Testing Results for Enamo Grip Coating After 5000 Hours of Exposure in Ultraviolet and Salt-Spray Chambers—Blistering and Rusting Evaluation

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Contents

Figure

1 Introduction

This report documents testing data and results of coupons coated with Enamo Grip coating after 5000 hours of exposure in accordance with ASTM D5894 (ASTM International, 2010). The average dry film thickness of the coating on the coupons was 9 mils (225 µm). The coated coupons have been exposed to the ultraviolet (UV) radiation and a salt solution for up to 5000 hours (30 weeks). The testing has been conducted according to ASTM D5894, Standard Practice for Cyclic Salt Fog/ UV Exposure of Painted Metal. This test simulate realistic test conditions to evaluate the outdoor corrosion of painted metal, including the synergistic effects of multiple factors including condensation, UV exposure, wet/dry cycling, and temperature cycling. The results of this test can be used to assess corrosion performance of coatings subjected to outdoor environmental conditions.

The testing was conducted in two week increment which consists of one week of UV exposure and one week of salt fog exposure. For each two week increment, the testing was conducted according to the following procedure. The testing started with fluorescent UV-Condensation exposure, per Section 8.1 of ASTM D5894. Southwest Research Institute® (SwRI®) placed three coupons for the coating type in UV-Condensation exposure chamber (here after called UV chamber). The coupons were placed in coupon holders that exposed a part of the coated surfaces of the coupons to the UV light. The coupons were exposed to the UV conditions for 4 hours followed by a 4-hour condensation period. The coupons were exposed for a total of 168 hours (1 week) in this UV chamber. Following UV exposure, the coupons were transferred to the salt spray chamber. The salt fog-dry exposure was conducted in accordance with Section 8.2 of ASTM D5894. The coupons are placed a coupon holder which directly exposed the coupons surfaces to the salt solution which is sprayed on the coupons. The coupons were exposed to a 1 hour fog cycle followed by a 1 hour dry cycle. The salt solution, as per ASTM D5894, consisted of 0.05 percent sodium chloride and 0.35 percent ammonium sulfate by mass. The coupons were exposed to the cyclic salt spray-dry conditions for a total of 168 hours (one week). The two week increment was repeated for 30 weeks.

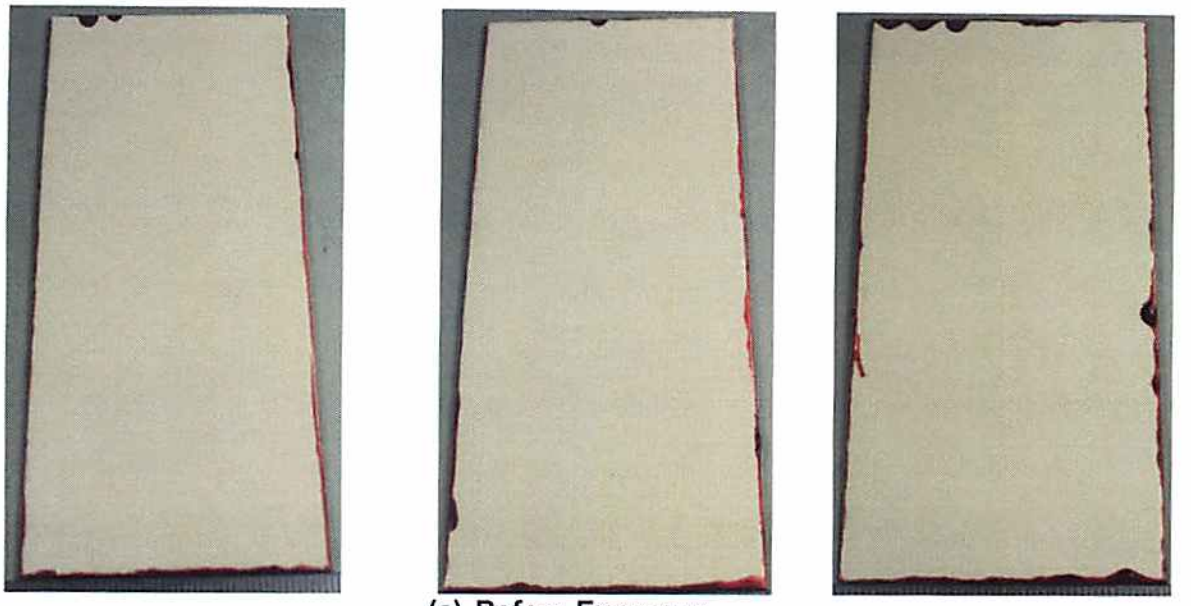
2 Testing Data and Results

The testing data is presented in form of coupons images after 5000 hours (30 weeks) of exposure. Images of the coupons before and after exposure are presented in Figures 1(a) and 1(b), respectively. The testing data is analyzed to determine the blistering and degree of rusting on the coupon.

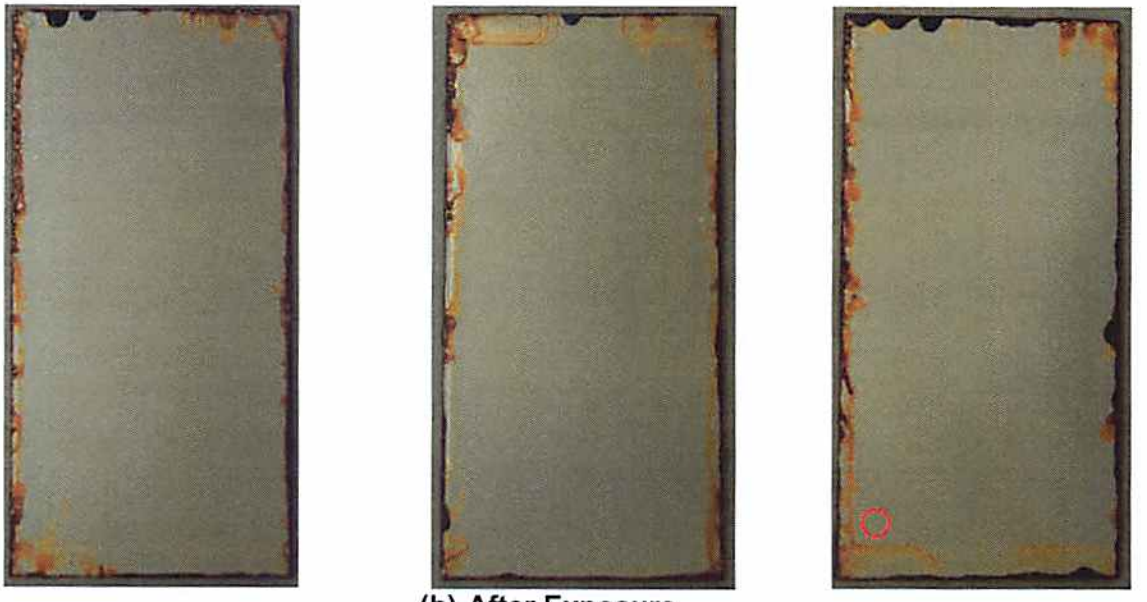
2.1 Blistering Evaluation: As seen in Figure 1(b), all three coupons show no signs of blistering after 5000 hours of exposure throughout their surfaces except on edges of the coupons. The edge blistering is so minor that it is not even visible in the images presented in Figure 1(b). This minor blistering is due to the edge effects and not due to the coating characteristics. The coating pass according to ASTM D714–02 because of no signs of blistering in the first two coupons' surfaces which are not affected by the edge effect.

2.2 Discoloration: The UV exposure causes discoloration in the coating but does not affect its corrosion performance. Figure 1 shows visible signs of discoloration in the coupons after 5000 hours of exposure. The coupons surfaces after 5000 hours of exposure show visible signs yellowish red color through their surfaces. This is due to the leaching of a paint solution which was applied on the edges of the coupons. The paint solution was applied to minimize edge

effect during the testing. The applied paint solution is red in color, and its leachate due to its interaction with the salt solution is yellowish red.



(a) Before Exposure



(b) After Exposure

Figure 1. Images of the Three Enamo Grip Coupons (a) Before and (b) After 5000 Hours of Exposure

Overtime, the paint releases the leachate due to its chemical interaction with the salt solution. The leachate causes the yellowish red color on the coupons' surfaces in Figures (b).

The coupons' surfaces are only partially exposed to the UV radiation in the UV chamber. If there is any effect of UV radiation on corrosion performance, it should produce a marked change in corrosion performance distinguished by two shades on a coupon surface. In Figure 1(b), there are not two visible shades of coating colors on all three coupons after 5000

hours of exposure, however, these shades are barely visible in the figure. The UV exposure does not affect corrosion performance of the coating. The coating does not show any marked change in rusting where discoloration due to UV exposure has occurred. This proves that even though UV exposure causes discoloration of the coating, it does not affect its corrosion performance.

2.3 Rusting Evaluation: The degree of rusting on the three coupons is evaluated in accordance with ASTM D610–08. After 5000 hours of the exposure, the left two two coupons in Figure 1 do not show any rusting which is visible with bare eyes, while the right most coupon has a pin point spot. Considering the level rusting in the three coupons after 5000 hours of exposure, the right most coupon has a rating of 9P, and the first two coupons rating is 10.

3 Conclusions

Three coupons coated with Enamo Grip coating were tested according to ASTM D5894 for 5000 hours of exposure. The average dry film thickness of the coating on the coupons was 9 mils.

The coating shows no signs of blistering after 5000 hours of exposure. Some blistering is noted on the edges of the coupons; however, this is due to the edge effect and not due to the deficiency in the coating.

The UV radiation cause minimal discoloration of the coating.

The coating system shows minimal signs of rusting, with one corrosion spot on one of the three coupons. This indicates that rusting is due to coting defects during coating preparation process and not due to deficiency in the coating. Therefore, it is concluded that the coating system has excellent corrosion resistance characteristics, with average rating of 10 as per ASTM D610.

4 References

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