

# Testing Results for Lining Kote UHS Coating After 5000 Hours of Exposure in Ultraviolet and Salt-Spray Chambers—Blistering and Rusting Evaluation

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# 1 Introduction

This report documents testing data and results of coupons coated with Lining Kote UHS 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 6.5 mils (165  $\mu\text{m}$ ). 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<sup>®</sup> (SwRI<sup>®</sup>) 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.

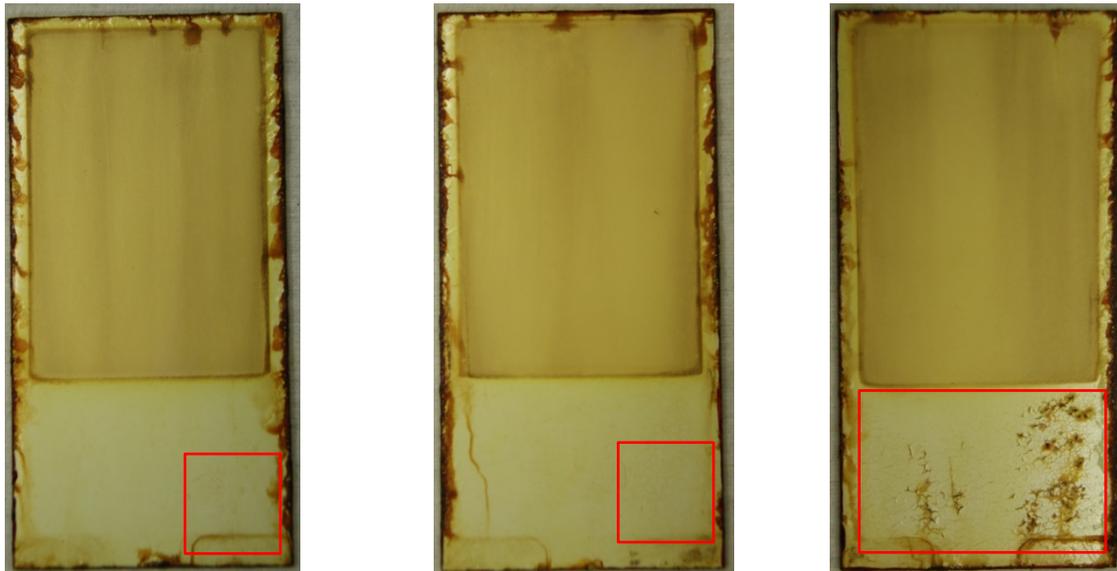
**2.1 Blistering Evaluation:** As seen in Figure 1(b), the coupons show no signs of blistering after 5000 hours of exposure throughout their surfaces except on edges of the coupons. The blistering is so minor that it is not even visible in the images presented in Figure 1(b). This minor blistering is 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 three 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(b) 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 Lining Kote UHS 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 1(b).

The coupons' surfaces were only partially exposed to the UV radiation in the UV chamber, and there is marked change in coating color in the area exposed to UV radiation. The exposed area is slightly darker compared to the rest of the coupons' surface area. In addition, it was observed that UV exposed surface has no corrosion spots whereas the coupons' surfaces not exposed to UV radiation developed cracks in the coating. Several corrosion spots developed in the coupons' areas where coating developed cracks. It appears that UV exposure improves coating's corrosion performance whereas non-exposure deteriorates 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 most coupon in Figure 1(b) shows signs of rusting with corrosion spots. Similarly, the middle coupon in Figure 1(b) also shows corrosion spots, similar to left most coupon in Figure 1(b). The right most coupon in Figure 1(b) shows extensive number of corrosion spots, much more than the first two coupons. Considering the rusting level in the three coupons after 5000 hours of exposure, the right most coupon in Figure 1(b) is rated 8S, and the remaining two coupons are rated 9S. The overall performance of the coating is rated as 9S.

### 3 Conclusions

Three coupons coated with Lining Kote UHS coating were tested according to ASTM D5894 for 5000 hours of exposure. The average dry film thickness of the coating on the coupons was 6.5 mils.

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

The UV radiation causes discoloration of the coating, and also improves its corrosion performance. The areas of the three coupons not exposed to UV radiation developed cracks in coating. Several corrosion locations developed on the coupons' substrate where coating cracked.

The coating showed significant sign of rusting. The overall corrosion performance of the coating is rated as 9S in accordance with ASTM D610.

### 4 References

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