrosion. An objective is to reduce test procedure proliferation and thereby reduce costs for establishing and maintaining unique test facilities, test methods, measurement methods, laboratory accreditations, and operator training. The net effect is to reduce cost while improving the quality of the test data by adopting uniform and standardized test methods. The procedure does not establish performance standards for the components. Performance standards are to be established by the users of the test and/or their clients. The method and format for documenting proficiency is defined.

1.2 Overview

Filiform corrosion is generated by exposing a coated substrate to a warm, humid environment. This filiform test procedure utilizes the SAE J2634 scribing method to ensure consistent exposure of the sample substrate to the corrosion products. The test part is inoculated with corrosion products by using ASTM B368-97 (2003)^{e1} followed by an immersion in de-ionized (DI) water to remove excess corrosion products and then placed in a temperature and humidity controlled test cabinet to initiate the formation of filiform corrosion. Posttest evaluations of length of filiform filament growth, density of filaments, and area of filiform growth can be assessed to evaluate the corrosion resistance of the component.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

SAE J2634 Scribing of Coatings in Preparation for Testing of Wheels and Wheel Trim

SAE J2636 Corrosion Test Master Establishment

2.1.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM B368-97 (2003)^{e1} Standard Method for Copper-Accelerated Acetic Acid-Salt Spray (Fog) Testing (CASS Test)

ASTM D1193 Standard Specification for Reagent Water

3. DEFINITIONS

3.1 FILIFORM CORROSION

Filiform corrosion is type of corrosion that propagates across the metal surface underneath a coating. The corrosion is almost always initiated at discontinuities in the coating and propagates in the presence of oxygen and sufficient relative humidity. Filiform corrosion is characterized by thin “thread-like” corrosion filaments. Each filament has a “head” (the point of propagation of the corrosion growth) and a “tail” (the corrosion by products); see Figures 1 and 2, respectively.

3.2 FILIFORM FILAMENT

An individual thread like corrosion element that grows in length; see Figure 1.

3.3 DENSITY

The number of filiform filaments distributed within a specified length, such as along a scribe or wheel spoke edge. A filament may grow from a scribe and curve to return to the scribe. This is counted as one filament for frequency counts.

3.4 EQUALIZATION ADJUSTMENT FACTOR

A factor calculated to equalize the data from two or more different test laboratories or test chambers based on a proficiency analysis (see Table 2).

3.5 TEST MASTER SAMPLE

A sample used to assess the proficiency of a laboratory to conduct a filiform test and to allow calculation of a laboratory adjustment factor to permit the comparison of data from different laboratories on an equalized basis. A test master is also used in each test to confirm that the test has been performed correctly by comparing the master sample with the established data of the proficiency assessment. A significant variation may result in the test being disqualified.

4. TEST PROCEDURE

4.1 Cabinet Settings

Set and check the humidity cabinet for the temperature, humidity, airflow and exhaust vent settings. Correct any discrepancies from predetermined levels.

Humidity Cabinet Settings:

The cabinet should be capable of maintaining the following parameters:

Temperature 60 °C ± 1 °C

Humidity 85% Relative Humidity ± 3%

Air Flow 6 to 24 m/min (20 to 80 ft/min) in the test area

NOTE: Chamber air flow baffles may be required to manage the flow within the test chamber. Multiple areas within the chamber should be assessed (mapped) for air flow to ensure consistent air flow to achieve the required corrosion growth.

4.2 Sample Preparation

Visually examine the painted surface and record any adverse conditions, such as sags, paint film porosity, scratches, etc., and record. Photograph of the sample anomalies before testing to document the original sample condition in the test report is recommended. Do not mark on the candidate test area unless the intent is to disqualify an area from evaluation. Measure the paint film thickness over the area to be scribed, and record on a schematic drawing of the part and in the required proficiency data sheets (the paint film thickness measured at a specific control point should be correlated with cross-sectional analysis for the entire part geometry). Prepare a master test sample in a similar manner.

4.3 Scribing

Scribe the test piece to the base metal with a carbide tip-scribing tool per SAE J2634. The scribe should be as long as practical (recommended 100 mm) but must be at least 40 mm long (the measuring length shall be at least 30 mm; no data is to be measured for the first 5 mm from the scribe ends). A laboratory scribing fixture as described in SAE J2634 should be utilized to make a straight scribe line. Scribes made free-hand will not allow acceptable gage repeatability and reproducibility measurements. On a machined wheel, the scribe should be made perpendicular to the machining lines.

Check the scribe with a multimeter for electrical continuity from end to end, to assure that the scribe has exposed the base metal. There must be electrical continuity down the full length of the scribe. If continuity is an issue anywhere along the scribe, a fresh scribe must be made. This may be done on the same sample if there is at least 20 mm separation from the old scribe and/or from a parallel edge. Electrical continuity is checked to assure that the scribe exposes the base metal. Particular care must be taken to scribe through multiple layers of paint.

NOTE: In some cases where multiple coatings are used, it may not be possible to scribe to the base metal. These coatings may be such that filiform is not a failure mechanism due to a robust coating and multiple coating layers and their thicknesses. If this occurs, then this is to be noted and the scribing data is to be provided demonstrating no penetration of the scribe to the base metal layer and the test disqualified.

4.4 Test Part Corrosion Inoculation

Place the scribed parts in CASS per ASTM B368-97 (2003)^{e1} such that the test surfaces are at an angle of approximately 45 degrees to the horizontal on a suitable nonmetallic rack. It is a good policy to photograph the parts at this stage to document which surface(s) are at appropriate test angles.

NOTE: The location of the test sample within the chamber may affect the repeatability of the test. Mapping of the test locations in the chamber is recommended to ensure consistent results. Measuring the weight loss on nickel panels at different locations within the chamber is recommended to verify the consistency of the corrosion within the chamber.

4.5 Exposure Conditions

Expose the parts 6 hours in the CASS cabinet as described in ASTM B368-97 (2003)^{e1}. When the CASS exposure is near completion, prepare a container at least 5 gallons in size with a slow but constant flow of DI water that meets ASTM D1193 (Type 4).

4.6 Post-Inoculation Rinsing

Dip the test samples and the master test sample into deionized water that meets ASTM D1193 (Type 4). The parts should be dipped slowly in a vertical direction, slowly turned 90 degrees and back to the original position then removed using the same vertical direction. The dip should be for about 3 seconds. The objective is to remove only the excess CASS solution. The DI water should enter the bottom of the container to promote flushing of any contamination out of the container with the overflowing water. Flow rate should be dependent on the number of samples being dipped at one time. After approximately 25 samples (dipped one at a time) have been dipped, the water in the container shall be dumped prior to proceeding with the sample rinsing procedure.