

Understanding the Effect of Scribe Method on Variability in Accelerated Corrosion Test Results

Sarah E. Specht
PPG
4325 Rosanna Dr
Allison Park, PA, 15101
USA

James Begley
PPG
4325 Rosanna Dr
Allison Park, PA, 15101
USA

Suprita Jharimune
PPG
4325 Rosanna Dr
Allison Park, PA, 15101
USA

Melinda Dent
PPG
4325 Rosanna Dr
Allison Park, PA, 15101
USA

Nicole Rakers
PPG
400 Guys Run Rd
Cheswick, PA, 15024
USA

Arif Mubarak
PPG
4325 Rosanna Dr
Allison Park, PA, 15101
USA

ABSTRACT

Accelerated corrosion tests are commonly used across the coatings industry to predict performance of coating systems and aid development of new coating systems for a variety of exposure environments. Variability in the results exist in almost all accelerated testing. To improve efficiency in coatings development and to gain better confidence in test results, it is important to understand the root cause of variability. This work investigates the effect that different scribe requirements (such as dimension or orientation) have on the outcome and comparability of accelerated corrosion test results. Discussion will focus on coating application and sample preparation prior to accelerated corrosion test exposure, as well as evaluation of scribe corrosion after various preparation protocols.

Key words: Accelerated testing, corrosion, scribe

INTRODUCTION

The coatings industry has made widespread use of a variety of accelerated test methods to quickly and effectively evaluate coating performance. Such accelerated methods are advantageous for predicting coating system performance where real-time testing is impractical. For example, it is not practical to evaluate coatings in harsh environments where coatings are expected to last for decades when the pace of innovation and new coating development is faster than the test time would need to be. Therefore a variety of test methods exist to evaluate coatings on metal substrates, such as steel or aluminum. Coatings that will be subjected to corrosive environments require testing in environments to simulate the effects of corrosion, typically involving exposure to moderate salt concentration and elevated temperatures for a specified amount of time.¹ Such tests, testing environments, and evaluation methods include ASTM B117,² ISO 9227,³ and ISO 12944⁴, to name a few.

Despite each method outlining many of the protocols for testing and evaluation, some variables or aspects of the test protocol remain unspecified. This lack of specificity in any given test allows for variability in the performance testing across the industry. One such example is the method for introducing a scribe to the test panels. Each of the corrosion evaluation methods in the documents mentioned above requires that a scratch or scribe be made through the coating down to bare substrate on test panels, but they do not necessarily specify the tool or method to be used. Previous studies by Maples et al. in 2018 and Rakers et al. in 2020 evaluated the effect of different scribe tools for narrow (<0.8 mm) and wide (ca. 2 mm) scribes to understand whether the scribe tool had any effect on the extent of corrosion after exposure.^{5,6} In both cases, the authors found that the scribe tool had no notable effect on the scribe creep results.

In many cases, the method specifies the location and orientation of the scribe on the panel but does not necessarily specify the orientation of the test panel in the corrosion exposure cabinet. Furthermore, different tests that utilize the same exposure conditions, such as ASTM B117 and ISO 9227 neutral salt fog exposure environments, do not necessarily require the same scribe shape, location, or orientation on the panel. The scribe orientation is, in many cases, specified by another standard; for example, ASTM B117 references ASTM D1654 for sample preparation, including scribe tool, width, and orientation.^{2,7} Meanwhile, ISO 9227 references ISO 17872 for the preparation of scribes on test samples.^{3,8} In both ASTM B117 and ISO 9227, it is noted that the test parameters, including the scribe parameters, should be “in accordance with the specification for the material or product being tested” and that if not specified, that the parameters should be agreed upon by all interested parties.^{2,3} One specific example is the use of ISO 12944-6 for the performance testing of coatings in corrosive environments, in which Annex A.1 describes the width and orientation of the scribe.⁴ The scribe width and orientation in ISO 12944-6 Annex A.1 is distinct from the scribe specifications in ISO 17872, adding another layer of complexity to the myriad methods for introducing scribes to test samples. While each of these test methods have all been designed to evaluate coatings for different applications in corrosive environments, it is worth noting that the differences in scribe preparation may lead to variability in performance results for the same coating system. It is therefore worth understanding whether and how these differences in preparation influence performance results.

In this study, we attempt to understand whether the orientation of the scribe on the panel has any effect on the scribe creep results for direct-to-metal coatings on steel substrate in continuous neutral salt spray testing. The orientation includes the length of the scribe, the location on the panel, and the relative length and proximity of the scribe to the nearest edges of the panels.