

BRIDGE COATING MAINTENANCE STRATEGIES

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Abstract

Choosing the proper maintenance strategy when scoping a coatings project is difficult, and potentially costly if incorrect procedures are utilized. This is especially true for steel bridges with millions of square feet of coated surface to be repaired and coated. For the last 30 years, bridge coating maintenance has been dominated by the desire to remove lead coatings from existing structures, followed by the application of Zinc/Epoxy/Urethane or other modern coatings systems. These modern coating systems are now reaching the age where major maintenance is required, and the decision must be made regarding how much coating to retain, and what methods will be used to clean and paint. This paper presents results of field and laboratory testing of alternative approaches to maintaining an Organic Zinc/Epoxy/Urethane bridge coatings system.

Maintenance alternatives evaluated during this project include degrees of power tool cleaning (e.g., SSPC-SP 3, SSPC-SP-15, and SSPC-SP-11), spot/sweep blasting (SSPC-SP 18) and a near white metal blast (SSPC-SP 10). In addition to alternative surface preparation techniques, the relative value of spot zinc versus spot epoxy priming during maintenance painting were evaluated. (Spot zinc refers to painting of zinc primer to areas of localized bare steel).

Data and knowledge presented in this paper will allow for other maintainers and owners of steel structures decide proper maintenance strategies for their bridges.

1. Introduction

When it comes to a bridge structure with a serviceable Organic Zinc / Epoxy / Urethane (OZ/E/U) coating system, there is no golden answer on the most cost-effective maintenance painting strategy. Depending on the severity and amount of corrosion and coating breakdown on the structure, planned maintenance surface preparations range from spot power tool cleaning and spot painting to a full SSPC-SP 10 media blast and full recoating operation.

The testing completed under this program took a closer look at how various levels of surface preparations perform on differing levels of corrosion. A field study occurred concurrently conducted on the Verrazano Narrows Bridge, while laboratory testing exposed the surface preparations to an accelerated corrosion environment to gain a better understanding of the systems performance in a shorter timeframe. Data and knowledge gathered from the testing will intend to help provide necessary guidance on surface preparation procedures to be used during maintenance bridge coating projects.

2. Experimental

2.1 Surface Preparations Evaluated

Under this program seven different types of Surface preparation methods were evaluated which are lists as follows:

- *Water Wash/SSPC-SP 3, Power Tool Cleaning (Wash/SP-3).*
- *Water Wash with Alkaline Cleaning Agent/ SSPC SP3 Power Tool Cleaning 10 Commercial Grade Power Tool Cleaning (Wash/SP-15)*
- *Water Wash/SSPC-SP 15 Commercial Grade Power Tool Cleaning (Wash/SP-15)*
- *Water Wash/SSPC-SP 18 Commercial Grade Power Tool Cleaning (Wash/SP-15)- Aluminum Oxide*
- *Water Wash/SSPC-SP 18 Commercial Grade Power Tool Cleaning (Wash/SP-15)- Using Steel Grit*
- *Water Wash/SSPC-SP 10 Near White Metal Blasting (Wash/SP-10)- Using Aluminum Oxide*
- *Water Wash/SSPC-SP 10 Near White Metal Blasting (Wash/SP-10)- Using Steel Grit*

2.2 Spot Epoxy Vs. Spot Zinc

In addition to various surface preparations, this program explored the effectiveness of a spot epoxy vs. a spot organic zinc when bare steel is exposed for all preparation scenarios excluding SP-10.

The repair coating system following each surface preparation was either Spot Epoxy/Full Epoxy/ Full Urethane Topcoat or Spot Organic Zinc/Full Epoxy/ Full Urethane Topcoat. The SP-10 systems reached Full Organic Epoxy/ Full Epoxy/ Full Urethane Topcoat.

2.3 Laboratory Test Plan

The Laboratory Test Plan is summarized in the test matrix seen below in

Table 1.

Table 1. Laboratory test matrix.

System #	Preconditioned panels 6"x12"	"New" 18"x18" steel	Repair Method	Prime	Intermediate	Caulk Method	Finish
1A	3	1	Wash/SP-3	Spot OZ	Full Epoxy	3 quarter	Full Urethane
1B	3		Wash/SP-3	Spot Epoxy			
2A	3	1	Wash/ Cleaner/SP-3	Spot OZ			
2B	3		Wash/ Cleaner/SP-3	Spot Epoxy			
3A	3	1	Wash/ SP-15	Spot OZ			
3B	3		Wash/SP-15	Spot Epoxy			
4A	3	1	SP-18 (Al Oxide)	Spot OZ			
4B	3		SP-18 (Al Oxide)	Spot Epoxy			
5A	3	1	SP-18 (Steel Grit)	Spot OZ			
5B	3		SP-18 (Steel Grit)	Spot Epoxy			
6	3	1	SP-10 (Al Oxide)	Full OZ			
7	3	1	SP-10 (Steel Grit)	Full OZ			

In total, 43 panels were used for this testing. Three panels for each surface prep system (36 total) consist of preconditioned 6" x 12" x 1/8" complex steel panels which were previously coated with a standard OZ/E/U system and weathered over the past four years in a northern industrial environment with periodic salt spray over that time. These panels have been categorized by the rust present on the panels as shown below in Figure 1. One panel of each corrosion designation (three total) has been selected for each repair method.

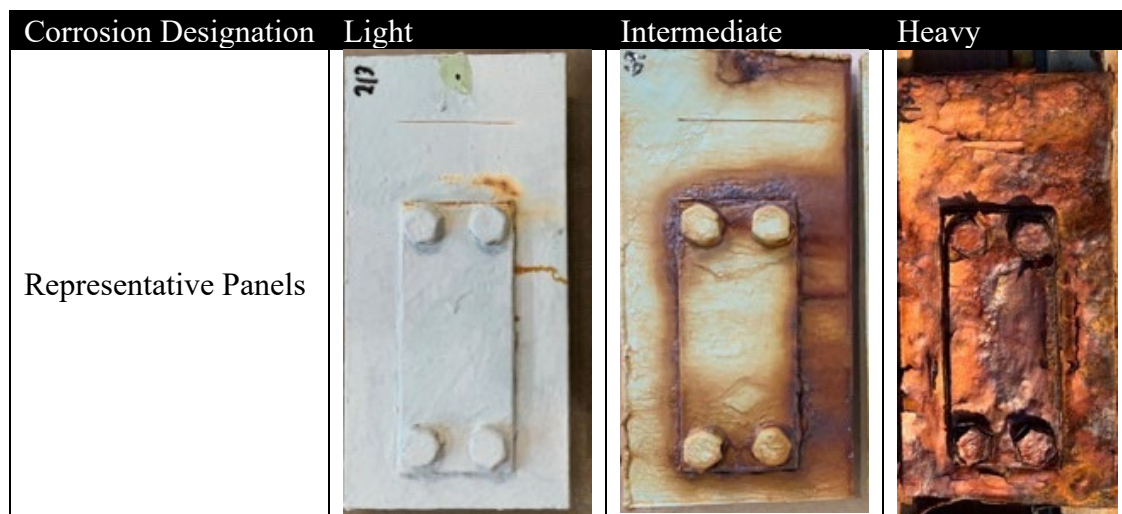


Figure 1. Preconditioned panels for each System

Additionally, for systems 1 through 5, one unexposed 18" x 18" x 1/8" panel was prepared by Aluminum Oxide media blast to an SP-10 (5 total). These panels were coated with an OZ/E system and exposed to accelerated weathering in 40 cycles of GMW14872 Cyclical Corrosion Laboratory Testing, Figure 2 shows a panel after exposure.



Figure 2. Large 18"x18" after Weathering

After weathering, these panels received the A and B portions of their system (primer coating) on the left and right sides of the panels as designated below in Figure 3. For systems 6 & 7, one unexposed 18" x 18" x 1/8" test panel was prepared and primed according to Table 1 (2 total). Due to the nature of the SP-10 surface preparation, these panels did not receive pre-weathering.

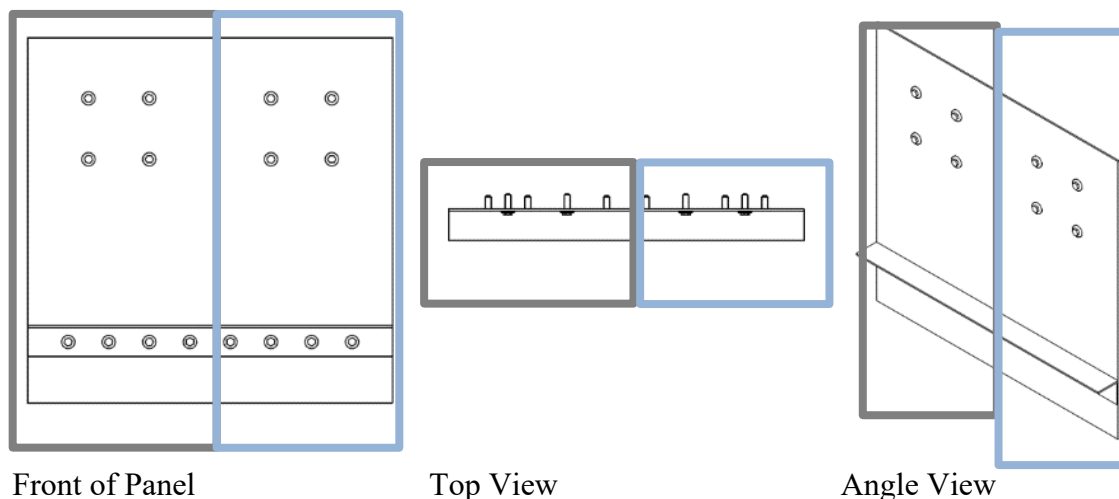


Figure 3. New Steel Panels (Left System A, Right System B)

2.4 Corrosion & Performance Testing

After coating application was completed, all panels were exposed to GMW 14872 Cyclical Corrosion Laboratory Testing. This testing is described below in **Error! Reference source**

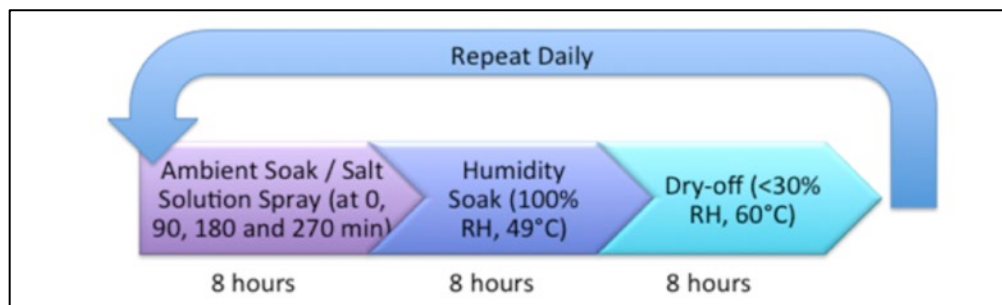


Figure 4. GMW14872 One Cycle

Visual panel inspections will be carried out at every 20 cycles at 20, 40, 60, 80, 100 and 120 cycles completed. These inspections will include photographs, ratings for rust through IAW ASTM D610, blistering IAW ASTM D714, and noting signs of crevice or fastener corrosion. Additionally, the final inspection will include adhesion testing of the coatings on the back of each pane by both knife IAW ASTM D6677 and dolly pull-off IAW ASTM D4541.

3. Results and Discussion

3.1 Corrosion and Performance: Laboratory Tests

At the time of this report testing has progressed past the 40-cycle inspection. As it is the most up-to-date point of the panel's conditions, it is the only cycle presented on for this report. Figure 5 displays the average D610 rust-through value after two inspections for panels which are showing visual corrosion products through the coating surface. Currently system 2 and 3 completed over a heavy rust precondition and receiving a spot coating of epoxy are performing the worst by this evaluation. Figure 6 displays the average D714 coating blistering value after 40 cycles for panels which have blistering present. Currently all blistering is at a size of "8" and a dispersion of "few" across the panels, which translates to a numerical value of 8.44 out of a possible 10 (10 being no blistering present). Any systems not shown in either figure have still yet to show rust-through or coating blistering on the bold coated surface.

In addition, 1.1.1.1.1 Appendix A documents the pre-weathering, surface preparation, and 40 cycle inspection photos for all systems. *Note: At this time only spot zinc systems are shown in Appendix A.*

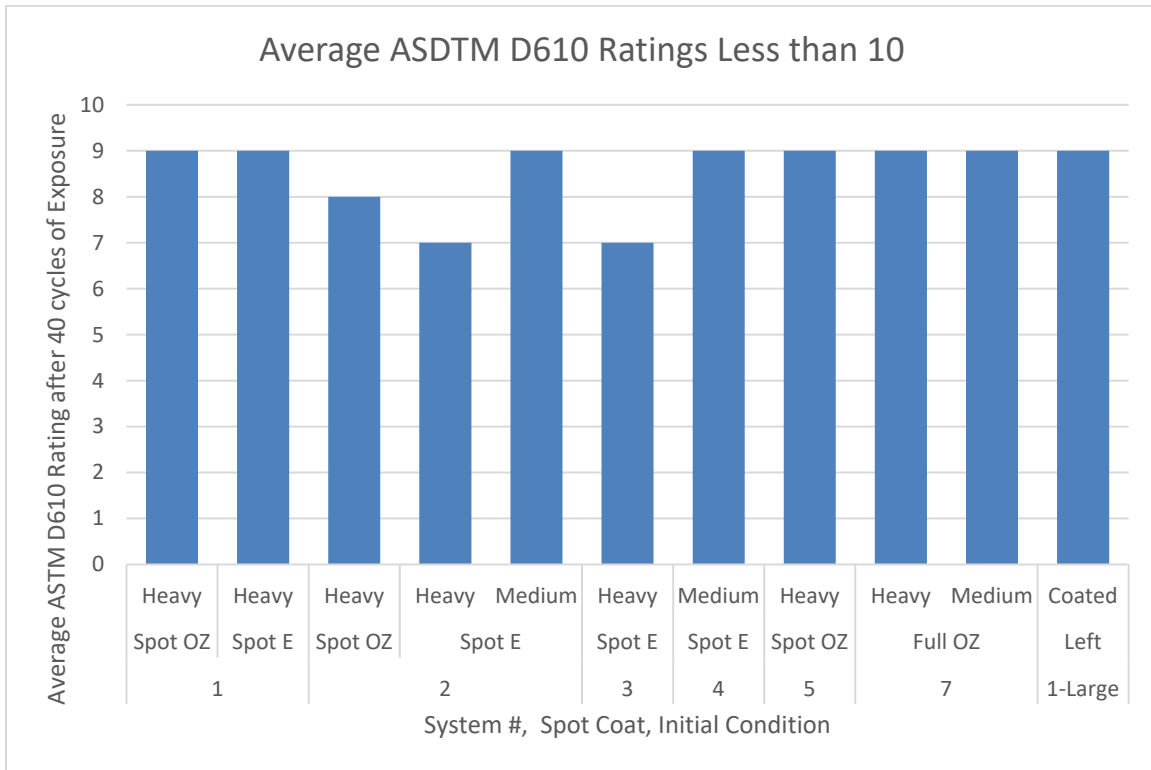


Figure 5. ASTM D610 Ratings for systems showing Rust through after 40 Cycles

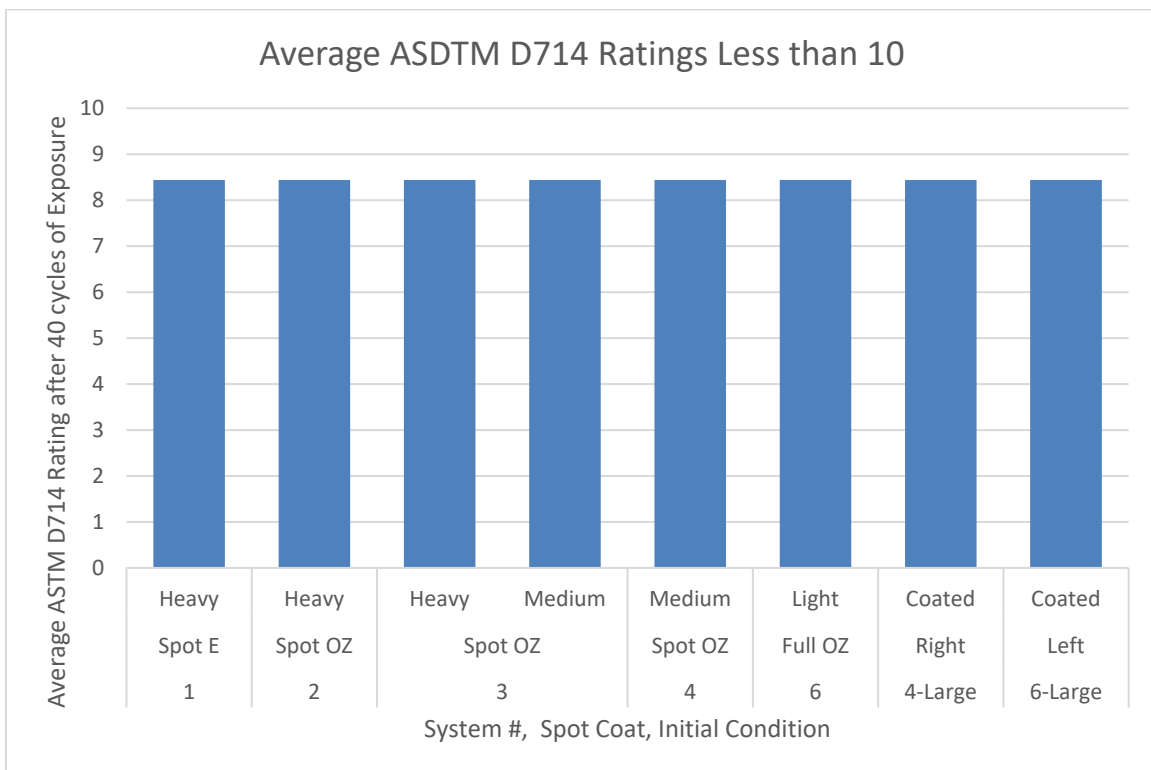


Figure 6. ASTM D610 Ratings for Systems showing coating blistering after 40 cycles.