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Corrosion Resistance

NIC Industries Quality Control Group

Requested By: Cerakote Division

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Prepared For: Marine Industries

Purpose: Evaluate the corrosion resistance of Teflon and Xylan coated bolts versus Cerakote E-100 Blackout coated bolts.

Test Method: Standard Practice for Operating Salt Spray (Fog) Apparatus ASTM B117 and Standard Practice for Evaluating Degree of Rusting on Painted Steel Surfaces ASTM D610

Coating Specifications:

- Three bolts and hex nuts coated separately by the Cerakote Training Department with Cerakote E-100 Blackout. Samples were prepared and cured as defined in the H-Series & Cerakote Elite Training Manual.
- Three bolts and hex nuts coated separately by a Dupont Certified Applicator with Teflon Black model 958G
- Three bolts and hex nuts coated separately by a Dupont Certified Applicator with Teflon Metallic Black model 420G
- Three bolts and hex nuts coated separately by a Whittford Certified Applicator with Xylan model 142X

A. Purpose

This document contains the performance results from corrosion testing performed on Xylan, Teflon Black, Teflon Metallic Black and Cerakote Blackout parts at the Cerakote Lab.

B. Scope

Testing shall be conducted per applicable ASTM standards in the order listed below to determine the corrosion resistance of three specialty coatings compared to Cerakote Blackout

C. Process for testing

- 1) Salt Fog Apparatus ASTM B117 with evaluation standard ASTM D610

The salt fog corrosion resistance testing was conducted per ASTM B117, with the exception of parts being placed into the chamber on their side. According to the ASTM, parts should be placed at an angle so that salty condensate cannot gather and pool on samples. Due to the shape of the bolts with nuts, angled placement was not possible nor necessary with the actual test area being the rounded bodies of the bolts. Three bolts per coating were used. All bolts were laid flat in the chamber where the Cerakote Lab observed percentage of corrosion daily. Photographs were taken weekly and at significant changes to show the progression of corrosion. Cerakote standard for maximum corrosion per ASTM D610 is rust grade 5G, 3% rusted. This analysis is not considered to be complete at the time of this report, as the Cerakote parts showed minimal signs of rust on the body of the bolts which did not meet the 3% rust specifications of ASTM D610.

D. Results

Results of testing is shown in Chart 1.

Chart 1. Corrosion resistance chart for Cerakote, Teflon and Xylan Bolts

Part No.	Type of Coating	Type of Analysis	Hours at 3% corrosion per ASTM	Total Hours in Chamber	Notes
E1, E2, E3	Cerakote Blackout	Corrosion	N/A	4008	Test concluded at 4K hours by preset parameters / product did not reach 3% rust on body of bolt
T1, T2, T3	Teflon Black 958G	Corrosion	48	640	All Teflon pulled at 640 hours due to excessive corrosion, possible instrument damage if left in chamber
TM1, TM2, TM3	Teflon Metallic Black 420G	Corrosion	24	640	All Teflon pulled at 640 hours due to excessive corrosion, possible instrument damage if left in chamber
X1, X2, X3	Xylan 142X	Corrosion	530	1871	All Xylan pulled at 1871 hours due to excessive corrosion, possible instrument damage if left in chamber

1) 48 Hour results

Rust was observed on both Teflon and Xylan bolts after 24 hours in the salt fog chamber. Per Cerakote standard ASTM D610 Teflon Metallic reached 3% red-rust and was left in the chamber for later comparison. At 48 hours, Teflon Black reached 3% red-rust and was also left in chamber for later comparison. Zero rust was observed on Cerakote bolts and nuts. Photo 1 depicts the amount of rust visible at 24 hours, while Photo 2 shows the Teflon Metallic bolts at the end of the 24 hour

period. Photo 3 illustrates the amount of corrosion on the Teflon Black bolts at 48 hours.



Photo 1. All four coatings in salt fog chamber at 24 hours.



Photo 2. Teflon Metallic red-rust at 24 hours.



Photo 3. Teflon Black red-rust at 48 hours.

2) Week Three Results

At 540 hours, Xylan reached per Cerakote Standard ASTM D610 of 3% red-rust on body of bolt and left in chamber for later comparison. Photo 4 shows the level of corrosion of Xylan at 540 hours. Photo 5 provides the appearance of all bolts at 540 hours.

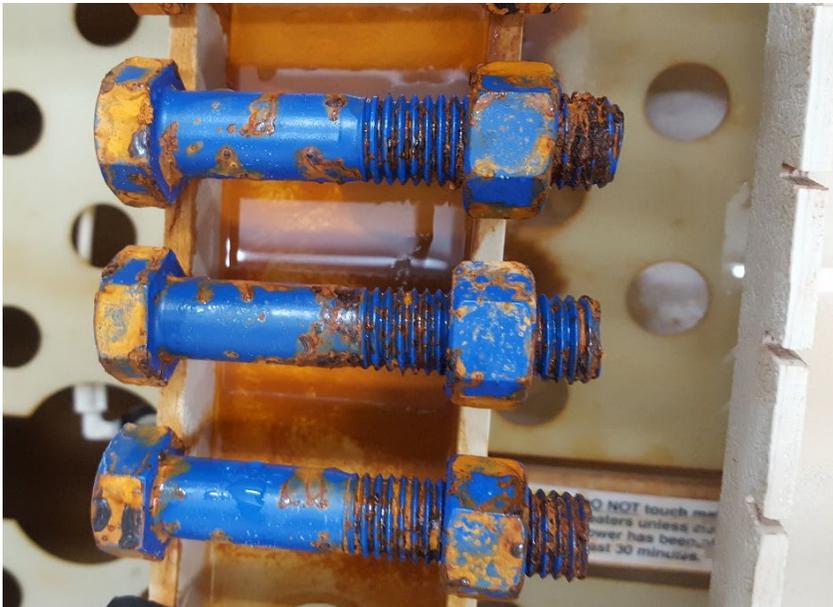


Photo 4. Xylan red-rust at 540 hours.



Photo 5. All bolts at 540 hours in chamber.

3) Week Four Results

Teflon Black and Teflon Metallic black were pulled from experiment at 640 hours due to excessive corrosion. Photos 6, 7, 8 and 9 depict how the Teflon Black, Teflon Metallic, Xylan and Cerakote bolts, respectively, appeared at 619 hours. Cerakote and Xylan were left in chamber to complete the analysis.



Photo 6. Teflon Black at 619 hours.



Photo 7. Teflon Metallic Black at 619 hours.



Photo 8. Xylan at 619 hours.



Photo 9. Cerakote Blackout at 619 hours.

4) Week 9 Results

The Xylan bolts were pulled from chamber at 1871 hours due to excessive corrosion. Photos 10 and 11 were taken of Xylan and Cerakote Blackout, respectively, at 1,500 hours for comparison.



Photo 10. Xylan at 1500 hours.



Photo 11. Cerakote Blackout at 1500 hours.

E. Week 23 Results

Cerakote had not reached 3% red-rust at 4000 hours and the test was concluded. Photo 11 shows Cerakote Black out 3,963 hours, which Photo 12 displays all bolts comparatively at the end of the analysis.



Photo 11. Cerakote Blackout at 3,963 hours.



Photo 12. Corrosion levels of Cerakote Blackout after 4,000 hours, Teflon Black and Teflon Metallic Black after 640 hours, and Xylan after 1871 hours.

E. Conclusion

Cerakote Blackout corrosion performance showed a 99.4% improvement over Teflon Metallic Black, a 99% improvement over Teflon Black, and an 87% improvement over Xylan. Cerakote greatly exceeded the corrosion performance of its competitors.