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Development of Coatings Performance Specifications for Steel Exposed to the Atmosphere

Aluminum Epoxy Mastic and Epoxy/Urethane Systems

by

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Provisions of the Clean Air Act Amendments of 1990 will restrict the use of high solvent-content paints beginning in 1996. Procurement reform indicates the use of other than military specifications and emphasizes the use of commercial products and performance specifications. In response to procurement reform and air quality regulations, the U.S. Army Corps of Engineers must replace some of its existing coating specifications.

This study developed two performance-oriented commercial item descriptions (CIDs) describing aluminum epoxy mastic and epoxy primer/polyurethane topcoat systems for use on minimally prepared steel surfaces that will be exposed to atmospheric corrosion. Accelerated corrosion tests were conducted to establish the performance envelope of these generic types of coating systems. Ten products, representative of each coating system, were exposed and evaluated for blistering, rusting, and rust undercutting. Standard Corps of Engineers coating systems were used as experimental controls and to establish the relative performance of the test coatings.

The study recommends that the Corps submit the draft CIDs to General Services Administration for review and authorization. Further, it is recommended that the Corps implement the authorized documents by inclusion in CWGS-09940, *Painting: Hydraulic Structures and Appurtenant Works*.

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Foreword

This study was conducted for the Electrical and Mechanical Branch, Engineering Division, Directorate of Civil Works, Headquarters, U.S. Army Corps of Engineers (HQUSACE) under “Civil Works Investigations and Studies”; Work Unit 31205, “Developing High Performance Coatings.” The technical monitors were R. Kinsel and J. Gilson, CECW-EE

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1 Introduction

Background

Historic Perspective

Structures operated and maintained by the U.S. Army Corps of Engineers contain millions of square feet of steel.* Protective coatings are used to extend the useful life of the steel and ultimately the structures they comprise. Any of a number of surface preparations and coatings may be used to protect a steel surface depending on the environment and intended use of the painted structure. A steel surface immersed in water, for example, will have distinctly different requirements from one exposed to the atmosphere.

Cost-effective corrosion protection in immersion requires rigorous surface preparation as defined in various specifications. Generally, the level of surface preparation that will be specified under given circumstances is the lowest level that will provide good coating performance. SSPC-SP 5, *White Metal Blast Cleaning*, or SSPC-SP 10, *Near-White Metal Blast Cleaning*, are typically specified for surfaces that will be immersed in fresh or salt water. Lesser degrees of surface preparation such as specified in SSPC-SP 2, *Hand Tool Cleaning*, SSPC-SP 3, *Power Tool Cleaning*, SSPC-SP 7, *Brush-Off Blast Cleaning*, or SSPC-SP 6, *Commercial Blast Cleaning* are usually specified for atmospheric exposures. Historically, the Corps of Engineers has specified SSPC-SP 3 and SSPC-SP 7 for atmospheric painting (CWGS-09940 June 1993; CW-09940 October 1992; CW-09940 August 1989; CW-09940 August 1981; CW-09940 April 1981; CW-09940 November 1979; CW-09940 January 1977; CE-1409 June 1973; and CE-1409 March 1968).

Coatings formulated for use on steel surfaces cleaned in accordance with SSPC-SP 2, SSPC-SP 3, or SSPC-SP 7 are often called “surface-tolerant coatings” (Kapsanis and Appleman 1992). This term derives from the fact that these surface preparation methods may leave traces of surface contaminants such as rust, salts, and old paint. Specific types of surface-tolerant coatings are formulated to provide good protection over these types of contaminated surfaces. Oil-based, long oil alkyd, and modified versions of these coatings containing inhibitive pigments are traditional

* 1 sq ft = 0.093 m².

types of surface-tolerant coatings (Thomas 1989). Red-lead linseed oil primer is a classic example of an oil-based surface-tolerant coating containing an inhibitive pigment.

Historically, the Corps has used coatings such as “TT-P-86 Paint, Red Lead-Based, Ready-Mixed” and “TT-P-615 Primer Coating: Basic Lead Silico Chromate” for priming steel exposed to the atmosphere (CW-09940 [August 1989, August 1981, April 1981, November 1979, January 1977], CE-1409 [June 1973, March 1968]). However, the use of TT-P-615 was discontinued in the August 1989 guide specification revision. The use of TT-P-86 was limited to maintenance painting in 1989 and was also discontinued in 1992. Use of these primers was curtailed because of worker safety and environmental concerns surrounding lead and chromium-pigmented coatings. “SSPC-Paint 25 Red-Iron Oxide, Zinc Oxide, Raw Linseed Oil and Alkyd Primer” was added to the guide specification in 1989. Oil-based, alkyd, and modified versions of these resins are used to topcoat surface-tolerant primers of similar resin chemistries. Traditionally the Corps has used “TT-P-38 Paint, Aluminum, Ready Mixed” and “TT-E-489 Enamel, Alkyd, Gloss,” as topcoats for TT-P-86, TT-P-615, and SSPC-Paint 25. TT-P-38 is a tung oil-modified phenolic material pigmented with leafing aluminum. TT-E-489 is used when colors such as black, white, or yellow are required.

Technology Drivers

Most of the research dollars in both the coatings industry and government are spent on developing new coating technologies with reduced levels of organic solvents. Local and state environmental regulations place limits on the volatile organic compound (VOC) content of architectural and industrial maintenance coatings. In response to the Clean Air Act Amendments of 1990, the U.S. Environmental Protection Agency (EPA) is developing a national rule governing VOCs in architectural and industrial maintenance coatings. The private sector is leading the effort to produce low-VOC technologies, but recently, government paint specifications have generally fallen behind the state-of-the-science and the government has been slow to adopt new paint technologies.

Today the hazards associated with lead and chromium pigments are well known. The Corps response to these hazards has been to eliminate the use of these materials on Corps jobs. SSPC-Paint 25 has replaced lead- and chromium-pigmented paints. Paint 25 is a good coating material, but is based on a relatively old technology. Like the traditional Federal Specification and Corps of Engineers paints, Paint 25 is a “formula specification.” Such specifications, which are based

primarily on the content of the coating, circumscribe the introduction of new and innovative products.

Federal procurement reform favors the use of performance-based specifications and commercially available materials. Materials made to conform to Military and other material specifications are rarely sold to the general public; in other words, they are not manufacturers' shelf products.

Rationale for Performance Specifications

The Corps has traditionally used paint specifications that are based on a material's composition, known as "formula specifications." Formula specifications used by the Corps include those prepared by the Corps, Army, Air Force, General Services Administration (GSA), Navy, and the Steel Structure Painting Council (SSPC).^{*} Acquisition reform will largely phase out military specifications prepared by the Army, Navy, and Air Force for use within the Corps by the end of 1995.

Procuring items without specific requirements is risky; unless requirements are properly defined and specified, one may choose a paint that is unsuitable in terms of the quality, performance, or fitness for a given application. The Corps needs an alternative to the traditional formula-based military specifications. Specifications based on a material's performance may provide the required alternative to formula specifications. A public sector procurement system based on performance specifications would offer the dual advantage of promoting competition while providing for a high quality product. However, government procurement documents must specify requirements without favoring individual manufacturers or proprietary products. Requiring the use of specific proprietary products in procurement documents is usually not allowed because it does not promote full and open competition.

GSA is the preparing activity for a number specifications known as Commercial Item Descriptions (CIDs), which may be based solely on performance, but often incorporate some compositional requirements. CIDs are intended for use in procurement documents for a class of commercially available products. SSPC is in the process of developing performance specifications similar to GSA's CIDs. The American Society for Testing and Materials (ASTM)^{**} has some existing standards for coated items that are based on performance of the coated end product.

^{*} Steel Structure painting Council, 4516 Henry St., Pittsburgh, PA 15213

^{**} American Society for Testing and Materials, 1916 Race St., Philadelphia, PA 19102-1187.

Accelerated tests are the most practical tool available to quickly assess coating performance. Field exposures and fence tests, while more reliable, take too long to be practical. Accelerated test methods, if used wisely, can reliably predict the relative performance of coatings and can thereby help produce performance specifications for generic classes of coatings such as barrier epoxy coatings, as a practical alternative to formula specifications.

Corps of Engineers Requirements for Paints for Atmospheric Steel

The factors driving technology within the coatings industry as well as current trends in procurement propelled by acquisition reform have combined to form the basis for most of the requirements for paints designed for use on steel exposed to atmospheric corrosion. New specifications adopted for use by the Corps should not be military specifications. Ideally, coatings specified by the Corps will be free of hazardous lead and chromium pigments, will contain low levels of VOCs, and will be based on performance rather than formula specifications.

Objective

The objective of this research was to develop performance-based material specifications to describe commercially available products that:

1. Are suitable for painting atmospheric steel
2. Are compatible with current Corps painting practices
3. Meet the demands of acquisition reform
4. Meet the requirements of air pollution regulations.

Approach

Twenty commercial products representing two generic coating systems were evaluated in accelerated weathering tests. The performance envelope for each generic system was determined, performance requirements were established, and draft performance specifications were developed.

Scope

The results of this study are applicable to Civil Works painting of steel surfaces exposed to atmospheric weathering. The research was not conducted to validate the

performance of, or to qualify individual products for use within the Corps of Engineers. The results of the research are intended solely to develop performance-based materials specifications for use by the Corps and other Federal agencies. The results contained herein do not represent an endorsement of any manufacturer or specific product.

Mode of Technology Transfer

The appended draft performance specifications will be submitted to General Services Administration (GSA Center, ATTN: 9FTE-10, Auburn, WA 98001, TEL: 206/931-7929, FAX: 206/931-7544) for review and adoption as CIDs. It is recommended that on implementation by GSA, the CIDs become standard coating systems within the Corps by adoption and reference in CWGS-09940, *Painting: Hydraulic Structures and Appurtenant Works*.

2 Evaluation of Aluminum Epoxy Mastic Coating Systems

Selection of Test Coatings

Epoxy coatings pigmented with aluminum offer an alternative to the use of traditional surface-tolerant coatings (Thomas 1989, Hare 1989, Hare 1990). Ten commercially available aluminum epoxy coatings were selected for evaluation. The selected coatings are manufactured in the United States and have a maximum VOC as applied of 340 grams per liter (g/L). The selected test coatings are compatible with minimally prepared rusted steel substrates. Table 1 lists the 10 aluminum epoxy mastic systems evaluated in this study.

Preparation of Test Specimens

Cold-rolled steel test panels measuring 3.0 x 9.0 in. were initially abrasive blast cleaned to SP-10 to promote the formation of uniform corrosion.* The test panels were then rusted to an initial condition approximating Hand Tool Cleaned (SP-2) steel prepared from steel of condition C of SSPC-Vis 1, by spraying atomized deionized water onto the test panels 10 times a day for 5 days. The test panels were allowed to dry completely prior to rewetting.

The 10 coating systems were applied in accordance with manufacturers' recommended procedures. Where the manufacturer provided an option to apply the coating system in one or two spray applications, two were used. Test panels were scribed prior to exposure in such a manner that the coating was uniformly removed down to the substrate along the entire length of the scribe. The dry film thickness of each coat of each system was measured using a nondestructive magnetic dry film thickness gage. Average dry film thicknesses for each system are listed in Table 1. Dry film thicknesses for individual panels can be found in Appendix A.

* 1 in. = 25.4 mm.

Table 1. Aluminum epoxy mastic coating system.

Manufacturer	Product Name	VOC (g/L)	Dry Film Thickness (0.001 in)
Davis Industrial Paint	SSPC Paint 25 TT-P-38 (2 coats)	~290 ~430	2.2 1.3 2.1 5.6 (total)
Sherwin-Williams	Epoxy Mastic Aluminum II (2 coats)	173	6.8 5.3 12.1 (total)
Sherwin-Williams	Surface Tolerant Epoxy Coating (2 coats)	174	6.0 5.5 11.5 (total)
Devoe	Bar Rust 239 Aluminum Epoxy Mastic (2 coats)	86	6.2 8.2 14.4 (total)
Sigma Coatings	Colturiet TCP Aluminum (2 coats)	239	5.9 6.5 12.4 (total)
International	Magna Mastic 7900 (1 coat)	121	5.5 (total)
International	Intergard Universal Aluminum (1 coat)	192	7.3 (total)
Caboline	Carbomastic 15LO (2 coats)	88	5.0 5.4 10.4 (total)
Carboline	Carbomastic 90 (2 coats)	84	5.2 6.0 11.2 (total)
Sherwin-Williams	Macropoxy Aluminum (2 coats)	175	6.3 4.1 10.4 (total)
Hempel	Hempadur 4515-1987 (2 coats)	180	7.8 8.7 16.5 (total)

Test Methods

Recent advancements have been made in developing more reliable accelerated test methods. One such method is the use of a cyclic corrosion chamber that incorporates a drying cycle and uses a dilute aqueous salt solution. This cyclic test is described in ASTM G 85, *Standard Practice for Modified Salt Spray (Fog) Testing, Annex A5. Dilute Electrolyte Cyclic Fog/Dry Test* (1994). This test procedure, coupled with ASTM G 53, *Standard Practice for Operating Light- and Water-*

Exposure Apparatus (Fluorescent UV-Condensation Type) for Exposure of Nonmetallic Materials (1991), reportedly produces coating failure modes similar to those observed in actual atmospheric weathering and results in improved rank correlations between exterior-exposed and laboratory-exposed test panels (Simpson, Ray, and Skerry 1991).

Six test panels from each system were exposed in a slightly modified version of a G 53/G 85 cyclic test. The concentration of the dilute salt solution was 0.4 percent ammonium sulfate and 0.05 percent sodium chloride. The salt spray temperature was 30 °C and the dry-off temperature was 40 °C. The UV-condensing cabinet was run at 60 °C during the 4h UV cycle (UV-A bulbs) and at 50 °C during the 4h condensation cycle. Samples were exposed for 1 week in the G 53 cabinet followed by 1 week in the G 85 cabinet. Coating system Number 2 from CWGS-09940 was used as an internal control. This system consists of "SSPC-Paint 25" (1st coat) and "TT-P-38, Paint, Aluminum, Ready Mixed" (2d and 3d coats).

The aluminum epoxy coatings were also evaluated for ease of application, mixing properties, sag resistance, leveling properties, film build properties, and ease of cleanup.

Inspection and Evaluation of Test Coupons

The coatings were periodically evaluated for rusting, blistering, and rust undercutting at the scribe in accordance with ASTM D610, SSPC-Vis. 2, ASTM D714, and ASTM D1654. A transparent grid overlay was used to enhance the results of the visual examination. Panels were rated at 336, 672, 1344, 2016, 2688, 3360, and 4032 hours.

Aluminum Epoxy Mastic Test Results and Discussion

The results of the periodic evaluations of the aluminum epoxy mastic coating systems exposed in the cyclic salt spray test are detailed in Appendix A and summarized in Table 2. Column 2 of Table 2 indicates the first appearance of blistering and the number of panels affected. Blistering at subsequent intervals is similarly indicated. Unless otherwise indicated, blistering occurred adjacent to the scribe and not over the entire face of the panel. First appearance of surface rusting is indicated in column 3 along with number of panels affected. Early rusting is often a good indicator of poor long-term performance. Column 4 shows the results of the rust undercutting analysis performed after completing the cyclic salt spray

Table 2. Aluminum epoxy mastic performance in cyclic salt spray test (4032 h).

Coating System	Blister – Occurrence at Scribe (# Panels)	Rust – First Occurrence (# Panels)	Scribe – Worst / Average Numerical Rating	Numerical – Blister / Rust / Scribe / Total
SSPC Paint 25 TT-P-38	3360 (6) 4032 (6)	672 (6)	7 / 8.8	7.2 / 9.2 / 8.8 / 25.2
S-W Ep Mastic Alum II S-W Ep Mastic Alum II	4032 (0)	672 (4)	6 / 6.3	10.0 / 9.0 / 6.3 / 25.3
S-W Sur Tol Epoxy S-W Sur Tol Epoxy	3360 (6) 4032 (6)	672 (2)	5 / 5.8	5.2 / 9.5 / 5.8 / 20.5
Devoe Bar Rust 239 Devoe Bar Rust 239	4032 (6)	672 (3)	6 / 6.8	7.3 / 9.3 / 6.8 / 23.5
Sigma Colturiet TCP Sigma Colturiet TCP	3360 (6) 4032 (6)	672 (1)	6 / 6.8	5.2 / 9.5 / 6.8 / 21.5
International Magna Mastic 7900 (1 coat)	2016 (2) not just at scribe 2688 (4) 3360 (6) 4032 (6)	672 (6)	9 / 9.0	5.3 / 1.7 / 9.0 / 16.0
International Intergard Universal Alum (1 coat)	3360 (6) 4032 (6)	672 (1)	6 / 8.0	6.5 / 9.5 / 8.0 / 24.0
Carbomastic 15LO Carbomastic 15LO	3360 (2) 4032 (5)	672 (1)	8 / 9.0	6.7 / 9.3 / 9.0 / 25.0
Carbomastic 90 Alum Carbomastic 90 Alum	4032 (3)	672 (1)	9 / 9.7	9.0 / 9.3 / 9.7 / 28.0
S-W Macropoxy Alum S-W Macropoxy Alum	3360 (6) 4032 (6)	none at 4032	4 / 5.7	4.2 / 10.0 / 5.7 / 19.9
Hempadur 4515-1987 Hempadur 4515-1987	2016 (1) 2688 (1) 3360 (6) 4032 (6)	none at 4032	5 / 6.0	3.8 / 10.0 / 6.0 / 19.8
Totals all AEM	2016 (0.3) 2688 (0.5) 3360 (3.8) 4032 (5.0)	672 (1.9)	6.6 / 7.3	6.3 / 7.8 / 7.3 / 21.4
Control	3360 (6) 4032 (6)	672 (6)	7 / 8.8	7.2 / 9.2 / 8.8 / 25.2

test. The first number indicates the lowest rating of the six test panels and the second number is the average numerical rating for all six panels. Column 5 lists the average numerical ratings and composite score for each coating system. The numerical rating for blistering is based only on the area adjacent to the scribe and not on the entire facial area of the test panels. The numerical blister rating is the average of the sum of the numerical ratings for blister frequency and size. Blister frequency is converted as follows: none = 10, few = 8, medium = 6, medium dense = 4, dense = 2, complete = 0. Averages for the 10 aluminum epoxy mastic systems are shown at the bottom of Table 2.

Early blistering is also known to correlate well with inferior long-term performance. On the average, first blistering occurred after 3360 hours of testing. This is true of 5 of the 10 epoxy systems as well as the control. First blistering occurred later (4032 h) or not at all for 3 epoxies and earlier for 2 others. One epoxy system experienced blistering over the entire panel and not just adjacent to the scribe. The final average blister rating for the group of epoxies was slightly lower than that observed for the control system, 6.3 versus 7.2. Three of the epoxy systems were more resistant to blistering than the control and two of these also had high composite scores.

First rusting typically appeared at the second inspection interval (672 h). This is true of all but two epoxy systems that did not exhibit surface rusting for the duration of the test exposure. Appearance of first rusting did not differ greatly between the control system and epoxy coatings. The average final rust rating of the epoxies was much lower than observed for the control system. However, all but one epoxy system scored near or above the control system while one product offered little corrosion protection in this test. The average rust rating of the nine best epoxies was 9.6.

The average rating for rust undercutting did not deviate drastically between test specimens for a given coating system. The average numerical rating for undercutting the epoxy systems was significantly lower than for the control system, 7.3 versus 8.8. However, three epoxy systems had better resistance to undercutting than the control system and two of these had excellent composite scores.

The average composite score of the aluminum epoxy mastics was significantly lower than the control system, 21.4 versus 25.2. Only two of the epoxy systems outperformed the control system. Overall, six of the aluminum epoxy mastic systems exhibited good to excellent performance, three fair, and only one poor.

3 Evaluation of Epoxy Primer/Urethane Topcoat Systems

Selection of Test Coatings

Ten commercially available epoxy/urethane coating systems were selected for evaluation. The selected systems are American made. The test coatings have a maximum VOC as applied of 340 g/L for the epoxy primer and 450 g/L for the urethane topcoat. The selected coatings are compatible with minimally prepared rusted steel substrates. Table 3 lists the epoxy/urethane coating systems.

Preparation of Test Specimens

Test panels were prepared and coatings were applied in the same manner as described above for the aluminum epoxy mastic coating systems. Standard Corps of Engineers coating system number 16 was applied as a control. This system, described in CWGS-09940, consists of SSPC Paint No. 25 (1st coat) and TT-E-489 (2d and 3d coats). Average dry film thicknesses for each system are listed in Table 3. Dry film thicknesses for individual panels can be found in Appendix B.

Test Methods

Test panels were exposed as described above for the aluminum epoxy mastic coating systems.

Inspection and Evaluation of Test Coupons

The coatings were periodically evaluated as described for the aluminum epoxy mastic coating systems except that panels were rated at 336, 672, 1344, 2016, 2688, and 3360 hours. In addition to corrosion degradation, each test system was evaluated for percent gloss retention. Gloss retention is primarily an appearance consideration and is not necessarily an indicator of coating performance.

Table 3. Epoxy/urethane coating systems.

Manufacturer	Product Name	VOC (g/L)	Dry Film Thickness (0.001 in)
Davis Industrial Paint	SSPC Paint 25 TT-P-489 (2 coats)	~290 <420	2.0 2.6/3.2 7.8 (total)
Carboline	Carbomastic 90 Carbothane 134HS	84 288	6.0 4.7 10.7 (total)
International	Intergard HS Universal Epoxy Interthane	192 414	6.1 3.4 9.5 (total)
Devoe	Bar Rust 236 Devthane 379	170 327	5.0 3.6 8.6 (total)
Sherwin-Williams	Surface Tolerant Epoxy High Solids Polyurethane	174 289	6.7 3.0 9.6 (total)
Devoe	Bar Rust 239 Devthane 379	86 327	5.7 3.3 9.0 (total)
Hempel	Hempadur 4515/1987 Hempathane 5521/1148	180 450	8.0 1.9 9.9 (total)
Sherwin-Williams	Macropoxy Acrothane	175 346	5.5 2.2 7.7 (total)
Sigma Coatings	EPTCP Aluminum VHSA Polyurethane	240 372	6.5 3.9 10.4 (total)
Carboline	Carbomastic 15LO Carbothane 134HS	88 288	5.4 6.8 12.2 (total)
Devoe	Devran 224 Devthane 379	340 327	5.1 3.0 8.1 (total)

Epoxy/Urethane Test Results and Discussion

The results of the periodic evaluations of the epoxy/urethane coating systems exposed in the cyclic salt spray test are detailed in Appendix B and summarized in Table 4. Column 2 of Table 4 indicates the first appearance of blistering and the number of panels effected. Blistering at subsequent intervals is similarly indicated.

Column 3 shows the percent gloss retention. Column 4 shows the results of the rust undercutting analysis performed after completion of the cyclic salt spray test.

Table 4. Epoxy/urethane performance in cyclic salt spray test (3360h).

Coating System	Blister - Occurrence at Scribe (# Panels)				Gloss Retention	Scribe – Worst and Average Numerical Rating	Numerical – Blister / Rust / Scribe / Total
	1344	2016	2688	3360			
SSPC 25 TT-E-489	1344 (4)	2016 (6)	2688 (6)	3360 (6)	58.0%	5 / 6.7	3.6 / 10 / 6.7 / 20.3
Carbomastic 90 Carbothane 134HS	1344 (0)	2016 (0)	2688 (3)	3360 (3)	90.4%	8 / 8.7	8.7 / 10 / 8.7 / 27.4
Intergard HS Interthane	1344 (0)	2016 (0)	2688 (2)	3360 (2)	94.1%	8 / 9.0	9.0 / 10 / 9.0 / 28.0
Bar Rust 236 Devthane 379	1344 (5)	2016 (6)	2688 (6)	3360 (6)	92.3%	5 / 6.7	3.7 / 10 / 6.7 / 20.4
S-W Sur Tol Epoxy S-W Hi Sol PU	1344 (1)	2016 (1)	2688 (2)	3360 (2)	38.1%	8 / 8.8	9.3 / 10 / 8.8 / 28.1
Bar Rust 239 Devthane 379	1344 (5)	2016 (5)	2688 (6)	3360 (6)	13.7%	6 / 6.5	4.0 / 10 / 6.5 / 20.5
Hempadur 1987 Hempathane 1148	1344 (6)	2016 (6)	2688 (6)	3360 (6)	99.3%	6 / 6.8	2.8 / 10 / 6.8 / 19.6
S-W Macropoxy S-W Acrothane	1344 (6)	2016 (6)	2688 (6)	3360 (6)	70.3%	5 / 6.2	2.7 / 10 / 6.2 / 18.9
Sigma EPTCP Sigma VHSA PU	1344 (5)	2016 (5)	2688 (5)	3360 (6)	92.1%	8 / 8.5	5.8 / 10 / 8.5 / 24.3
Carbomastic 15LO Carbothane 134HS	1344 (0)	2016 (0)	2688 (3)	3360 (3)	95.4%	6 / 7.8	8.3 / 10 / 7.8 / 26.1
Devran 224 Devthane 379	1344 (5)	2016 (6)	2688 (6)	3360 (6)	99.3%	5 / 6.5	4.5 / 10 / 6.5 / 21.0
Totals all e/u coatings Control	<u>1344</u> 3.30 4	<u>2016</u> 3.50 6	<u>2688</u> 4.20 6	<u>3360</u> 4.30 6	78.5% 58.0%	6.5 / 7.5 5.0 / 6.7	5.9 / 10 / 7.5 / 23.4 3.6 / 10 / 6.7 / 20.3

The first number indicates the lowest rating of the six test panels and the second number is the average numerical rating for all six panels. Column 5 lists the average numerical ratings and composite score for each coating system. The numerical rating for blistering is based only on the area adjacent to the scribe and not on the entire facial area of the test panels. Averages for the 10 epoxy/urethane systems are shown at the bottom of Table 4.

Early blistering is known to correlate well with inferior long-term performance. On average first blistering occurred after 1344 hours of testing. This is true of seven of the 10 epoxy/urethane systems as well as the control. First blistering occurred later (2688 h) for three epoxy/urethane systems. The final average blister rating for all of the epoxy/urethane systems was significantly higher than that observed for the control system, 5.9 versus 3.6. Eight of the epoxy/urethane systems are more resistant to blistering than the control system. Blistering was only observed adjacent to the scribe and general blistering was not seen for any of the coating systems.

Early rusting in accelerated testing is often a sign of poor long-term performance. None of the epoxy/urethane systems or the control exhibited any surface rusting for the duration of the test.

The average numerical rating for rust undercutting did not deviate drastically between test specimens for a given coating system. The average numerical rating for undercutting for the epoxy/urethane systems was slightly better than for the control system, 7.5 versus 6.7. Seven epoxy/urethane systems have as good or better resistance to undercutting than the control system.

The average percent gloss retention for the epoxy/urethane systems is significantly better than the control system, 78.5 versus 58.0 percent. All but two of the test systems have gloss retentions superior to the control.

The average composite score of the epoxy/urethane systems was significantly higher than the control system, 23.4 versus 20.3. Only two of the epoxy/urethane systems failed to outperform the control system. Overall, five of the epoxy/urethane systems exhibited good to excellent performance and five fair performance.

4 Determination of Coating System Salient Characteristics

Commercial Item Descriptions

GSA authorizes the use of a wide variety of CIDs including those for protective coatings and related materials. GSA is usually the preparing activity for these CIDs, but this is not a requirement. In some cases, a DOD agency is the preparing activity; for example the Navy is the preparing activity for “CID, A-A-50542, Coating System: Reflective, Slip-Resistant, Chemical-Resistant Urethane for Maintenance Facility Floors.”

CIDs are flexible procurement documents. There is no single format or prescription, although CIDs prepared by GSA follow a fairly well established format, including a title, description of salient characteristics, certification, regulatory, and packaging, packing, and marking requirements, and in some cases, quantitative requirements. A-A-50542, prepared by the Navy, is much longer than the average GSA-prepared CID and includes additional sections on quality assurance and supply sources. The description of the salient characteristics is the heart of the CID.

Salient Characteristics for Aluminum Epoxy Mastic and Epoxy/Urethane Systems

Appendixes C and D contain draft CIDs for aluminum epoxy mastic and epoxy/urethane systems for use on minimally prepared atmospherically exposed steel surfaces. The draft CIDs closely follow the format of the Navy prepared CID, A-A-50542, and include an abstract, salient characteristics, notes, and sections on quality assurance and packaging.

The abstract presents a brief description of the product and its intended use. The salient characteristics section presents the requirements for the basic properties and performance requirements for the coating system. The quality assurance section spells out responsibilities, and inspection and certification requirements.

The packaging section contains provisions for labeling and packaging, and safety and application data requirements. The notes provide additional relevant information including usage constraints, timeliness for qualification, and sources of products.

The salient characteristics are the most important part of the CID and the rationale behind each of the requirements is therefore also important. The application properties and appearance of the dried paint film provide for defect-free application and curing at the manufacturers' recommended film thickness as applied by commonly used application methods. The dry time requirements are consistent with applying a two-coat system in a 2-day period. The pot life requirements provide for a material that remains usable over a reasonable period of time. Intercoat adhesion requirements ensure that the coating can be successfully topcoated even after a moderate delay in the painting schedule. Requirements for accelerated corrosion assure a level of corrosion protection consistent both with existing Corps painting practices and superior products of the type being evaluated. Requirements for volatile organics ensure compliance with environmental regulations where applicable and with DOD goals associated with pollution prevention.

5 Conclusions and Recommendations

Performance of Aluminum Epoxy Mastics Versus Standard Corps System

Four of the 10 aluminum epoxy mastic systems evaluated meet the performance criteria established in the draft CID. Three of these materials exhibit better overall performance in accelerated corrosion testing than does the standard Corps system for this application. The four products meeting the draft criteria have slightly superior resistance to blistering and slightly inferior resistance to rust undercutting in comparison with the standard Corps system. Rust inhibitive primers, such as those used in the standard Corps system, are more effective at reducing undercutting at film discontinuities and damaged areas than are thick film barrier systems such as epoxies. Conversely, barrier epoxy coatings often provide superior moisture and blister resistance. Overall, coatings complying with the requirements of the draft CID should provide excellent corrosion protection over minimally prepared steel surfaces.

Performance of Epoxy/Urethane Systems Versus Standard Corps System

Four of the 10 epoxy/urethane systems evaluated meet the performance criteria established in the draft CID. Each of these materials exhibit better overall performance in accelerated corrosion testing than does the standard Corps system for this application. Four other systems also outperformed the Corps standard; however, each of these systems exhibited early blistering adjacent to the scribe that progressed to a greater extent than the systems meeting the criteria. Overall, coatings complying with the requirements of the draft CID should provide excellent corrosion protection over minimally prepared steel surfaces.

Commercial Availability

Aluminum epoxy mastic and epoxy/urethane systems are widely available. The products evaluated here represent a small cross section of the available products. CIDs for these systems should make these products widely available to the Corps as well as to other federal end users.

Air Pollution Regulations

Air pollution regulations stemming from the Clean Air Act Amendments of 1990 and earlier legislation place limitations on the amount of volatile organic solvents that paints may contain. The EPA is working to establish a rule with a national scope for architectural and industrial maintenance coatings. However, at this time the EPA has not produced a final rule and the exact categorization and allowable VOC contents are subject to speculation. Existing and proposed rules in California and other states offer a more well-defined target. A review of EPA deliberations and proposed and existing state and local rules suggests an upper limit of 340 g/L for industrial maintenance coatings. This limit is recommended for the aluminum epoxy mastic system and the epoxy primer of the epoxy/urethane system. Half of the urethane topcoats evaluated either approach or exceed the 340 g/L level. An interim VOC level of 420 g/L for the urethane topcoat is recommended.

General Services Administration

It is recommended that the draft CIDs for aluminum epoxy mastic and epoxy/urethane systems be submitted to GSA for coordination, review, and authorization.

Corps of Engineers

It is recommended that the Corps revise CWGS-09940 to include the subject CIDs. The CIDs should be established as alternatives to systems number 2 and 16 of CWGS-09940.

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Federal Specification TT-E-489, *Enamel, Alkyd, Gloss, Low VOC Content* (1994).

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Appendix A: Aluminum Epoxy Mastic Test Results

US ARMY CORP OF ENGINEERS	ALUMINUM EPOXY MASTIC PROGRAM
COATING SYSTEM DATA	
COATING ID	CARBOMASTIC 15LO
MANUFACTURER	CARBOLINE
VOLUME % SOLIDS	90% +/- 2%
VOC	0.74 LB/GAL (88 G/L)
POT LIFE	4 HOURS @ 75F
INDUCTION TIME	NONE
DRYING TIME MINIMUM	RECOAT 24 HOURS @ 75F / FULL CURE 5 DAYS @ 75F
RECOMMENDED FILM THICKNESS	MILS PER COAT : DRY 5.7 / WET 5.5-7.5
MIXING RATIOS	1 PART A : 1 PART B BY VOLUME
THINNING	
APPLICATION DATA	
DATE/TIME	3/10/93 @ 2:00 P.M.
RH	63%
TEMPERATURE	73F
SUBSTRATE CONDITION	CARBOMASTIC 15LO
COATING BATCH NUMBERS	A: 3A7722L / B: 3A7697L
THINNING	#76 @ 20%
EQUIPMENT	DEVILBISS MBC 704E
NUMBER OF COATS	2ND
SAG INDEX	9 MILS THINNED 20%
DRY FILM THICKNESS, MILS	
SAMPLE 55	4.6
SAMPLE 56	5.3
SAMPLE 57	5.4
SAMPLE 58	5.2
SAMPLE 59	4.8
SAMPLE 60	4.7
1st COAT	
	4.6
2nd COAT	
	6
TOTAL	
	10.6
1st COAT	
	5.3
2nd COAT	
	6
TOTAL	
	11.3
1st COAT	
	5
2nd COAT	
	5
TOTAL	
	10.4
1st COAT	
	4.4
2nd COAT	
	4.4
TOTAL	
	9.8
1st COAT	
	5.6
2nd COAT	
	5.6
TOTAL	
	10.4
1st COAT	
	5.3
2nd COAT	
	5.3
TOTAL	
	10

PANEL EVALUATION	CARBOMASTIC 15LO
CLIENT: U.S. Army Corp of Eng.	
ALUMINUM/EPOXY MASTIC PROGRAM	
DATE: 4/19/93	
EVALUATION HOURS: 672	
COATING EVALUATION DATA	
TEST PANEL NUMBER	55 56 57 58 59 60
ASTM D610 RUST GRADE	0 0 0 0 0 0.03%
ASTM D714 DEGREE OF BLISTERING, SIZE	0 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0 0 0 0 0 0
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS	
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	FINAL EVALUATION ONLY
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	FINAL EVALUATION ONLY
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0 0 0 0 0 <1%
TABLE 2, RATING # OF UNSCRIBED AREAS	10 10 10 10 10 9
COMMENTS	

PANEL EVALUATION	CARBOMASTIC 15LO
CLIENT: U.S. Army Corp of Eng. ALUMINUM/EPOXY MASTIC PROGRAM DATE: 5/17/93 EVALUATION HOURS: 1344	
COATING EVALUATION DATA	
TEST PANEL NUMBER	55 56 57 58 59 60
ASTM D610 RUST GRADE	0 0 0 0 0.03% 0.03%
ASTM D714 DEGREE OF BLISTERING, SIZE	0 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0 0 0 0 0 0
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED TABLE 2, RATING # OF UNSCRIBED AREAS	
FINAL EVALUATION ONLY	
FINAL EVALUATION ONLY	
0	0 0 0 0 <1% <1%
10	10 10 10 10 9 9
COMMENTS	

PANEL EVALUATION	CARBOMASTIC 15LO
CLIENT: U.S. Army Corp of Eng. ALUMINUM/EPOXY MASTIC PROGRAM DATE: 6/14/93 EVALUATION HOURS: 2016	
COATING EVALUATION DATA	
TEST PANEL NUMBER	55 56 57 58 59 60
ASTM D610 RUST GRADE	0 0 0 0 0.03% 0.03%
ASTM D714 DEGREE OF BLISTERING, SIZE	0 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0 0 0 0 0 0
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS	
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	FINAL EVALUATION ONLY
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	FINAL EVALUATION ONLY
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0 0 0 0 <1% <1%
TOTAL RATING # OF UNSCRIBED AREAS	10 10 10 10 9 9
COMMENTS	

PANEL EVALUATION	CARBOMASTIC 15LO
CLIENT: U.S. Army Corp of Eng. ALUMINUM/EPOXY MASTIC PROGRAM DATE: 7/12/93 EVALUATION HOURS: 2688	
COATING EVALUATION DATA	
TEST PANEL NUMBER	55 56 57 58 59 60
ASTM D610 RUST GRADE	0.10% 0 0 0 0.10% 0.10%
ASTM D714 DEGREE OF BLISTERING, SIZE	0 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0 0 0 0 0 0
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS	
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	FINAL EVALUATION ONLY
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	FINAL EVALUATION ONLY
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	<1% 0 0 0 <1% <1%
TABLE 2, RATING # OF UNSCRIBED AREAS	9 10 10 10 9 9
COMMENTS	

PANEL EVALUATION	CARBOMASTIC 15LO
CLIENT: U.S. Army Corp of Eng. ALUMINUM/EPOXY MASTIC PROGRAM DATE: 8/9/93 EVALUATION HOURS: 3360	
COATING EVALUATION DATA	
TEST PANEL NUMBER	55 56 57 58 59 60
ASTM D610 RUST GRADE	0.10% 0 0.03% 0.10% 0.10%
ASTM D714 DEGREE OF BLISTERING, SIZE	0 0 0 0 8 8
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0 0 0 0 Few Few
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED TABLE 2, RATING # OF UNSCRIBED AREAS	
FINAL EVALUATION ONLY	
FINAL EVALUATION ONLY	
<1%	0 0 <1% <1% <1%
9	10 10 9 9 9

PANEL EVALUATION		CARBOMASTIC 15LO					
CLIENT: U.S. Army Corp of Eng.							
ALUMINUM/EPOXY MASTIC PROGRAM							
DATE: 9/6/93							
EVALUATION HOURS: 4032-Final							
COATING EVALUATION DATA							
TEST PANEL NUMBER	55	56	57	58	59	60	COMMENTS
ASTM D610 RUST GRADE	0.10%	0	0	0.03%	0.10%	0.10%	Blistering has occurred only along the scribe edges.
ASTM D714 DEGREE OF BLISTERING, SIZE	0	6	4	4	4	6	
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0	Few	Few	Few	Med	Med	
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS							
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	0	1/64"	1/64"	1/64"	1/32"	1/64"	Loss of adhesion and underfilm rust creepage from scribe has occurred only under blisters.
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	10	9	9	9	8	9	
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	<1%	0	0	<1%	<1%	<1%	
TABLE 2, RATING # OF UNSCRIBED AREAS	9	10	10	9	9	9	

US ARMY CORP OF ENGINEERS	ALUMINUM EPOXY MASTIC PROGRAM
COATING SYSTEM DATA	
COATING ID	CARBOMASTIC 90 ALUMINUM (REPLACES KOPCOTE ALUMINUM MASTIC)
MANUFACTURER	CARBOLINE
VOLUME % SOLIDS	90% +/- 2%
VOC	0.70 LB/GAL (84 G/L)
POT LIFE	4 HOURS @ 75F
INDUCTION TIME	NONE
DRYING TIME MINIMUM	RECOAT 12 HOURS @ 75F / FULL CURE 2 DAYS @ 75F
RECOMMENDED FILM THICKNESS	MILS PER COAT : DRY 5 / WET 5.5
MIXING RATIOS	1 PART A : 1 PART B BY BOLUME
THINNING	#2 THINNER @ 25% MAXIMUM
APPLICATION DATA	
DATE/TIME	3/11/93 @ 1:00 P.M.
RH	52%
TEMPERATURE	72F
SUBSTRATE CONDITION	SSPC VIS 1-C @ 2-2.5 MILS PROFILE
COATING BATCH NUMBERS	A: 2K3751M / B: 2H3301M
THINNING	#2 @ 25%
EQUIPMENT	DEVILBISS MBC 704E
NUMBER OF COATS	1ST COAT
SAG INDEX	20 MILS
DRY FILM THICKNESS, MILS	
SAMPLE 61	5.2
SAMPLE 62	5.1
SAMPLE 63	4.48
SAMPLE 64	5.2
SAMPLE 65	5.8
SAMPLE 66	5.4
1st COAT	
3/11/93 @ 1:00 P.M.	
52%	
72F	
SSPC VIS 1-C @ 2-2.5 MILS PROFILE	
A: 2K3751M / B: 2H3301M	
#2 @ 25%	
DEVILBISS MBC 704E	
1ST COAT	
20 MILS	
2nd COAT	
3/12/93 @ 1:00 P.M.	
61%	
75F	
CARBOMASTIC 90 ALUMINUM	
A: 2K3751M / B: 2H3301M	
#2 @ 25%	
DEVILBISS MBC 704E	
2ND COAT	
20 MILS	
TOTAL	
11.2	
11.3	
9.88	
10.2	
12.6	
11.8	

PANEL EVALUATION	CARBOMASTIC 90 ALUMINUM																														
CLIENT: U.S. Army Corp of Eng. ALUMINUM/EPOXY MASTIC PROGRAM DATE: 4/19/93 EVALUATION HOURS: 672																															
COATING EVALUATION DATA																															
TEST PANEL NUMBER	61 62 63 64 65 66																														
ASTM D610 RUST GRADE	0 0 0 0 0.03% 0																														
ASTM D714 DEGREE OF BLISTERING, SIZE	0 0 0 0 0 0																														
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0 0 0 0 0 0																														
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS																															
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10%;"></td> </tr> <tr> <td colspan="10" style="text-align: center;">FINAL EVALUATION ONLY</td> </tr> <tr> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> </table>											FINAL EVALUATION ONLY																			
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MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10%;"></td> </tr> <tr> <td colspan="10" style="text-align: center;">FINAL EVALUATION ONLY</td> </tr> <tr> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> </table>											FINAL EVALUATION ONLY																			
FINAL EVALUATION ONLY																															
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10%;"></td> </tr> <tr> <td style="text-align: center;">0</td> <td style="text-align: center;"><1%</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> </tr> </table>											0	0	0	0	0	<1%	0	0	0	0										
0	0	0	0	0	<1%	0	0	0	0																						
TABLE 2, RATING # OF UNSCRIBED AREAS	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10%;"></td> </tr> <tr> <td style="text-align: center;">10</td> <td style="text-align: center;">9</td> <td style="text-align: center;">10</td> <td style="text-align: center;">10</td> <td style="text-align: center;">10</td> <td style="text-align: center;">10</td> </tr> </table>											10	10	10	10	10	9	10	10	10	10										
10	10	10	10	10	9	10	10	10	10																						
COMMENTS																															

PANEL EVALUATION	CARBOMASTIC 90 ALUMINUM
CLIENT: U.S. Army Corp of Eng. ALUMINUM/EPOXY MASTIC PROGRAM DATE: 6/14/93 EVALUATION HOURS: 2016	
COATING EVALUATION DATA	
TEST PANEL NUMBER	61 62 63 64 65 66
ASTM D610 RUST GRADE	0 0.03% 0 0.03% 0.10% 0
ASTM D714 DEGREE OF BLISTERING, SIZE	0 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0 0 0 0 0 0
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS	
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	FINAL EVALUATION ONLY
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	FINAL EVALUATION ONLY
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0 <1% 0 <1% <1% 0
TOTAL RATING # OF UNSCRIBED AREAS	10 9 10 9 9 10
COMMENTS	

PANEL EVALUATION	CARBOMASTIC 90 ALUMINUM									
CLIENT: U.S. Army Corp. of Eng.										
ALUMINUM/EPOXY MASTIC PROGRAM										
DATE: 7/12/93										
EVALUATION HOURS: 2688										
COATING EVALUATION DATA										
TEST PANEL NUMBER	61	62	63	64	65	66				
ASTM D610 RUST GRADE	0	0.10%	0.03%	0.10%	0.10%	0				
ASTM D714 DEGREE OF BLISTERING, SIZE	0	0	0	0	0	0				
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0	0	0	0	0	0				
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS										
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	FINAL EVALUATION ONLY									
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	FINAL EVALUATION ONLY									
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0	<1%	<1%	<1%	<1%	0				
TABLE 2, RATING # OF UNSCRIBED AREAS	10	9	9	9	9	10				
COMMENTS										

PANEL EVALUATION	CARBOMASTIC 90 ALUMINUM
CLIENT: U.S. Army Corp of Eng. ALUMINUM/EPOXY MASTIC PROGRAM DATE: 8/9/93 EVALUATION HOURS: 3360	
COATING EVALUATION DATA	
TEST PANEL NUMBER	61 62 63 64 65 66
ASTM D610 RUST GRADE	0 0.10% 0.03% 0.10% 0.10% 0
ASTM D714 DEGREE OF BLISTERING, SIZE	0 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0 0 0 0 0 0
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS	
MEANS CREEPAGE FROM SCRIBE, TABLE 1, INCHES	FINAL EVALUATION ONLY
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	FINAL EVALUATION ONLY
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0 < 1% < 1% < 1% < 1% < 1% 0
TABLE 2, RATING # OF UNSCRIBED AREAS	10 9 9 9 9 10
COMMENTS	

PANEL EVALUATION		CARBOMASTIC 90 ALUMINUM									
CLIENT: U.S. Army Corp of Eng.											
ALUMINUM/EPOXY MASTIC PROGRAM											
DATE: 9/6/93											
EVALUATION HOURS: 4032-Final											
COATING EVALUATION DATA											
TEST PANEL NUMBER	61	62	63	64	65	66	COMMENTS				
ASTM D610 RUST GRADE	0	0.10%	0.03%	0.10%	0.10%	0	Blistering has occurred only along scribe edges.				
ASTM D714 DEGREE OF BLISTERING, SIZE	8	8	8	0	0	0					
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	Few	Few	Few	0	0	0					
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS											
MEANS CREEPAGE FROM SCRIBE, TABLE 1, INCHES	0	1/64"	1/64"	0	0	0	The only loss of adhesion and underfilm rusting from the scribe has occurred under blisters.				
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	10	9	9	10	10	10					
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0	<1%	<1%	<1%	<1%	0					
TABLE 2, RATING # OF UNSCRIBED AREAS	10	9	9	9	9	10					

US ARMY CORP OF ENGINEERS		ALUMINUM EPOXY MASTIC PROGRAM	
COATING SYSTEM DATA			
COATING ID	INDUSTRIAL ALUMINUM TT-P-38		
MANUFACTURER	DAVIS INDUSTRIAL COATING		
VOLUME % SOLIDS	NOT AVAILABLE		
VOC	NOT AVAILABLE		
POT LIFE	NOT AVAILABLE		
INDUCTION TIME	NOT AVAILABLE		
DRYING TIME MINIMUM	NOT AVAILABLE		
RECOMMENDED FILM THICKNESS	NOT AVAILABLE		
MIXING RATIOS	SINGLE COMPONENT		
THINNING	T-120 SPRAYING THINNER		
APPLICATION DATA			
DATE/TIME	3/11/93 @ 9:00 AM	3/12/93 @ 2:00 PM	3/13/93 @ 2:00 PM
RH	61%	55%	60%
TEMPERATURE	75F	70F	71F
SUBSTRATE CONDITION	SSPC VIS1-C@2 MILS	SSPC SP5 RED OXIDE	TT-P-2-38 Aluminum
COATING BATCH NUMBERS	07172139, LOT 793	UHA10993C	UHA10993C
THINNING	NONE	NONE	NONE
EQUIPMENT	BINKS CONVENTIONAL	BINKS CONVENTIONAL	BINKS CONVENTIONAL
NUMBER OF COATS	1	1ST	2ND
SAG INDEX	4 MILS	3 MILS	3 MILS
DRY FILM THICKNESS, MILS			
SAMPLE 33	2	1.3	1.9
SAMPLE 34	2.4	1.1	2.4
SAMPLE 35	2.1	1.3	2
SAMPLE 36	2.5	1.4	2.2
SAMPLE 37 B*	2.2	1.6	1.9
SAMPLE 38 B	2.2	1.2	2.1
			TOTAL
			5.2
			5.9
			5.4
			6.1
			5.7
			5.5

PANEL EVALUATION	SSPC 25 / TT-P-38
CLIENT: U.S. Army Corp of Eng. ALUMINUM/EPOXY MASTIC PROGRAM DATE: 7/12/93 EVALUATION HOURS: 2688	
COATING EVALUATION DATA	
TEST PANEL NUMBER	33 34 35 36 37B 38B
ASTM D610 RUST GRADE	0.03% 0.03% 0.03% 0.03% 0.03% 0.03%
ASTM D714 DEGREE OF BLISTERING, SIZE	0 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0 0 0 0 0 0
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED TABLE 2, RATING # OF UNSCRIBED AREAS	
FINAL EVALUATION ONLY	
FINAL EVALUATION ONLY	
<1%	<1% <1% <1% <1% <1% <1%
9	9 9 9 9 9 9
COMMENTS	

PANEL EVALUATION	SSPC 25 / TT-P-38					
CLIENT: U.S. Army Corp of Eng.						
ALUMINUM/EPOXY MASTIC PROGRAM						
DATE: 8/9/93						
EVALUATION HOURS: 3360						
COATING EVALUATION DATA						
TEST PANEL NUMBER	33	34	35	36	37B	38B
ASTM D610 RUST GRADE	0.03%	0.10%	0.10%	0.03%	0.03%	0.03%
ASTM D714 DEGREE OF BLISTERING, SIZE	8	8	8	8	8	6
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	Few	Few	Med	Dense	Med	Few
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS						
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES						
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER						
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	<1%	<1%	<1%	<1%	<1%	<1%
TABLE 2: RATING # OF UNSCRIBED AREAS	9	9	9	9	9	9
COMMENTS						
Blistering has occurred only along the edges of the scribe.						
FINAL EVALUATION ONLY						
FINAL EVALUATION ONLY						

PANEL EVALUATION	SSPC 25 / TT-P-38									
CLIENT: U.S. Army Corp of Eng.										
ALUMINUM/EPOXY MASTIC PROGRAM										
DATE: 9/6/93										
EVALUATION HOURS: 4032-Final										
COATING EVALUATION DATA										
TEST PANEL NUMBER	33	34	35	36	37B	38B				
ASTM D610 RUST GRADE	0.03%	0.10%	0.10%	0.03%	0.03%	0.03%	All blistering occurred along scribe edges.			
ASTM D714 DEGREE OF BLISTERING, SIZE	8	8	8	8	8	8				
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	Few	Few	Med	Dense	Med	Few				
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS										
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	IC/Steel	IC/Steel	IC/Steel	IC/Steel	IC/Steel	IC/Steel	IC/Steel	IC/Steel	IC/Steel	IC/Steel
	> 5/8	5/8 + 1/84	5/8 + 1/84	5/8 + 1/84	5/8 + 1/84	5/8 + 1/84	5/8 + 1/84	5/8 + 1/84	> 5/8 + 1/84	
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	0	10	0	9	0	9	0	9	0	7
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%
TABLE 2, RATING # OF UNSCRIBED AREAS	9	9	9	9	9	9	9	9	9	10
COMMENTS	Blistering along scribe edges was between primer and top coat. Loss of adhesion between primer and steel as well as under film rust creepage was very minimal.									

US ARMY CORP OF ENGINEERS	ALUMINUM EPOXY MASTIC PROGRAM
COATING SYSTEM DATA	
COATING ID	BAR RUST 239 EPOXY ALUMINUM MASTIC
MANUFACTURER	DEVOE COATINGS
VOLUME % SOLIDS	90%
VOC	0.72 LB/GAL (86 G/L)
POT LIFE	4 HOURS @ 77F
INDUCTION TIME	15 MIN @ 77F
DRYING TIME MINIMUM	RECOAT 8 HOURS @ 77F / FULL CURE 24 HOURS @ 77F
RECOMMENDED FILM THICKNESS	MILS PER COAT : DRY 6-8 / WET 6.7-8.9
MIXING RATIOS	1 PART A : 1 PART B BY VOLUME
THINNING	T-4 THINNER @ 10% MAXIMUM
APPLICATION DATA	
DATE/TIME	3/12/93 @ 10:00 A.M.
RH	61%
TEMPERATURE	75f
SUBSTRATE CONDITION	SSPC VIS 1-C @ 2.0 MILS PROFILE
COATING BATCH NUMBERS	A: N210202 / B: N210161
THINNING	T-4 @ 10%
EQUIPMENT	DEVILBISS MBC 704E
NUMBER OF COATS	1ST COAT
SAG INDEX	> 22 MILS
DRY FILM THICKNESS, MILS	
SAMPLE 19	5.5
SAMPLE 20	7
SAMPLE 21	5.5
SAMPLE 22	6.6
SAMPLE 23	7.6
SAMPLE 24	5.1
1st COAT	
2nd COAT	
TOTAL	

PANEL EVALUATION	BAR RUST 239 EPOXY ALUMINUM MASTIC					
CLIENT: U.S. Army Corp of Eng.						
ALUMINIUM/EPOXY MASTIC PROGRAM						
DATE: 4/5/93						
EVALUATION HOURS: 336						
COATING EVALUATION DATA						
TEST PANEL NUMBER	19	20	21	22	23	24
ASTM D610 RUST GRADE	0	0	0	0	0	0
ASTM D714 DEGREE OF BLISTERING, SIZE	0	0	0	0	0	0
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0	0	0	0	0	0
COMMENTS: There are no visible changes on any panels in this set after 336 hours of exposure.						
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS						
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES						
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER						
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0	0	0	0	0	0
TABLE 2, RATING # OF UNSCRIBED AREAS	10	10	10	10	10	10

PANEL EVALUATION	BAR RUST 239 EPOXY ALUMINUM MASTIC
CLIENT: U.S. Army Corp of Eng. ALUMINUM/EPOXY MASTIC PROGRAM DATE: 4/19/93 EVALUATION HOURS: 672	
COATING EVALUATION DATA	
TEST PANEL NUMBER	19 20 21 22 23 24
ASTM D610 RUST GRADE	0 0.03% 0.03% 0.03% 0 0
ASTM D714 DEGREE OF BLISTERING, SIZE	0 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0 0 0 0 0 0
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS	
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	FINAL EVALUATION ONLY
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	FINAL EVALUATION ONLY
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0 <1% <1% <1% 0 0
RATING # OF UNSCRIBED AREAS	10 9 9 9 10 10
COMMENTS	

PANEL EVALUATION		BAR RUST 239 EPOXY ALUMINUM MASTIC									
CLIENT: U.S. Army Corp. of Eng.											
ALUMINUM/EPOXY MASTIC PROGRAM											
DATE: 5/17/93											
EVALUATION HOURS: 1344											
COATING EVALUATION DATA											
TEST PANEL NUMBER	19	20	21	22	23	24	COMMENTS				
ASTM D610 RUST GRADE	0	0.03%	0.03%	0.03%	0.03%	0					
ASTM D714 DEGREE OF BLISTERING, SIZE	0	0	0	0	0	0					
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0	0	0	0	0	0					
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS											
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	FINAL EVALUATION ONLY										
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	FINAL EVALUATION ONLY										
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0	<1%	<1%	<1%	<1%	0					
TABLE 2, RATING # OF UNSCRIBED AREAS	10	9	9	9	9	10					

PANEL EVALUATION	BAR RUST 239 EPOXY ALUMINUM MASTIC					
CLIENT: U.S. Army Corp of Eng.						
ALUMINUM/EPOXY MASTIC PROGRAM						
DATE: 6/14/93						
EVALUATION HOURS: 2016						
COATING EVALUATION DATA					COMMENTS	
TEST PANEL NUMBER	19	20	21	22	23	24
ASTM D610 RUST GRADE	0	0.03%	0.03%	0.03%	0.03%	0
ASTM D714 DEGREE OF BLISTERING, SIZE	0	0	0	0	0	0
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0	0	0	0	0	0
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS						
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES						
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER						
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0	<1%	<1%	<1%	<1%	0
TOTAL RATING # OF UNSCRIBED AREAS	10	9	9	9	9	10

PANEL EVALUATION		BAR RUST 239 EPOXY ALUMINUM MASTIC									
CLIENT: U.S. Army Corp of Eng. ALUMINUM/EPOXY MASTIC PROGRAM DATE: 9/13/93 EVALUATION HOURS: 4032-FINAL											
COATING EVALUATION DATA											
TEST PANEL NUMBER		19	20	21	22	23	24				
ASTM D610 RUST GRADE		0	0.03%	0.03%	0.03%	0.03%	0	Blistering has occurred only along the scribe edges on this set of panels.			
ASTM D714 DEGREE OF BLISTERING, SIZE		8	8	4	6	8	8				
ASTM D714 DEGREE OF BLISTERING, FREQUENCY		Few	Few	Medium	Few	Few	Few				
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS											
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES		> 1/16"	1/16"	< 1/8"	1/8"	< 1/16"	1/64				
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER		6	7	6	6	7	9	Loss of adhesion and underfilm rust creepage from scribe has occurred under blisters.			
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED		0	< 1%	< 1%	< 1%	< 1%	0				
TABLE 2, RATING # OF UNSCRIBED AREAS		10	9	9	9	9	10				

US ARMY CORP OF ENGINEERS	ALUMINUM EPOXY MASTIC PROGRAM
COATING SYSTEM DATA	
COATING ID	HEMPADUR 4515-1987
MANUFACTURER	HEMPEL
VOLUME % SOLIDS	82%
VOC	1.5 LB/GAL (180 G/L)
POT LIFE	3 HOURS @ 68F
INDUCTION TIME	NONE
DRYING TIME MINIMUM	RECOAT 8 HOURS @ 68F / FULL CURE 7 DAYS @ 68F
RECOMMENDED FILM THICKNESS	MILS PER COAT : DRY 8 / WET 10
MIXING RATIOS	1 PART A : 1 PART B BY VOLUME
THINNING	#0846 THINNER @ 5% MAXIMUM
APPLICATION DATA	
DATE/TIME	3/12/93 @ 3:00 P.M.
RH	55%
TEMPERATURE	70F
SUBSTRATE CONDITION	SSPC VIS 1-C @ 2.0 MILS PROFILE
COATING BATCH NUMBERS	A: UH2820323 / B: UH1030166
THINNING	#0846 @ 5%
EQUIPMENT	DEVILBISS MBC 704E
NUMBER OF COATS	1
SAG INDEX	14 MILS
DRY FILM THICKNESS, MILS	
SAMPLE 72	8
SAMPLE 73	7.5
SAMPLE 74	8
SAMPLE 75	7
SAMPLE 76	8.5
SAMPLE 77	8
1st COAT	
3/12/93 @ 3:00 P.M.	
55%	
70F	
SSPC VIS 1-C @ 2.0 MILS PROFILE	
A: UH2820323 / B: UH1030166	
#0846 @ 5%	
DEVILBISS MBC 704E	
1	
14 MILS	
2nd COAT	
3/13/93 @ 8:00 A.M.	
59%	
71F	
HEMPADUR 4515/1987 (1ST COAT)	
A: UH2820323 / B: UH1030166	
#0846 @ 5%	
DEVILBISS MBC 704E	
1	
14 MILS	
TOTAL	
17	
15.4	
17.2	
16.3	
16	
17	

PANEL EVALUATION	HEMPADUR 4515/1987
CLIENT: U.S. Army Corp of Eng. ALUMINUM/EPOXY MASTIC PROGRAM DATE: 4/5/93 EVALUATION HOURS: 336	
COATING EVALUATION DATA	
TEST PANEL NUMBER	72 73 74 75 76 77
ASTM D610 RUST GRADE	0 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, SIZE	0 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0 0 0 0 0 0
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS	
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	FINAL EVALUATION ONLY
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	FINAL EVALUATION ONLY
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0 0 0 0 0 0
TOTAL RATING # OF UNSCRIBED AREAS	10 10 10 10 10 10
COMMENTS There are no visible changes on any panels in this set after 336 hours of exposure.	

PANEL EVALUATION	HEMPADUR 4515/1987									
CLIENT: U.S. Army Corp of Eng.										
ALUMINUM/EPOXY MASTIC PROGRAM										
DATE: 4/19/93										
EVALUATION HOURS: 672										
COATING EVALUATION DATA										
TEST PANEL NUMBER	72	73	74	75	76	77				
ASTM D610 RUST GRADE	0	0	0	0	0	0	There are no visible changes on any panels in this set after 672 hours of exposure			
ASTM D714 DEGREE OF BLISTERING, SIZE	0	0	0	0	0	0				
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0	0	0	0	0	0				
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS										
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	FINAL EVALUATION ONLY									
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	FINAL EVALUATION ONLY									
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0	0	0	0	0	0				
TABLE 2, RATING # OF UNSCRIBED AREAS	10	10	10	10	10	10				

PANEL EVALUATION		HEMPADUR 4515/1987					
CLIENT: U.S. Army Corp of Eng. ALUMINUM/EPOXY MASTIC PROGRAM DATE: 6/14/93 EVALUATION HOURS: 2016							
COATING EVALUATION DATA							
TEST PANEL NUMBER	72	73	74	75	76	77	COMMENTS
ASTM D610 RUST GRADE	0	0	0	0	0	0	
ASTM D714 DEGREE OF BLISTERING, SIZE	0	2	0	0	0	0	
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0	Few	0	0	0	0	
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS							
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	FINAL EVALUATION ONLY						
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	FINAL EVALUATION ONLY						
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0	0	0	0	0	0	
TOTAL RATING # OF UNSCRIBED AREAS	10	10	10	10	10	10	

PANEL EVALUATION	HEMPADUR 4515/1987																																																		
CLIENT: U.S. Army Corp of Eng. ALUMINUM/EPOXY MASTIC PROGRAM DATE: 7/12/93 EVALUATION HOURS: 2688																																																			
COATING EVALUATION DATA																																																			
TEST PANEL NUMBER	72 73 74 75 76 77																																																		
ASTM D610 RUST GRADE	0 0 0 0 0 0																																																		
ASTM D714 DEGREE OF BLISTERING, SIZE	0 2 0 0 0 0																																																		
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0 Few 0 0 0 0																																																		
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS																																																			
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES																																																			
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER																																																			
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED																																																			
TABLE 2, RATING # OF UNSCRIBED AREAS																																																			
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FINAL EVALUATION ONLY																																																			
FINAL EVALUATION ONLY																																																			
0	0	0	0	0	0	0	0	0	0																																										
10	10	10	10	10	10	10	10	10	10																																										
COMMENTS																																																			

US ARMY CORP OF ENGINEERS	ALUMINUM EPOXY MASTIC PROGRAM
COATING SYSTEM DATA	
COATING ID	INTERGARD UNIVERSAL ALUMINUM
MANUFACTURER	PORTER INTERNATIONAL
VOLUME % SOLIDS	80% +/- 2%
VOC	1.60 LB/GAL (192 G/L)
POT LIFE	4 HOURS @ 75F
INDUCTION TIME	15 MINS @ 75F
DRYING TIME MINIMUM	RECOAT 6 HOURS @ 75F / FULL CURE NOT STATED
RECOMMENDED FILM THICKNESS	MILS PER COAT : DRY 4-8 / WET 6.3-10.0
MIXING RATIOS	1 PART A : 1 PART B BY VOLUME
THINNING	#T-5 THINNER @ 12% MAXIMUM
APPLICATION DATA	
DATE/TIME	3/10/93 @ 4:00 P.M.
RH	63%
TEMPERATURE	73F
SUBSTRATE CONDITION	SSPC VIS 1-C @ 2.2 MILS PROFILE
COATING BATCH NUMBERS	A: UHA 10055B / B: UHN 12602M
THINNING	#T-5 @ 12%
EQUIPMENT	DEVILBISS MBC 704E
NUMBER OF COATS	1
SAG INDEX	> 24 MILS / 7 MILS THINNED 12%
DRY FILM THICKNESS, MILS	
SAMPLE 49	7.3
SAMPLE 50	6.9
SAMPLE 51	7.8
SAMPLE 52	6.7
SAMPLE 53	7.1
SAMPLE 54	8
1st COAT	
2nd COAT	
TOTAL	
7.3	
6.9	
7.8	
6.7	
7.1	
8	

PANEL EVALUATION	INTERGARD UNIVERSAL ALUMINUM																		
CLIENT: U.S. Army Corp of Eng. ALUMINUM/EPOXY MASTIC PROGRAM DATE: 4/5/93 EVALUATION HOURS: 336																			
COATING EVALUATION DATA																			
TEST PANEL NUMBER	49 50 51 52 53 54																		
ASTM D610 RUST GRADE	0 0 0 0 0 0																		
ASTM D714 DEGREE OF BLISTERING, SIZE	0 0 0 0 0 0																		
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0 0 0 0 0 0																		
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS																			
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td style="width: 16.6%;"> </td><td style="width: 16.6%;"> </td></tr> <tr><td colspan="6" style="text-align: center;">FINAL EVALUATION ONLY</td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> </table>							FINAL EVALUATION ONLY											
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MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td style="width: 16.6%;"> </td><td style="width: 16.6%;"> </td></tr> <tr><td colspan="6" style="text-align: center;">FINAL EVALUATION ONLY</td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> </table>							FINAL EVALUATION ONLY											
FINAL EVALUATION ONLY																			
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td style="width: 16.6%;"> </td><td style="width: 16.6%;"> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr> </table>													0	0	0	0	0	0
0	0	0	0	0	0														
TABLE 2, RATING # OF UNSCRIBED AREAS	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td style="width: 16.6%;"> </td><td style="width: 16.6%;"> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td>10</td><td>10</td><td>10</td><td>10</td><td>10</td><td>10</td></tr> </table>													10	10	10	10	10	10
10	10	10	10	10	10														
COMMENTS There are no visible effects on any panels in this set after 336 hours of exposure.																			

PANEL EVALUATION	INTERGARD UNIVERSAL ALUMINUM
CLIENT: U.S. Army Corp of Eng. ALUMINUM/EPOXY MASTIC PROGRAM DATE: 4/19/93 EVALUATION HOURS: 672	
COATING EVALUATION DATA	
TEST PANEL NUMBER	49 50 51 52 53 54
ASTM D610 RUST GRADE	0 0 0 0 0 0.03%
ASTM D714 DEGREE OF BLISTERING, SIZE	0 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0 0 0 0 0 0
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS	
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	FINAL EVALUATION ONLY
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	FINAL EVALUATION ONLY
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0 0 0 0 0 <1%
TABLE 2, RATING # OF UNSCRIBED AREAS	10 10 10 10 10 9
COMMENTS	

PANEL EVALUATION	INTERGARD UNIVERSAL ALUMINUM
CLIENT: U.S. Army Corp of Eng. ALUMINUM/EPOXY MASTIC PROGRAM DATE: 5/17/93 EVALUATION HOURS: 1344	
COATING EVALUATION DATA	
TEST PANEL NUMBER	49 50 51 52 53 54
ASTM D610 RUST GRADE	0 0 0 0 0 0.03%
ASTM D714 DEGREE OF BLISTERING, SIZE	0 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0 0 0 0 0 0
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS	
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	FINAL EVALUATION ONLY
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	FINAL EVALUATION ONLY
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0 0 0 0 0 <1%
TABLE 2, RATING # OF UNSCRIBED AREAS	10 10 10 10 10 9
COMMENTS	

PANEL EVALUATION	INTERGARD UNIVERSAL ALUMINUM
<p>CLIENT: U.S. Army Corp of Eng. ALUMINUM/EPOXY MASTIC PROGRAM DATE: 6/14/93 EVALUATION HOURS: 2016</p>	
<p>COATING EVALUATION DATA</p>	
TEST PANEL NUMBER	49
ASTM D610 RUST GRADE	0
ASTM D714 DEGREE OF BLISTERING, SIZE	0
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0
<p>ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS</p>	
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	0
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	0
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0
TABLE 2, RATING # OF UNSCRIBED AREAS	0

	50	51	52	53	54	COMMENTS
	0	0.03%	0	0	0.03%	
	0	0	0	0	0	
	0	0	0	0	0	

	50	51	52	53	54	COMMENTS
	0	0	0	0	0	
	0	0	0	0	0	
	0	0	0	0	0	

	50	51	52	53	54	COMMENTS
	0	0	0	0	0	
	0	0	0	0	0	
	0	0	0	0	0	

PANEL EVALUATION	INTERGARD UNIVERSAL ALUMINUM									
CLIENT: U.S. Army Corp of Eng.										
ALUMINUM/EPOXY MASTIC PROGRAM										
DATE 7/12/93										
EVALUATION HOURS: 2688										
COATING EVALUATION DATA										
TEST PANEL NUMBER	49	50	51	52	53	54				
ASTM D610 RUST GRADE	0	0	0.03%	0	0	0.03%				
ASTM D714 DEGREE OF BLISTERING, SIZE	0	0	0	0	0	0				
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0	0	0	0	0	0				
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS										
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES										
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER										
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0	0	<1%	0	0	<1%				
TABLE 2, RATING # OF UNSCRIBED AREAS	10	10	9	10	10	9				
FINAL EVALUATION ONLY										
FINAL EVALUATION ONLY										

PANEL EVALUATION	INTERGARD UNIVERSAL ALUMINUM									
CLIENT: U.S. Army Corp of Eng.										
ALUMINIUM/EPOXY MASTIC PROGRAM										
DATE: 8/9/93										
EVALUATION HOURS: 3360										
COATING EVALUATION DATA										
TEST PANEL NUMBER	49	50	51	52	53	54				
ASTM D610 RUST GRADE	0.03%	0	0.03%	0.03%	0	0.03%	Blistering has occurred only at the edge of the			
ASTM D714 DEGREE OF BLISTERING, SIZE	8	8	8	8	8	8	scribe.			
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	Few	Few	Few	Few	Few	Few				
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS										
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	FINAL EVALUATION ONLY									
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	FINAL EVALUATION ONLY									
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	<1%	0	<1%	<1%	0	<1%				
TOTAL RATING # OF UNSCRIBED AREAS	9	10	9	9	10	9				

PANEL EVALUATION		INTERGARD UNIVERSAL ALUMINUM									
CLIENT: U.S. Army Corp of Eng.											
ALUMINUM/EPOXY MASTIC PROGRAM											
DATE: 9/13/93											
EVALUATION HOURS: 4032-FINAL											
COATING EVALUATION DATA											
TEST PANEL NUMBER	49	50	51	52	53	54					
ASTM D610 RUST GRADE	0.03%	0	0.03%	0.03%	0	0.03%	Blistering has occurred only along the scribe edges.				
ASTM D714 DEGREE OF BLISTERING, SIZE	8	4	8	6	8	8					
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	Med	Med/Den	Faw	Med/Den	Med	Med					
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS											
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	1/64"	1/16"	1/32"	> 1/16"	1/64"	1/64"	Loss of adhesion and underfilm rust creepage from the scribe has occurred only under blisters.				
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	9	7	8	6	9	9					
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	< 1%	0	< 1%	< 1%	0	< 1%					
TABLE 2, RATING # OF UNSCRIBED AREAS	9	10	9	9	10	10					

US ARMY CORP OF ENGINEERS	ALUMINUM EPOXY MASTIC PROGRAM																					
COATING SYSTEM DATA																						
COATING ID	MAGNA MASTIC 7900																					
MANUFACTURER	PORTER INTERNATIONAL																					
VOLUME % SOLIDS	84% +/- 2%																					
VOC	1.01 LB/GAL (121 G/L)																					
POT LIFE	4 HOURS @ 75F																					
INDUCTION TIME	15 MINS @ 75F																					
DRYING TIME MINIMUM	RECOAT 24 HOURS @ 75F / FULL CURE NOT STATED																					
RECOMMENDED FILM THICKNESS	MILS PER COAT : DRY 5 / WET 6																					
MIXING RATIOS	1 PART A: 1 PART B BY VOLUME																					
THINNING	#T-5 THINNER @ 12% MAXIMUM																					
APPLICATION DATA																						
DATE/TIME	3/10/93 @ 3:00 P.M.																					
RH	59%																					
TEMPERATURE	72F																					
SUBSTRATE CONDITION	SSPC VIS 1-C @ 2.3 MILS PROFILE																					
COATING BATCH NUMBERS	A: 2213639 / B: 2213681																					
THINNING	T-5 @ 12%																					
EQUIPMENT	DEVILBISS MBC 704E																					
NUMBER OF COATS	1																					
SAG INDEX	15 MILS THINNED 12%																					
DRY FILM THICKNESS, MILS																						
SAMPLE 43	8																					
SAMPLE 44	5.7																					
SAMPLE 45	4.5																					
SAMPLE 46	5.5																					
SAMPLE 47	4.8																					
SAMPLE 48	4.4																					
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 33%;">1st COAT</th> <th style="width: 33%;">2nd COAT</th> <th style="width: 33%;">TOTAL</th> </tr> </thead> <tbody> <tr> <td>N/A</td> <td>N/A</td> <td>8</td> </tr> <tr> <td>N/A</td> <td>N/A</td> <td>5.7</td> </tr> <tr> <td>N/A</td> <td>N/A</td> <td>4.5</td> </tr> <tr> <td>N/A</td> <td>N/A</td> <td>5.5</td> </tr> <tr> <td>N/A</td> <td>N/A</td> <td>4.8</td> </tr> <tr> <td>N/A</td> <td>N/A</td> <td>4.4</td> </tr> </tbody> </table>		1st COAT	2nd COAT	TOTAL	N/A	N/A	8	N/A	N/A	5.7	N/A	N/A	4.5	N/A	N/A	5.5	N/A	N/A	4.8	N/A	N/A	4.4
1st COAT	2nd COAT	TOTAL																				
N/A	N/A	8																				
N/A	N/A	5.7																				
N/A	N/A	4.5																				
N/A	N/A	5.5																				
N/A	N/A	4.8																				
N/A	N/A	4.4																				

PANEL EVALUATION	MAGNA MASTIC 7900
CLIENT: U.S. Army Corp of Eng. ALUMINUM/EPOXY MASTIC PROGRAM DATE: 4/19/93 EVALUATION HOURS: 672	
COATING EVALUATION DATA	
TEST PANEL NUMBER	43 44 45 46 47 48
ASTM D610 RUST GRADE	0.03% 0.03% 0.10% 0.03% 0.03% 0.30%
ASTM D714 DEGREE OF BLISTERING, SIZE	0 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0 0 0 0 0 0
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS	
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	FINAL EVALUATION ONLY
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	FINAL EVALUATION ONLY
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	<1% <1% <1% <1% <1% <1%
TABLE 2, RATING # OF UNSCRIBED AREAS	9 9 9 9 9 9
COMMENTS	

PANEL EVALUATION

CLIENT: U.S. Army Corp of Eng.
 ALUMINUM/EPOXY MASTIC PROGRAM
 DATE: 5/17/93
 EVALUATION HOURS: 1344

COATING EVALUATION DATA

TEST PANEL NUMBER
 ASTM D610 RUST GRADE
 ASTM D714 DEGREE OF BLISTERING, SIZE
 ASTM D714 DEGREE OF BLISTERING, FREQUENCY

ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS

MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES

MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER

RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED

TABLE 2, RATING # OF UNSCRIBED AREAS

MAGNA MASTIC 7900

COMMENTS

43	44	45	46	47	48
0.03%	0.03%	0.10%	0.03%	0.03%	0.03%
0	0	0	0	0	0
0	0	0	0	0	0

There are no visible changes in this set of panels since previous (672 hours) evaluation.

FINAL EVALUATION ONLY

FINAL EVALUATION ONLY

<1%	<1%	<1%	<1%	<1%	<1%
9	9	9	9	9	9

PANEL EVALUATION	MAGNA MASTIC 7900
<p>CLIENT: U.S. Army Corp of Eng. ALUMINUM/EPOXY MASTIC PROGRAM DATE: 6/14/93 EVALUATION HOURS: 2016</p>	
<p>COATING EVALUATION DATA</p>	
TEST PANEL NUMBER	43 44 45 46 47 48
ASTM D610 RUST GRADE	0.10% 3.00% 10% 10% 5% 20%
ASTM D714 DEGREE OF BLISTERING, SIZE	0 0 0 8 0 8
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0 0 0 0 Few 0 0 Few
<p>ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS</p>	
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	FINAL EVALUATION ONLY
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	FINAL EVALUATION ONLY
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	<1% 3% 10% 10% 5% 20%
TABLE 2, RATING # OF UNSCRIBED AREAS	9 8 6 6 7 5
<p>COMMENTS</p>	

PANEL EVALUATION	MAGNA MASTIC 7900
CLIENT: U.S. Army Corp of Eng. ALUMINUM/EPOXY MASTIC PROGRAM DATE: 8/9/93 EVALUATION HOURS: 3360	
COATING EVALUATION DATA	
TEST PANEL NUMBER	43 44 45 46 47 48
ASTM D610 RUST GRADE	10% 40% 90% 90% 16% 95%
ASTM D714 DEGREE OF BLISTERING, SIZE	8 8 8 8 8 8
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	Few Med Med Dense Few Dense
ASTM D 1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS	
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	FINAL EVALUATION ONLY
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	FINAL EVALUATION ONLY
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	10% 40% 90% 90% 16% 95%
TABLE 2, RATING # OF UNSCRIBED AREAS	9 3 0 0 5 0
COMMENTS	

PANEL EVALUATION	MAGNA MASTIC 7900
CLIENT: U.S. Army Corp of Eng. ALUMINUM/EPOXY MASTIC PROGRAM DATE: 9/13/93 EVALUATION HOURS: 4032-FINAL	
COATING EVALUATION DATA	
TEST PANEL NUMBER	43 44 45 46 47 48
ASTM D610 RUST GRADE	10% 60% 90% 90% 32% 95%
ASTM D714 DEGREE OF BLISTERING, SIZE	8 8 8 6 8 8
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	Med. Dense Dense Dense Few Dense
ASTM D 1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS	
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	1/64" 1/64" 1/64" 1/64" 1/64" 1/64"
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	9 9 9 9 9 9
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	10% 60% 90% 90% 32% 95%
TABLE 2, RATING # OF UNSCRIBED AREAS	6 1 0 0 3 0
COMMENTS	

US ARMY CORP OF ENGINEERS	ALUMINUM EPOXY MASTIC PROGRAM
COATING SYSTEM DATA	
COATING ID	EPOXY MASTIC ALUMINUM II
MANUFACTURER	SHERWIN-WILLIAMS
VOLUME % SOLIDS	80% +/- 2%
VOC	1.43 LB/GAL (173 G/L)
POT LIFE	3 HOURS @ 77F
INDUCTION TIME	15 MIN @ 77F
DRYING TIME MINIMUM	RECOAT 18 HOURS @ 77F / FULL CURE 10 DAYS @ 77F
RECOMMENDED FILM THICKNESS	MILS PER COAT : DRY 4-6 / WET 5-7.5
MIXING RATIOS	1 PART A : 1 PART B BY VOLUME
THINNING	R2K4 XYLENE @ 10% MAXIMUM
APPLICATION DATA	
DATE/TIME	3/2/93 @ 8:00 A.M.
RH	63%
TEMPERATURE	73F
SUBSTRATE CONDITION	SPPC VIS 1-C @ 2.0 MILS PROFILE
COATING BATCH NUMBERS	PART A T0692 / PART B T0992
THINNING	R2K4 XYLENE @ 10%
EQUIPMENT	DEVILBISS MCB 704E
NUMBER OF COATS	1
SAG INDEX	14 MILS / 7 MILS THINNED
DRY FILM THICKNESS, MILS	
SAMPLE 1	6.6
SAMPLE 2	6.7
SAMPLE 3	6.8
SAMPLE 4	6.8
SAMPLE 5	6.7
SAMPLE 6	7.2
1st COAT	
3/2/93 @ 8:00 A.M.	
63%	
73F	
SPPC VIS 1-C @ 2.0 MILS PROFILE	
PART A T0692 / PART B T0992	
R2K4 XYLENE @ 10%	
DEVILBISS MCB 704E	
1	
14 MILS / 7 MILS THINNED	
2nd COAT	
3/3/93 @ 3:00 P.M.	
60%	
73F	
EPOXY MASTIC ALUMINUM II	
A: T0692 B: T0992	
R2K4 XYLENE @ 10%	
DEVILBISS MCB 704E	
1	
7 MILS THINNED 10%	
TOTAL	
12.5	
11.4	
12	
12	
12.5	
12.1	

PANEL EVALUATION	EPOXY MASTIC ALUMINUM II
CLIENT: U.S. Army Corp of Eng. ALUMINUM/EPOXY MASTIC PROGRAM DATE: 4/5/93 EVALUATION HOURS: 336	
COATING EVALUATION DATA	
TEST PANEL NUMBER	1 2 3 4 5 6
ASTM D610 RUST GRADE	0 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, SIZE	0 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0 0 0 0 0 0
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED TABLE 2, RATING # OF UNSCRIBED AREAS	
	There is no visible effect from 336 hours of exposure on any of the panels in this set.
	FINAL EVALUATION ONLY
	FINAL EVALUATION ONLY
	0 0 0 0 0 0
	10 10 10 10 10 10

PANEL EVALUATION	EPOXY MASTIC ALUMINUM II								
CLIENT: U.S. Army Corp of Eng. ALUMINUM/EPOXY MASTIC PROGRAM DATE: 4/19/93 EVALUATION HOURS: 672									
COATING EVALUATION DATA									
TEST PANEL NUMBER	1 2 3 4 5 6								
ASTM D610 RUST GRADE	0 0 0 0.03% 0.03% 0.03%								
ASTM D714 DEGREE OF BLISTERING, SIZE	0 0 0 0 0 0								
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0 0 0 0 0 0								
ASTM D 1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED TABLE 2, RATING # OF UNSCRIBED AREAS									
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="2" style="text-align: center;">FINAL EVALUATION ONLY</th> </tr> </thead> <tbody> <tr> <td style="width: 50%;"></td> <td style="width: 50%;"></td> </tr> <tr> <td style="text-align: center;"><1%</td> <td style="text-align: center;">0 0 <1% <1% <1%</td> </tr> <tr> <td style="text-align: center;">9</td> <td style="text-align: center;">10 10 9 9 9</td> </tr> </tbody> </table>		FINAL EVALUATION ONLY				<1%	0 0 <1% <1% <1%	9	10 10 9 9 9
FINAL EVALUATION ONLY									
<1%	0 0 <1% <1% <1%								
9	10 10 9 9 9								
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="2" style="text-align: center;">FINAL EVALUATION ONLY</th> </tr> </thead> <tbody> <tr> <td style="width: 50%;"></td> <td style="width: 50%;"></td> </tr> <tr> <td style="text-align: center;"><1%</td> <td style="text-align: center;">0 0 <1% <1% <1%</td> </tr> <tr> <td style="text-align: center;">9</td> <td style="text-align: center;">10 10 9 9 9</td> </tr> </tbody> </table>		FINAL EVALUATION ONLY				<1%	0 0 <1% <1% <1%	9	10 10 9 9 9
FINAL EVALUATION ONLY									
<1%	0 0 <1% <1% <1%								
9	10 10 9 9 9								
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="2" style="text-align: center;">FINAL EVALUATION ONLY</th> </tr> </thead> <tbody> <tr> <td style="width: 50%;"></td> <td style="width: 50%;"></td> </tr> <tr> <td style="text-align: center;"><1%</td> <td style="text-align: center;">0 0 <1% <1% <1%</td> </tr> <tr> <td style="text-align: center;">9</td> <td style="text-align: center;">10 10 9 9 9</td> </tr> </tbody> </table>		FINAL EVALUATION ONLY				<1%	0 0 <1% <1% <1%	9	10 10 9 9 9
FINAL EVALUATION ONLY									
<1%	0 0 <1% <1% <1%								
9	10 10 9 9 9								
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="2" style="text-align: center;">FINAL EVALUATION ONLY</th> </tr> </thead> <tbody> <tr> <td style="width: 50%;"></td> <td style="width: 50%;"></td> </tr> <tr> <td style="text-align: center;"><1%</td> <td style="text-align: center;">0 0 <1% <1% <1%</td> </tr> <tr> <td style="text-align: center;">9</td> <td style="text-align: center;">10 10 9 9 9</td> </tr> </tbody> </table>		FINAL EVALUATION ONLY				<1%	0 0 <1% <1% <1%	9	10 10 9 9 9
FINAL EVALUATION ONLY									
<1%	0 0 <1% <1% <1%								
9	10 10 9 9 9								

PANEL EVALUATION	EPOXY MASTIC ALUMINUM II
CLIENT: U.S. Army Corp of Eng. ALUMINUM/EPOXY MASTIC PROGRAM DATE: 5/17/93 EVALUATION HOURS: 1344	
COATING EVALUATION DATA	
TEST PANEL NUMBER	1 2 3 4 5 6
ASTM D610 RUST GRADE	0 0 0 0.03% 0.03% 0.03%
ASTM D714 DEGREE OF BLISTERING, SIZE	0 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0 0 0 0 0 0
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS	
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	FINAL EVALUATION ONLY
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	FINAL EVALUATION ONLY
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	<1% 0 <1% <1% <1% <1%
TABLE 2, RATING # OF UNSCRIBED AREAS	9 10 10 9 9 9
COMMENTS	

PANEL EVALUATION	EPOXY MASTIC ALUMINUM II
CLIENT: U.S. Army Corp of Eng. ALUMINUM/EPOXY MASTIC PROGRAM DATE: 7/12/93 EVALUATION HOURS: 2688	
COATING EVALUATION DATA	
TEST PANEL NUMBER	1 2 3 4 5 6
ASTM D610 RUST GRADE	0.03% 0.03% 0.03% 0.03% 0.03% 0.03%
ASTM D714 DEGREE OF BLISTERING, SIZE	0 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0 0 0 0 0 0
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS	
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	FINAL EVALUATION ONLY
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	FINAL EVALUATION ONLY
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	<1% <1% <1% <1% <1% <1%
TABLE 2, RATING # OF UNSCRIBED AREAS	9 9 9 9 9 9
COMMENTS	

PANEL EVALUATION	EPOXY MASTIC ALUMINUM II
CLIENT: U.S. Army Corp of Eng. ALUMINUM/EPOXY MASTIC PROGRAM DATE: 8/9/93 EVALUATION HOURS: 3360	
COATING EVALUATION DATA	
TEST PANEL NUMBER	1 2 3 4 5 6
ASTM D610 RUST GRADE	0.03% 0.03% 0.03% 0.03% 0.03% 0.03%
ASTM D714 DEGREE OF BLISTERING, SIZE	0 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0 0 0 0 0 0
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS	
MEAS CREEPAGE FROM SCRIBE, TABLE 1, INCHES	FINAL EVALUATION ONLY
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	FINAL EVALUATION ONLY
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	<1% <1% <1% <1% <1% <1%
TABLE 2, RATING # OF UNSCRIBED AREAS	9 9 9 9 9 9
COMMENTS There are no visible changes in any panels in this set since the previous (2688 hr) evaluation.	

PANEL EVALUATION	EPOXY MASTIC ALUMINUM II
CLIENT: U.S. Army Corp. of Eng. ALUMINUM/EPOXY MASTIC PROGRAM DATE: 9/13/93 EVALUATION HOURS: 4032-Final	
COATING EVALUATION DATA	
TEST PANEL NUMBER	1 2 3 4 5 6
ASTM D610 RUST GRADE	0.1% 0.1% 0.1% 0.1% 0.1% 0.1%
ASTM D714 DEGREE OF BLISTERING, SIZE	0 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0 0 0 0 0 0
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS	
MEAS CREEPAGE FROM SCRIBE, TABLE 1, INCHES	1/16" 3/32" >1/16" <1/16" >1/16" >1/16"
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	7 6 6 7 6 6
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	<1% <1% <1% <1% <1% <1%
TABLE 2, RATING # OF UNSCRIBED AREAS	9 9 9 9 9 9
COMMENTS	

PANEL EVALUATION	MACROPOXY ALUMINUM
CLIENT: U.S. Army Corp of Eng. ALUMINUM/EPOXY MASTIC PROGRAM DATE: 4/5/93 EVALUATION HOURS: 336	
COATING EVALUATION DATA	
TEST PANEL NUMBER	7 8 9 10 11 12
ASTM D610 RUST GRADE	0 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, SIZE	0 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0 0 0 0 0 0
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS	
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	FINAL EVALUATION ONLY
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	FINAL EVALUATION ONLY
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0 0 0 0 0 0
TABLE 2, RATING # OF UNSCRIBED AREAS	10 10 10 10 10 10
COMMENTS There are no visible effects on any panels in this set after 336 hours of exposure.	

PANEL EVALUATION	MACROPOXY ALUMINUM
CLIENT: U.S. Army Corp of Eng. ALUMINUM/EPOXY MASTIC PROGRAM DATE: 5/17/93 EVALUATION HOURS: 1344	
COATING EVALUATION DATA	
TEST PANEL NUMBER	7 8 9 10 11 12
ASTM D610 RUST GRADE	0 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, SIZE	0 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0 0 0 0 0 0
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS	
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	FINAL EVALUATION ONLY
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	FINAL EVALUATION ONLY
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0 0 0 0 0 0
TABLE 2: RATING # OF UNSCRIBED AREAS	10 10 10 10 10 10
COMMENTS There are no visible changes only any panels in this set after 1344 hours of exposure.	

PANEL EVALUATION	MACROPOXY ALUMINUM
CLIENT: U.S. Army Corp of Eng. ALUMINUM/EPOXY MASTIC PROGRAM DATE: 6/14/93 EVALUATION HOURS: 2016	
COATING EVALUATION DATA	
TEST PANEL NUMBER	7 8 9 10 11 12
ASTM D610 RUST GRADE	0 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, SIZE	0 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0 0 0 0 0 0
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS	
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	FINAL EVALUATION ONLY
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	FINAL EVALUATION ONLY
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0 0 0 0 0 0
TABLE 2, RATING # OF UNSCRIBED AREAS	10 10 10 10 10 10
COMMENTS There are no visible changes on any panels in this set after 2016 hours of exposure.	

PANEL EVALUATION	MACROPOXY ALUMINUM
CLIENT: U.S. Army Corp of Eng. ALUMINUM/EPOXY MASTIC PROGRAM DATE: 7/12/93 EVALUATION HOURS: 2688	
COATING EVALUATION DATA	
TEST PANEL NUMBER	7 8 9 10 11 12
ASTM D610 RUST GRADE	0 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, SIZE	0 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0 0 0 0 0 0
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS	
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	FINAL EVALUATION ONLY
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	FINAL EVALUATION ONLY
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0 0 0 0 0 0
RATING # OF UNSCRIBED AREAS	10 10 10 10 10 10
COMMENTS	

PANEL EVALUATION	MACROPOXY ALUMINUM
CLIENT: U.S. Army Corp of Eng. ALUMINUM/EPOXY MASTIC PROGRAM DATE: 8/9/93 EVALUATION HOURS: 3360	
COATING EVALUATION DATA	
TEST PANEL NUMBER	7 8 9 10 11 12
ASTM D610 RUST GRADE	0 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, SIZE	4 4 4 4 6 6
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	Few Few Med. Med. Few. Few.
COMMENTS All blistering is right at the edges of the scribe.	
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS	
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	FINAL EVALUATION ONLY
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	FINAL EVALUATION ONLY
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0 0 0 0 0 0
TABLE 2, RATING # OF UNSCRIBED AREAS	10 10 10 10 10 10

PANEL EVALUATION	MACROPOXY ALUMINUM
CLIENT: U.S. Army Corp. of Eng. ALUMINUM/EPOXY MASTIC PROGRAM DATE: 9/13/93 EVALUATION HOURS: 4032-FINAL	
COATING EVALUATION DATA	
TEST PANEL NUMBER	7 8 9 10 11 12
ASTM D610 RUST GRADE	0 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, SIZE	4 2 2 4 6 4
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	Med. Med/Den Dense Med/Den Med. Med.
ASTM D 1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS	
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	<1/16" >3/16" >3/16" 1/8" <1/16" 1/8"
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	7 4 4 6 7 6
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0 0 0 0 0 0
TABLE 2, RATING # OF UNSCRIBED AREAS	10 10 10 10 10 10
COMMENTS: Blistering has occurred only along the scribe edges. Loss of adhesion and underfilm rust creepage along the scribe has occurred only under the blisters.	

US ARMY CORP OF ENGINEERS	ALUMINUM EPOXY MASTIC PROGRAM
COATING SYSTEM DATA	
COATING ID	SURFACE TOLERANT EPOXY COATING
MANUFACTURER	SHERWIN-WILLIAMS
VOLUME % SOLIDS	80% +/- 2%
VOC	1.45 LB/GAS (174 G/L)
POT LIFE	4 HOUR @ 77F
INDUCTION TIME	15 MIN @ 77F
DRYING TIME MINIMUM	RECOAT 18 HOURS @ 77f / FULL CURE 10 DAY @ 77F
RECOMMENDED FILM THICKNESS	MILS PER COAT : DRY 6 / WET 7
MIXING RATIOS	4 PARTS A : 1 PART B BY VOLUME
THINNING	R2K4 XYLENE @ 10% MAXIMUM
APPLICATION DATA	
DATE/TIME	3/2/93 @ 9:00 A.M.
RH	63%
TEMPERATURE	74F
SUBSTRATE CONDITION	SSPC VIS 1-C @ 2.5 MILS PROFILE
COATING BATCH NUMBERS	A: T2211 / B: T2340
THINNING	R2K4 XYLENE @ 10%
EQUIPMENT	DEVILBISS MCB 704e
NUMBER OF COATS	1
SAG INDEX	15 MILS / 7 MILS THINNED
DRY FILM THICKNESS, MILS	
SAMPLE 13	5.5
SAMPLE 14	6.9
SAMPLE 15	5.9
SAMPLE 16	5.5
SAMPLE 17	5.5
SAMPLE 18	6.8
1st COAT	
3/2/93 @ 9:00 A.M.	
63%	
74F	
SSPC VIS 1-C @ 2.5 MILS PROFILE	
A: T2211 / B: T2340	
R2K4 XYLENE @ 10%	
DEVILBISS MCB 704e	
1	
15 MILS / 7 MILS THINNED	
2nd COAT	
3/13/93 @ 4:30 P.M.	
59%	
72F	
SURFACE TOL EPOXY COATING (1ST COAT)	
A: T2211 / B: T2340	
R2K4 XYLENE 10%	
DEVILBISS MCB 704e	
1	
7 MILS THINNED 10%	
TOTAL	
11	
12.2	
11.6	
9.7	
11.3	
13.2	

PANEL EVALUATION	SURFACE TOLERANT EPOXY				
CLIENT: U.S. Army Corp of Eng. ALUMINUM/EPOXY MASTIC PROGRAM DATE: 4/5/93 EVALUATION HOURS: 336					
COATING EVALUATION DATA					
TEST PANEL NUMBER	13 14 15 16 17 18				
ASTM D610 RUST GRADE	0 0 0 0 0 0				
ASTM D714 DEGREE OF BLISTERING, SIZE	0 0 0 0 0 0				
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0 0 0 0 0 0				
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS					
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	-				
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	-				
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0 0 0 0 0 0				
RATING OF UNSCRIBED AREAS, TABLE 2, RATING # OF UNSCRIBED AREAS	10 10 10 10 10 10				
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; text-align: center;">FINAL EVALUATION ONLY</td> <td style="width: 50%;"></td> </tr> <tr> <td style="width: 50%; text-align: center;">FINAL EVALUATION ONLY</td> <td style="width: 50%;"></td> </tr> </table>		FINAL EVALUATION ONLY		FINAL EVALUATION ONLY	
FINAL EVALUATION ONLY					
FINAL EVALUATION ONLY					
COMMENTS There are no visible effects on any panels in this set after 336 hours of exposure.					

PANEL EVALUATION	SURFACE TOLERANT EPOXY
CLIENT: U.S. Army Corp of Eng. ALUMINUM/EPOXY MASTIC PROGRAM DATE: 4/19/93 EVALUATION HOURS: 672	
COATING EVALUATION DATA	
TEST PANEL NUMBER	13 14 15 16 17 18
ASTM D610 RUST GRADE	0 0 0 0 0.03% 0.03%
ASTM D714 DEGREE OF BLISTERING, SIZE	0 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0 0 0 0 0 0
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS	
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	FINAL EVALUATION ONLY
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	FINAL EVALUATION ONLY
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0 0 0 0 <1% <1%
RATING # OF UNSCRIBED AREAS	10 10 10 10 9 9
COMMENTS	

PANEL EVALUATION	SURFACE TOLERANT EPOXY
<p>CLIENT: U.S. Army Corp of Eng. ALUMINUM/EPOXY MASTIC PROGRAM DATE: 5/17/93 EVALUATION HOURS: 1344</p>	
<p>COATING EVALUATION DATA</p>	
TEST PANEL NUMBER	13 14 15 16 17 18
ASTM D610 RUST GRADE	0.03% 0 0 0 0.03% 0.03%
ASTM D714 DEGREE OF BLISTERING, SIZE	0 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0 0 0 0 0 0
<p>ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS</p>	
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	FINAL EVALUATION ONLY
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	FINAL EVALUATION ONLY
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	<1% 0 0 0 <1% <1%
TABLE 2, RATING # OF UNSCRIBED AREAS	9 10 10 10 9 9
COMMENTS	

PANEL EVALUATION	SURFACE TOLERANT EPOXY
<p>CLIENT: U.S. Army Corp of Eng. ALUMINUM/EPOXY MASTIC PROGRAM DATE: 6/14/93 EVALUATION HOURS: 2016</p>	
<p>COATING EVALUATION DATA</p>	
TEST PANEL NUMBER	13 14 15 16 17 18
ASTM D610 RUST GRADE	0.03% 0 0 0 0.03% 0.035
ASTM D714 DEGREE OF BLISTERING, SIZE	0 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0 0 0 0 0 0
<p>ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS</p>	
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	FINAL EVALUATION ONLY
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	FINAL EVALUATION ONLY
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	<1% 0 0 0 <1% <1%
TABLE 2, RATING # OF UNSCRIBED AREAS	9 10 10 10 9 9
<p>COMMENTS</p> <p>No visible changes in this set of panels since previous (1344 hr.) evaluation.</p>	

PANEL EVALUATION	SURFACE TOLERANT EPOXY																		
CLIENT: U.S. Army Corp of Eng. ALUMINUM/EPOXY MASTIC PROGRAM DATE: 7/12/93 EVALUATION HOURS: 2688																			
COATING EVALUATION DATA																			
TEST PANEL NUMBER	13 14 15 16 17 18																		
ASTM D610 RUST GRADE	0 0 0 0 0.03% 0.03%																		
ASTM D714 DEGREE OF BLISTERING, SIZE	0 0 0 0 0 0																		
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0 0 0 0 0 0																		
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS																			
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 16.6%;"> </td> </tr> <tr> <td colspan="6" style="text-align: center;">FINAL EVALUATION ONLY</td> </tr> <tr> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> </tr> </table>							FINAL EVALUATION ONLY											
FINAL EVALUATION ONLY																			
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 16.6%;"> </td> </tr> <tr> <td colspan="6" style="text-align: center;">FINAL EVALUATION ONLY</td> </tr> <tr> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> </tr> </table>							FINAL EVALUATION ONLY											
FINAL EVALUATION ONLY																			
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 16.6%;"><1%</td> <td style="width: 16.6%;">0</td> <td style="width: 16.6%;">0</td> <td style="width: 16.6%;">0</td> <td style="width: 16.6%;"><1%</td> <td style="width: 16.6%;"><1%</td> </tr> </table>	<1%	0	0	0	<1%	<1%												
<1%	0	0	0	<1%	<1%														
TABLE 2, RATING # OF UNSCRIBED AREAS	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 16.6%;">9</td> <td style="width: 16.6%;">10</td> <td style="width: 16.6%;">10</td> <td style="width: 16.6%;">10</td> <td style="width: 16.6%;">9</td> <td style="width: 16.6%;">9</td> </tr> </table>	9	10	10	10	9	9												
9	10	10	10	9	9														
COMMENTS																			

PANEL EVALUATION	SURFACE TOLERANT EPOXY
<p>CLIENT: U.S. Army Corp of Eng. ALUMINUM/EPOXY MASTIC PROGRAM DATE: 8/9/93 EVALUATION HOURS 3360</p>	
<p>COATING EVALUATION DATA</p>	
TEST PANEL NUMBER	13 14 15 16 17 18
ASTM D610 RUST GRADE	0.03% 0 0 0.03% 0.03%
ASTM D714 DEGREE OF BLISTERING, SIZE	6 6 8 8 6 8
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	Med. Dense Med. Few Few
<p>ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS</p>	
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	FINAL EVALUATION ONLY
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	FINAL EVALUATION ONLY
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	<1% 0 0 <1% <1%
TABLE 2, RATING # OF UNSCRIBED AREAS	9 10 10 10 9 9
<p>COMMENTS</p> <p>Blistering is occurring only at the edge of the scribe.</p>	

PANEL EVALUATION	SURFACE TOLERANT EPOXY
CLIENT: U.S. Army Corp. of Eng. ALUMINUM/EPOXY MASTIC PROGRAM DATE: 9/13/93 EVALUATION HOURS 4032-FINAL	
COATING EVALUATION DATA	
TEST PANEL NUMBER	13 14 15 16 17 18
ASTM D610 RUST GRADE	0 0 0 0.03% 0.03% 0.03%
ASTM D714 DEGREE OF BLISTERING, SIZE	4 2 4 8 6 6
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	Dense Medium Medium Medium Medium Medium
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS	
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	> 1/8" > 1/8" < 1/8" < 1/8" < 1/8" 1/16"
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	5 5 6 6 6 7
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	< 1% 0 0 0 < 1% < 1%
TABLE 2, RATING # OF UNSCRIBED AREAS	9 10 10 10 9 9
COMMENTS Blistering has occurred only along the scribe edges. Loss of adhesion and underfilm rust creepage has occurred only under blisters along the scribe edges.	

US ARMY CORP OF ENGINEERS	ALUMINUM EPOXY MASTIC PROGRAM
COATING SYSTEM DATA	
COATING ID	COLTURIET TCP ALUMINUM
MANUFACTURER	SIGMA COATINGS
VOLUME % SOLIDS	80% +/-2%
VOC	2.0 LB/GAL (239 g/L)
POT LIFE	6 HOURS @ 68F
INDUCTION TIME	NONE
DRYING TIME MINIMUM	RECOAT 14 HOURS @ 68F / FULL CURE 5 DAYS @ 68F
RECOMMENDED FILM THICKNESS	MILS PER COAT : DRY 5-8 / WET 6-9.6
MIXING RATIOS	77 PARTS A: 23 PARTS B BY VOLUME
THINNING	#91-92 THINNER @ 15% MAXIMUM
APPLICATION DATA	
DATE/TIME	3/11/93 @ 8:00 A.M.
RH	58%
TEMPERATURE	70F
SUBSTRATE CONDITION	SSPC VIS 1-C @ 2.0 MILS PROFILE
COATING BATCH NUMBERS	A: 188052 / B: 069112
THINNING	#91-92 @ 15%
EQUIPMENT	DEVILBISS MBC 704E
NUMBER OF COATS	1
SAG INDEX	> 24 MILS / 16 MILS THINNED
DRY FILM THICKNESS, MILS	
SAMPLE 37A	6.5
SAMPLE 38A	5.5
SAMPLE 39	6
SAMPLE 40	5.5
SAMPLE 41	6
SAMPLE 42	5.7
1st COAT	
3/11/93 @ 8:00 A.M.	
58%	
70F	
SSPC VIS 1-C @ 2.0 MILS PROFILE	
A: 188052 / B: 069112	
#91-92 @ 15%	
DEVILBISS MBC 704E	
1	
> 24 MILS / 16 MILS THINNED	
2nd COAT	
3/12/93 @ 11:00 A.M.	
61%	
75F	
COLTURIET TCP ALUMINUM	
A: 188052 / B: 069112	
#91-92 @ 15%	
DEVILBISS MBC 704E	
1	
16 MILS THINNED 15%	
TOTAL	
13	
11.8	
11.8	
11.8	
13.5	
12.3	

PANEL EVALUATION	COLTURIET TCP ALUMINUM
CLIENT: U.S. Army Corp of Eng. ALUMINUM/EPOXY MASTIC PROGRAM DATE: 4/19/93 EVALUATION HOURS: 672	
COATING EVALUATION DATA	
TEST PANEL NUMBER	37A 38A 39 40 41 42
ASTM D610 RUST GRADE	0.03% 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, SIZE	0 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0 0 0 0 0 0
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS	
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	FINAL EVALUATION ONLY
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	FINAL EVALUATION ONLY
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	<1% 0 0 0 0 0
TABLE 2, RATING # OF UNSCRIBED AREAS	9 10 10 10 10 10
COMMENTS	

PANEL EVALUATION	COLTURIET TCP ALUMINUM																		
CLIENT: U.S. Army Corp of Eng. ALUMINUM/EPOXY MASTIC PROGRAM DATE: 5/17/93 EVALUATION HOURS: 1344																			
COATING EVALUATION DATA																			
TEST PANEL NUMBER	37A 38A 39 40 41 42																		
ASTM D610 RUST GRADE	0 0 0 0.03% 0 0																		
ASTM D714 DEGREE OF BLISTERING, SIZE	0 0 0 0 0 0																		
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0 0 0 0 0 0																		
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS																			
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 16.6%;"> </td> </tr> <tr> <td colspan="6" style="text-align: center;">FINAL EVALUATION ONLY</td> </tr> <tr> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> </tr> </table>							FINAL EVALUATION ONLY											
FINAL EVALUATION ONLY																			
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 16.6%;"> </td> </tr> <tr> <td colspan="6" style="text-align: center;">FINAL EVALUATION ONLY</td> </tr> <tr> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> </tr> </table>							FINAL EVALUATION ONLY											
FINAL EVALUATION ONLY																			
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 16.6%;"> </td> </tr> <tr> <td style="text-align: center;"><1%</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;"><1%</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> </tr> </table>							<1%	0	0	<1%	0	0						
<1%	0	0	<1%	0	0														
TABLE 2, RATING # OF UNSCRIBED AREAS	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 16.6%;"> </td> </tr> <tr> <td style="text-align: center;">9</td> <td style="text-align: center;">10</td> <td style="text-align: center;">10</td> <td style="text-align: center;">9</td> <td style="text-align: center;">10</td> <td style="text-align: center;">10</td> </tr> </table>							9	10	10	9	10	10						
9	10	10	9	10	10														
COMMENTS																			

PANEL EVALUATION	COLTURIET TCP ALUMINUM
<p>CLIENT: U.S. Army Corp of Eng. ALUMINUM/EPOXY MASTIC PROGRAM DATE: 6/14/93 EVALUATION HOURS: 2016</p>	
COATING EVALUATION DATA	
TEST PANEL NUMBER	37A 38A 39 40 41 42
ASTM D610 RUST GRADE	0.03% 0.03% 0 0.03% 0 0
ASTM D714 DEGREE OF BLISTERING, SIZE	0 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0 0 0 0 0 0
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS	
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	FINAL EVALUATION ONLY
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	FINAL EVALUATION ONLY
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	<1% <1% 0 <1% 0 0
TABLE 2, RATING # OF UNSCRIBED AREAS	9 9 10 9 10 10
COMMENTS	

PANEL EVALUATION	COLTURIET TCP ALUMINUM
CLIENT: U.S. Army Corp of Eng. ALUMINUM/EPOXY MASTIC PROGRAM DATE: 7/12/93 EVALUATION HOURS: 2688	
COATING EVALUATION DATA	
TEST PANEL NUMBER	37A 38A 39 40 41 42
ASTM D610 RUST GRADE	0.03% 0.03% 0 0.03% 0.03% 0
ASTM D714 DEGREE OF BLISTERING, SIZE	0 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0 0 0 0 0 0
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS	
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	FINAL EVALUATION ONLY
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	FINAL EVALUATION ONLY
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	<1% <1% 0 <1% <1% 0
TABLE 2, RATING # OF UNSCRIBED AREAS	9 9 10 9 9 10
COMMENTS	

PANEL EVALUATION	COLTURIET TCP ALUMINIUM
CLIENT: U.S. Army Corp of Eng. ALUMINIUM/EPOXY MASTIC PROGRAM DATE: 8/9/93 EVALUATION HOURS: 3360	
COATING EVALUATION DATA	
TEST PANEL NUMBER	37A 38A 39 40 41 42
ASTM D610 RUST GRADE	0.03% 0.03% 0 0.03% 0.03% 0
ASTM D714 DEGREE OF BLISTERING, SIZE	6 6 8 8 8 6
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	Few Few Few Few Few Few
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED TABLE 2, RATING # OF UNSCRIBED AREAS	
	FINAL EVALUATION ONLY
	FINAL EVALUATION ONLY
<1%	<1% <1% 0 <1% <1% 0
9	9 9 10 9 9 10
COMMENTS Blistering has occurred only at the edges of the scribe.	

Appendix B: Epoxy/Urethane System Test Results

US ARMY CORPS OF ENGINEERS		EPOXY / URETHANE PROGRAM	
COATING SYSTEM DATA			
COATING ID	CARBOMASTIC 90	CARBOTHANE 134HS	
MANUFACTURER	CARBOLINE	CARBOLINE	
VOLUME % SOLIDS	90% +/- 2%	66% +/- 2%	
VOC	0.70 LB/GAL 984 G/L	2.4 LB/GAL (288 G/L)	
POT LIFE	4 HOURS AT 75F	6 HOURS AT 75F	
INDUCTION TIME	NONE	NONE	
DRYING TIME MINIMUM TO RECOAT	12 HOURS AT 75F	8 HOURS AT 75F FULL CURE - 7 DAYS	
RECOMMENDED FILM THICKNESS, DRY	5 MILS PER COAT DRY	2-4 MILS DRY / 3-6 MILS WET	
MIXING RATIOS	1:1 BY VOLUME	8 PARTS A : 1 PART B BY VOLUME	
THINNING	CARBOLINE NO. 2	CARBOLINE NO. 214	
APPLICATION DATA			
DATE/TIME	4/8/93 @ 2:00 PM	4/13/93 @ 2:00 P.M.	
RH	55%	50%	
TEMPERATURE	73F	74F	
SUBSTRATE CONDITION	SSPC VIS. -1C	N/A	
COATING BATCH NUMBERS	A: 2K375M B: 2H3301M	A: 2F2797M B: 2K0112C	
THINNING	10% WITH NO. 2 THINNER	NONE	
EQUIPMENT	BINKS CONVENTIONAL	BINKS CONVENTIONAL	
NUMBER OF COATS	1	1	
SAG INDEX	20 MILS	9 MILS	
DRY FILM THICKNESS, MILS			
SAMPLE 1	6.9 MILS	5.5 MILS	TOTAL
SAMPLE 2	5.4 MILS	5.3 MILS	12.4 MILS
SAMPLE 3	5.8 MILS	4.6 MILS	10.7 MILS
SAMPLE 4	5.6 MILS	4.3 MILS	10.4 MILS
SAMPLE 5	6.2 MILS	3.5 MILS	9.9 MILS
SAMPLE 6	6.4 MILS	4.8 MILS	9.7 MILS
			11.2 MILS

PANEL EVALUATION	CARBOMASTIC 90 / CARBOTHANE 134HS
CLIENT: U.S. ARMY CORPS OF ENG.	
EPOXY URETHANE PROGRAM	
DATE: 6/21/93	
EVALUATION HOURS: 1344	
COATING EVALUATION DATA	
TEST PANEL NUMBER	1 2 3 4 5 6
ASTM D610 RUST GRADE	0 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, SIZE	0 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0 0 0 0 0 0
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS	
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	FINAL EVALUATION ONLY
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	FINAL EVALUATION ONLY
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0 0 0 0 0 0
TABLE 2, RATING # OF UNSCRIBED AREAS	10 10 10 10 10 10
COMMENTS	
There are no visible effects on any panels in this set after 1344 hours of exposure.	

PANEL EVALUATION	CARBOMASTIC 90 / CARBOTHANE 134HS
CLIENT: U.S. ARMY CORPS OF ENG. EPOXY URETHANE PROGRAM DATE: 7/19/93 EVALUATION HOURS: 2016	
COATING EVALUATION DATA	
TEST PANEL NUMBER	1 2 3 4 5 6
ASTM D610 RUST GRADE	0 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, SIZE	0 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0 0 0 0 0 0
ASTM D 1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS	
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	FINAL EVALUATION ONLY
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	FINAL EVALUATION ONLY
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0 0 0 0 0 0
TABLE 2, RATING # OF UNSCRIBED AREAS	10 10 10 10 10 10
COMMENTS	

PANEL EVALUATION	CARBOMASTIC 90 / CARBOTHANE 134HS					
CLIENT: U.S. ARMY CORPS OF ENG.						
EPOXY URETHANE PROGRAM						
DATE: 8/16/93						
EVALUATION HOURS: 2688						
COATING EVALUATION DATA						
TEST PANEL NUMBER	1	2	3	4	5	6
ASTM D610 RUST GRADE	0	0	0	0	0	0
ASTM D714 DEGREE OF BLISTERING, SIZE	0	0	0	4	8	8
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0	0	0	Few	Few	Few
Blistering on this set of panels is localized along scribe edges.						
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS						
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	FINAL EVALUATION ONLY					
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	FINAL EVALUATION ONLY					
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0	0	0	0	0	0
TOTAL RATING # OF UNSCRIBED AREAS	10	10	10	10	10	10
COMMENTS						

PANEL EVALUATION	CARBOMASTIC 90 / CARBOTHANE 134HS
CLIENT: U.S. ARMY CORPS OF ENG.	
EPOXY URETHANE PROGRAM	
DATE: 9/13/93	
EVALUATION HOURS: 3360-FINAL	
COATING EVALUATION DATA	
TEST PANEL NUMBER	1 2 3 4 5 6
ASTM D610 RUST GRADE	0 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, SIZE	0 0 0 4 8 8
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0 0 0 Few Few Few
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS	
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	1/32" 1/64" 1/64" 1/32" 1/64" 1/64"
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	8 9 9 8 9 9
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0 0 0 0 0 0
TABLE 2, RATING # OF UNSCRIBED AREAS	10 10 10 10 10 10
% Gloss Retention (Avg. of all panels) 90.4%	Yellowing Index: 3.0% more yellow
COMMENTS	
Blistering has occurred only along the scribe edge in this set of panels throughout the exposure period.	

US ARMY CORPS OF ENGINEERS		EPOXY / URETHANE PROGRAM	
COATING SYSTEM DATA			
COATING ID	CARBOMASTIC 15LO	CARBOETHANE 134 HS	
MANUFACTURER	CARBOLINE	CARBOLINE	
VOLUME % SOLIDS	90% +/- 2%	66% +/- 2%	
VOC	0.74 LB/GAL (88 G/L)	2.4 LB/GAL (288 G/L)	
POT LIFE	4 HOURS AT 75F	6 HOURS AT 75F	
INDUCTION TIME	NONE	NONE	
DRYING TIME MINIMUM TO RECOAT	24 HOURS TO RECOAT	8 HOURS AT 75F FULL CURE - 7 DAYS	
RECOMMENDED FILM THICKNESS, DRY	5-7 MILS DRY / 5-7.5 WET	2-4 MILS DRY 3-6 MILS WET	
MIXING RATIOS	1:1 BY VOLUME	8 PARTS A : 1 PART B BY VOLUME	
THINNING	CARBOLINE NO. 76		
APPLICATION DATA			
DATE/TIME	4/9/93 @ 9:00 AM	4/13/93 @ 9:00 PM	
RH	55%	50%	
TEMPERATURE	73F	74F	
SUBSTRATE CONDITION	SSPC VIS. -1C	N/A	
COATING BATCH NUMBERS	A: 3A7722L B: 3A7697L	A: 2F2797M B: 2K0112C	
THINNING	15% WITH NO. 76	NONE	
EQUIPMENT	BINKS CONVENTIONAL	BINKS CONVENTIONAL	
NUMBER OF COATS	1	1	
SAG INDEX	> 24 MILS	9 MILS	
DRY FILM THICKNESS, MILS			
SAMPLE 7	5.8 MILS	6.0 MILS	11.8 MILS
SAMPLE 8	6.1 MILS	6.0 MILS	12.1 MILS
SAMPLE 9	5.6 MILS	7.5 MILS	13.1 MILS
SAMPLE 10	5.3 MILS	6.7 MILS	12.0 MILS
SAMPLE 11	5.0 MILS	7.3 MILS	12.3 MILS
SAMPLE 12	4.4 MILS	7.4 MILS	11.8 MILS
1ST COAT		2ND COAT	
5.8 MILS		6.0 MILS	
6.1 MILS		6.0 MILS	
5.6 MILS		7.5 MILS	
5.3 MILS		6.7 MILS	
5.0 MILS		7.3 MILS	
4.4 MILS		7.4 MILS	
TOTAL		TOTAL	
11.8 MILS		11.8 MILS	
12.1 MILS		12.1 MILS	
13.1 MILS		13.1 MILS	
12.0 MILS		12.0 MILS	
12.3 MILS		12.3 MILS	
11.8 MILS		11.8 MILS	

PANEL EVALUATION	CARBOMASTIC 15LO / CARBOTHANE 134HS									
CLIENT: U.S. ARMY CORPS OF ENG.										
EPOXY URETHANE PROGRAM										
DATE: 5/10/93										
EVALUATION HOURS: 336										
COATING EVALUATION DATA										
TEST PANEL NUMBER	7	8	9	10	11	12				
ASTM D610 RUST GRADE	0	0	0	0	0	0	There are no effects visible on any panels in this set			
ASTM D714 DEGREE OF BLISTERING, SIZE	0	0	0	0	0	0	0 after 336 hours of exposure.			
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0	0	0	0	0	0				
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS										
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES							FINAL EVALUATION ONLY			
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER							FINAL EVALUATION ONLY			
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0	0	0	0	0	0				
TABLE 2, RATING # OF UNSCRIBED AREAS	10	10	10	10	10	10				

PANEL EVALUATION	CARBOMASTIC 15LO / CARBOTHANE 134HS									
CLIENT: U.S. ARMY CORPS OF ENG. EPOXY URETHANE PROGRAM DATE: 6/21/93 EVALUATION HOURS: 1344										
COATING EVALUATION DATA										
TEST PANEL NUMBER	7	8	9	10	11	12				
ASTM D610 RUST GRADE	0	0	0	0	0	0	There are no visible effects on any panels in this set			
ASTM D714 DEGREE OF BLISTERING, SIZE	0	0	0	0	0	0	after 1344 hours of exposure.			
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0	0	0	0	0	0				
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS										
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES										
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER										
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0	0	0	0	0	0	0	0	0	0
TABLE 2, RATING # OF UNSCRIBED AREAS	10	10	10	10	10	10	10	10	10	10
FINAL EVALUATION ONLY										
FINAL EVALUATION ONLY										

PANEL EVALUATION	CARBOMASTIC 15LO / CARBOTHANE 134 HS											
CLIENT: U.S. ARMY CORPS OF ENG.												
EPOXY URETHANE PROGRAM												
DATE: 7/19/93												
EVALUATION HOURS: 2016												
COATING EVALUATION DATA												
TEST PANEL NUMBER	7	8	9	10	11	12						COMMENTS
ASTM D610 RUST GRADE	0	0	0	0	0	0						
ASTM D714 DEGREE OF BLISTERING, SIZE	0	0	0	0	0	0						
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0	0	0	0	0	0						
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS												
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES												FINAL EVALUATION ONLY
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER												FINAL EVALUATION ONLY
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0	0	0	0	0	0						0
TABLE 2, RATING # OF UNSCRIBED AREAS	10	10	10	10	10	10						10

PANEL EVALUATION	CARBOMASTIC 15LO / CAROTHANE 134 HS									
CLIENT: U.S. ARMY CORPS OF ENG.										
EPOXY URETHANE PROGRAM										
DATE: 8/16/93										
EVALUATION HOURS: 2688										
COATING EVALUATION DATA										
TEST PANEL NUMBER	7	8	9	10	11	12				
ASTM D610 RUST GRADE	0	0	0	0	0	0	All blistering on this set of panels is localized along			
ASTM D714 DEGREE OF BLISTERING, SIZE	4	8	8	0	0	0	scribe edges.			
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	Med	Few	Few	0	0	0				
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS										
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES										
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER										
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0	0	0	0	0	0				
TABLE 2. RATING # OF UNSCRIBED AREAS	10	10	10	10	10	10				
	FINAL EVALUATION ONLY									
	FINAL EVALUATION ONLY									

PANEL EVALUATION	CARBOMASTIC 15LO / CARBOTHANE 134 HS									
CLIENT: U.S. ARMY CORPS OF ENG.										
EPOXY URETHANE PROGRAM										
DATE: 9/13/93										
EVALUATION HOURS: 3360										
COATING EVALUATION DATA										
TEST PANEL NUMBER	7	8	9	10	11	12				
ASTM D610 RUST GRADE	0	0	0	0	0	0	Blistering on this set of panels has occurred only			
ASTM D714 DEGREE OF BLISTERING, SIZE	4	8	8	0	0	0	along the scribe edges throughout the exposure			
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	Med	Med	Few	0	0	0	0 period.			
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS										
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	3/32"	1/16"	1/32"	1/64"	1/64"	1/32"	1/32"			
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	6	7	8	9	9	8				
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0	0	0	0	0	0	0			
TABLE 2, RATING # OF UNSCRIBED AREAS	10	10	10	10	10	10	10			
% Gloss Retention (Average of all panels)	95.4%						Yellow Index: 64.1% more yellow			

US ARMY CORP OF ENGINEERS		EPOXY / URETHANE PROGRAM	
COATING SYSTEM DATA			
COATING ID	INDUSTRIAL ENAMEL TTE489		
MANUFACTURER	DAVIS INDUSTRIAL COATING		
VOLUME % SOLIDS	N/A		
VOC	N/A		
POT LIFE	N/A		
INDUCTION TIME	N/A		
DRYING TIME MINIMUM	N/A		
RECOMMENDED FILM THICKNESS	N/A		
MIXING RATIOS	SINGLE COMPONENT		
THINNING	T-120 SPRAYING THINNER		
APPLICATION DATA			
DATE/TIME	1ST COAT	2ND COAT	3RD COAT
RH	4/12/93 @ 10:00 AM	4/13/93 @ 10:00 AM	4/14/93 @ 10:00 AM
TEMPERATURE	60%	60%	60%
SUBSTRATE CONDITION	75F	73F	73F
COATING BATCH NUMBERS	SSPC VIS. 1-C	SSPC-25 RED OXIDE	TTE489 ENAMEL
THINNING	07172139 LOT 793	01133123 NONE	01133123 NONE
EQUIPMENT	NONE	NONE	NONE
NUMBER OF COATS	BINKS CONVENTIONAL	BINKS CONVENTIONAL	BINKS CONVENTIONAL
SAG INDEX	1	1ST	2ND
	5 MILS	6 MILS	6 MILS
DRY FILM THICKNESS, MILS			
SAMPLE 51	1st COAT	2nd COAT	3rd COAT
SAMPLE 52	2.1 MILS	2.4 MILS	3.5 MILS
SAMPLE 53	2.1 MILS	2.0 MILS	3.6 MILS
SAMPLE 54	1.8 MILS	2.3 MILS	3.3 MILS
SAMPLE 55	2.3 MILS	2.5 MILS	3.0 MILS
SAMPLE 56	2.1 MILS	3.3 MILS	3.1 MILS
	1.9 MILS	2.9 MILS	2.9 MILS
			TOTAL
			8.0 MILS
			7.7 MILS
			7.4 MILS
			7.8 MILS
			8.5 MILS
			7.7 MILS

PANEL EVALUATION	SSPC-25 RED OXIDE / TT-E-489 ENAMEL
CLIENT: U.S. Army Corp of Eng. EPOXY URETHANE PROGRAM DATE: 5/24/93 EVALUATION HOURS: 672	
COATING EVALUATION DATA	
TEST PANEL NUMBER	51 52 53 54 55 56
ASTM D610 RUST GRADE	0 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, SIZE	0 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0 0 0 0 0 Few
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS	
MEANS CREEPAGE FROM SCRIBE, TABLE 1, INCHES	FINAL EVALUATION ONLY
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	FINAL EVALUATION ONLY
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0 0 0 0 0 0
TOTAL RATING # OF UNSCRIBED AREAS	10 10 10 10 10 10
COMMENTS	

PANEL EVALUATION	SSPC-25 RED OXIDE / TT-E-489 ENAMEL									
CLIENT: U.S. Army Corp of Eng.										
EPOXY URETHANE PROGRAM										
DATE: 6/21/93										
EVALUATION HOURS: 1344										
COATING EVALUATION DATA										
TEST PANEL NUMBER	51	52	53	54	55	56				
ASTM D610 RUST GRADE	0	0	0	0	0	0	Blisters on Panel No. 51 are in scattered dense groups. Others are localized along edges of			
ASTM D714 DEGREE OF BLISTERING, SIZE	8	0	6	4	0	6	the scribes.			
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	Dense	0	Med	Med	0	Med				
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS										
MEANS CREEPAGE FROM SCRIBE, TABLE 1, INCHES							FINAL EVALUATION ONLY			
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER							FINAL EVALUATION ONLY			
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	10%	0	0	0	0	0				
TABLE 2, RATING # OF UNSCRIBED AREAS	6	10	10	10	10	10				

PANEL EVALUATION	SSPC-25 RED OXIDE / TT-E-489 ENAMEL									
CLIENT: U.S. Army Corp. of Eng.										
EPOXY URETHANE PROGRAM										
DATE: 7/19/93										
EVALUATION HOURS: 2016										
COATING EVALUATION DATA										
TEST PANEL NUMBER	51	52	53	54	55	56				
ASTM D610 RUST GRADE	0	0	0	0	0	0	0 Except for Panel No. 51 all blistering is localized			
ASTM D714 DEGREE OF BLISTERING, SIZE	6*	6	6	4	6	6	6 along scribe edges.			
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	Med	Med	Dense	Med	Dense	Dense				
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS										
MEANS CREEPAGE FROM SCRIBE, TABLE 1, INCHES							FINAL EVALUATION ONLY			
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER							FINAL EVALUATION ONLY			
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	10%	0	0	0	0	0	0			
TABLE 2, RATING # OF UNSCRIBED AREAS	6	10	10	10	10	10	10			

PANEL EVALUATION	SSPC-25 RED OXIDE / TT-3-489 ENAMEL							
CLIENT: U.S. Army Corp of Eng. EPOXY URETHANE PROGRAM DATE: 8/16/93 EVALUATION HOURS: 2688								
COATING EVALUATION DATA								
TEST PANEL NUMBER	51	52	53	54	55	56		
ASTM D610 RUST GRADE	0	0	0	0	0	0	Except for Panel No. 51 blistering is along the	
ASTM D714 DEGREE OF BLISTERING, SIZE	8	8	4	4	2	4	scribe edges only.	
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	Dense	Med	Dense	Dense	Dense	Dense		
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS								
MEANS CREEPAGE FROM SCRIBE, TABLE 1, INCHES							FINAL EVALUATION ONLY	
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER							FINAL EVALUATION ONLY	
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	10%	0	0	0	0	0		
TABLE 2, RATING # OF UNSCRIBED AREAS	6	10	10	10	10	10		

PANEL EVALUATION	SSPC-25 RED OXIDE / TT-P-489									
CLIENT: U.S. Army Corp of Eng.										
EPOXY URETHANE PROGRAM										
DATE: 9/13/93										
EVALUATION HOURS: 3360										
COATING EVALUATION DATA										
TEST PANEL NUMBER	51	52	53	54	55	56				
ASTM D610 RUST GRADE	0	0	0	0	0	0				
ASTM D714 DEGREE OF BLISTERING, SIZE	8	6	4	4	4	4				
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	Dense	Dense	Dense	Dense	Dense	Dense				
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS										
MEANS CREEPAGE FROM SCRIBE, TABLE 1, INCHES	1/32"	1/64"	1/8"	1/8"	3/16"	1/8"				
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	8	9	6	6	5	6				
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	10	0	0	0	0	0				
TABLE 2, RATING # OF UNSCRIBED AREAS	6	10	10	10	10	10				
% Gloss Retention (average of all panels): 58%										
Yellowing Index: 40% yellowing										
COMMENTS	Except for Panel 51, all blistering is localized along scribe edges.									

US ARMY CORPS OF ENGINEERS		EPOXY / URETHANE PROGRAM	
COATING SYSTEM DATA			
COATING ID	BAR RUST 236	DEVTHANE 379	
MANUFACTURER	DEVCOE	DEVCOE	
VOLUME % SOLIDS	80%	62%	
VOC	1.4 LB/GAL (170 G/L)	2.7 LBS/GAL (327 G/L)	
POT LIFE	4 HOURS AT 77F	8 HOURS AT 77F	
INDUCTION TIME	15 MINS AT 77F	NONE	
DRYING TIME MINIMUM TO RECOAT	5 HOURS	FULL CURE 16-24 HOURS AT 77F	
RECOMMENDED FILM THICKNESS, DRY	5-8 MILS DRY, 6.2-10 MILS WET	2-3 MILS DRY, 3-3.5 MILS WET	
MIXING RATIOS	4 PART A : 1 PART B BY VOLUME	4 PARTS A : 1 PART B BY VOLUME	
THINNING	10% MAXIMUM WITH T-10 THINNER	5% MAX WITH T-9 THINNER	
APPLICATION DATA			
DATE/TIME	4/16/93 @ 9:30 AM	4/17/93	
RH	60%	62%	
TEMPERATURE	74F	73F	
SUBSTRATE CONDITION	SSPC VIS. 1-C	BAR RUST 236	
COATING BATCH NUMBERS	A: N302089A B: N302135A	A: N212141C B: C208157	
THINNING	NONE	NONE	
EQUIPMENT	BINKS CONVENTIONAL	BINKS CONVENTIONAL	
NUMBER OF COATS	1	1	
SAG INDEX	13 MILS	6 MILS	
DRY FILM THICKNESS, MILS			
SAMPLE 25	5.6 MILS	4.03 MILS	TOTAL
SAMPLE 69	5.3 MILS	3.97 MILS	9.9 MILS
SAMPLE 70	5.0 MILS	4.62 MILS	9.3 MILS
SAMPLE 71	5.1 MILS	2.80 MILS	9.6 MILS
SAMPLE 96	4.8 MILS	2.93 MILS	7.9 MILS
SAMPLE 97	4.4 MILS	3.00 MILS	7.0 MILS
			7.3 MILS

PANEL EVALUATION	BAR RUST 236 / DEVTHANE 379									
CLIENT: U.S. ARMY CORPS OF ENG. EPOXY URETHANE PROGRAM										
DATE: 5/10/93										
EVALUATION HOURS: 336										
COATING EVALUATION DATA										
TEST PANEL NUMBER	25	69	70	71	96	97				
ASTM D610 RUST GRADE	0	0	0	0	0	0				
ASTM D714 DEGREE OF BLISTERING, SIZE	0	0	0	0	0	0				
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0	0	0	0	0	0				
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS										
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES							FINAL EVALUATION ONLY			
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER							FINAL EVALUATION ONLY			
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0	0	0	0	0	0				
TABLE 2, RATING # OF UNSCRIBED AREAS	10	10	10	10	10	10				
COMMENTS										

PANEL EVALUATION	BAR RUST 236 / DEVTHANE 379									
CLIENT: U.S. ARMY CORPS OF ENG.										
EPOXY URETHANE PROGRAM										
DATE: 6/21/93										
EVALUATION HOURS: 1344										
COATING EVALUATION DATA										
TEST PANEL NUMBER	25	69	70	71	96	97				
ASTM D610 RUST GRADE	0	0	0	0	0	0	All blistering is localized along scribe edges.			
ASTM D714 DEGREE OF BLISTERING, SIZE	8	8	8	0	6	8				
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	Few	Few	Few	0	Few	Few				
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS										
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES							FINAL EVALUATION ONLY			
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER							FINAL EVALUATION ONLY			
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0	0	0	0	0	0				
TABLE 2, RATING # OF UNSCRIBED AREAS	10	10	10	10	10	10				

PANEL EVALUATION		BAR RUST 236 / DEVTHANE 379									
CLIENT: U.S. ARMY CORPS OF ENG.											
EPOXY URETHANE PROGRAM											
DATE: 9/13/93											
EVALUATION HOURS: 3360-FINAL											
COATING EVALUATION DATA											
TEST PANEL NUMBER	25	69	70	71	96	97	COMMENTS				
ASTM D610 RUST GRADE	0	0	0	0	0	0	Blistering has occurred only along the scribe edges				
ASTM D714 DEGREE OF BLISTERING, SIZE	4	6	6	6	6	4	throughout the exposure period.				
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	Dense	Dense	Dense	Dense	Dense	Dense					
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS											
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	5/32"	1/16"	1/32"	1/32"	1/32"	1/32"	1/32"	> 1/16"			
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	5	7	8	8	6	6					
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0	0	0	0	0	0					
TABLE 2, RATING # OF UNSCRIBED AREAS	10	10	10	10	10	10					
% Gloss Retention (average of all panels): 92.3%											
% Yellowing Index: 82.6% more yellow											

US ARMY CORPS OF ENGINEERS		EPOXY / URETHANE PROGRAM	
COATING SYSTEM DATA			
COATING ID	BAR RUST 239	DEVTHANE 379	
MANUFACTURER	DEVOE	DEVOE	
VOLUME % SOLIDS	90%	62%	
VOC	0.72 LB/GAL (86 G/L)	2.7 LB/GAL (327 G/L)	
POT LIFE	4 HOURS AT 77F	8 HOURS AT 77F	
INDUCTION TIME	15 MIN AT 77F	NONE	
DRYING TIME MINIMUM TO RECOAT	8 HRS. RECOAT / 24 HRS FULL CURE	16-24 HRS. FULL CURE	
RECOMMENDED FILM THICKNESS, DRY	6-8 MILS DRY / 6.7-8.9 MILS WET	2-3 MILS DRY / 3-3.5 WET	
MIXING RATIOS	1 PART A : 1 PART B BY VOLUME	4 PARTS A : 1 PART B BY VOLUME	
THINNING	12 MILS	T-9 THINNER AT 5% MAX.	
APPLICATION DATA			
DATE/TIME	4/6/93 @ 10:00 AM	4/7/93 @ 10:30 AM	
RH	60%	62%	
TEMPERATURE	74F	73F	
SUBSTRATE CONDITION	SSPC VIS. 1-C	BAR RUST 239	
COATING BATCH NUMBERS	A: N210202 B: N21061	A: N212141-C B: C208157B	
THINNING	10% WITH T-4 THINNER	NONE	
EQUIPMENT	BINKS CONVENTIONAL	BINKS CONVENTIONAL	
NUMBER OF COATS	1	1	
SAG INDEX	12 MILS	6 MILS	
DRY FILM THICKNESS, MILS			
SAMPLE 31A	4.8 MILS	5.1 MILS	9.9 MILS
SAMPLE 32A	6.1 MILS	2.6 MILS	8.7 MILS
SAMPLE 33	6.1 MILS	2.5 MILS	8.6 MILS
SAMPLE 34	5.9 MILS	3.1 MILS	9.0 MILS
SAMPLE 67	5.6 MILS	3.3 MILS	8.9 MILS
SAMPLE 68	5.7 MILS	3.3 MILS	9.0 MILS
1ST COAT		2ND COAT	
4.8 MILS		5.1 MILS	
6.1 MILS		2.6 MILS	
6.1 MILS		2.5 MILS	
5.9 MILS		3.1 MILS	
5.6 MILS		3.3 MILS	
5.7 MILS		3.3 MILS	
TOTAL		TOTAL	
9.9 MILS		9.9 MILS	
8.7 MILS		8.7 MILS	
8.6 MILS		8.6 MILS	
9.0 MILS		9.0 MILS	
8.9 MILS		8.9 MILS	
9.0 MILS		9.0 MILS	

PANEL EVALUATION		BAR RUST 239 / DEVTHANE 379					
CLIENT: U.S. ARMY CORPS OF ENG.							
EPOXY URETHANE PROGRAM							
DATE: 5/10/93							
EVALUATION HOURS: 336							
COATING EVALUATION DATA							
TEST PANEL NUMBER	31A	32A	33	34	67	68	COMMENTS
ASTM D610 RUST GRADE	0	0	0	0	0	0	There were no visible effects on any panels in this set after 336 hours of exposure.
ASTM D714 DEGREE OF BLISTERING, SIZE	0	0	0	0	0	0	
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0	0	0	0	0	0	
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS							
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES							FINAL EVALUATION ONLY
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER							FINAL EVALUATION ONLY
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0	0	0	0	0	0	
TOTAL RATING # OF UNSCRIBED AREAS	10	10	10	10	10	10	

PANEL EVALUATION		BAR RUST 239 / DEVTHANE 379										
CLIENT: U.S. ARMY CORPS OF ENG.												
EPOXY URETHANE PROGRAM												
DATE: 9/13/93												
EVALUATION HOURS: 3360												
COATING EVALUATION DATA												
TEST PANEL NUMBER	31A	32A	33	34	67	68						COMMENTS
ASTM D610 RUST GRADE	0	0	0	0	0	0	Blistering has occurred only along the scribe edges					
ASTM D714 DEGREE OF BLISTERING, SIZE	6	6	6	6	6	6	throughout the testing period.					
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	Dense	Dense	Dense	Dense	Dense	Dense						
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS												
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	1/16"	1/16"	5/64"	5/64"	5/64"	1/16"						
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	7	7	6	6	6	7						
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0	0	0	0	0	0						
TABLE 2, RATING # OF UNSCRIBED AREAS	10	10	10	10	10	10						
% Gloss Retention (average of all panels): 13.7%												
Yellowing Index: 82.4% yellowing												

US ARMY CORPS OF ENGINEERS		EPOXY / URETHANE PROGRAM	
COATING SYSTEM DATA			
COATING ID	DEVTHANE 379	DEVTHANE 379	
MANUFACTURER	DEVOE	DEVOE	
VOLUME % SOLIDS	62%	62%	
VOC	2.84 LB/GAL (340 G/L)	2.7 LBS/GAL (327 G/L)	
POT LIFE	8 HOURS AT 77F	8 HOURS AT 77F	
INDUCTION TIME	30 MIN AT 77F	NONE	
DRYING TIME MINIMUM TO RECOAT	5 HOURS	FULL CURE 16-25 HOURS	
RECOMMENDED FILM THICKNESS, DRY	4-6 MILS DRY, 6.7-10 MILS WET	2-3 MILS DRY, 3.3-5 MILS WET	
MIXING RATIOS	1PART A : 1 PART B BY VOLUME	4 PARTS A : 1 PART B BY VOLUME	
THINNING	10% MAXIMUM WITH T-10 THINNER	5% MAX WITH T-9 THINNER	
APPLICATION DATA			
DATE/TIME	4/6/93 @ 9:00 AM	4/7/93 @ 9:00 AM	
RH	60%	62%	
TEMPERATURE	74F	73F	
SUBSTRATE CONDITION	SSPC VIS. 1-C	DEVTHANE 224	
COATING BATCH NUMBERS	A: N010092C B: C008007	AI N212141C B: C208157	
THINNING	NONE	NONE	
EQUIPMENT	BINKS CONVENTIONAL	BINKS CONVENTIONAL	
NUMBER OF COATS	1	1	
SAG INDEX	13 MILS THINNED 5%	6 MILS	
DRY FILM THICKNESS, MILS			
SAMPLE 90	4.3 MILS	2.8 MILS	7.1 MILS
SAMPLE 91	5.2 MILS	3.0 MILS	8.2 MILS
SAMPLE 92	5.0 MILS	3.2 MILS	8.2 MILS
SAMPLE 93	5.5 MILS	2.9 MILS	8.4 MILS
SAMPLE 94	4.9 MILS	3.4 MILS	8.3 MILS
SAMPLE 95	5.6 MILS	2.9 MILS	8.5 MILS
		2ND COAT	TOTAL
		2.8 MILS	7.1 MILS
		3.0 MILS	8.2 MILS
		3.2 MILS	8.2 MILS
		2.9 MILS	8.4 MILS
		3.4 MILS	8.3 MILS
		2.9 MILS	8.5 MILS

PANEL EVALUATION	DEVTRAN 224 / DEVTHANE 379					
CLIENT: U.S. ARMY CORPS OF ENG.						
EPOXY URETHANE PROGRAM						
DATE: 5/24/93						
EVALUATION HOURS: 672						
COATING EVALUATION DATA						
TEST PANEL NUMBER	90	91	92	93	94	95
ASTM D610 RUST GRADE	0	0	0	0	0	0
ASTM D714 DEGREE OF BLISTERING, SIZE	0	0	0	0	0	0
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0	0	0	0	0	0
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS						
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES						
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER						
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0	0	0	0	0	0
TABLE 2. RATING # OF UNSCRIBED AREAS	10	10	10	10	10	10
COMMENTS						
FINAL EVALUATION ONLY						
FINAL EVALUATION ONLY						

PANEL EVALUATION		DEVTRAN 224 / DEVTHANE 379									
CLIENT: U.S. ARMY CORPS OF ENG.											
EPOXY URETHANE PROGRAM											
DATE: 6/21/93											
EVALUATION HOURS: 1344											
COATING EVALUATION DATA											
TEST PANEL NUMBER											
ASTM D610 RUST GRADE	0	0	0	0	0	0	0	0	0	0	0
ASTM D714 DEGREE OF BLISTERING, SIZE	8	4	4	0	4	4	4	4	4	4	4
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	Few	Few	Few	0	Med	Med	Few	Few	Med	Med	Med
ASTM D 1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS											
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES											
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER											
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0	0	0	0	0	0	0	0	0	0	0
TABLE 2, RATING # OF UNSCRIBED AREAS	10	10	10	10	10	10	10	10	10	10	10
COMMENTS											
All blistering is localized along scribe edges.											
FINAL EVALUATION ONLY											
FINAL EVALUATION ONLY											

PANEL EVALUATION	DEVTRAN 224 / DEVTHANE 379									
CLIENT: U.S. ARMY CORPS OF ENG. EPOXY URETHANE PROGRAM DATE: 7/19/93 EVALUATION HOURS: 2016										
COATING EVALUATION DATA										
TEST PANEL NUMBER	90	91	92	93	94	95				
ASTM D610 RUST GRADE	0.03%	0	0	0	0	0				
ASTM D714 DEGREE OF BLISTERING, SIZE	8	4	8	4	4	4	Blistering is along the scribe edges only.			
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	Dense	Med	Few	Med	Med	Med				
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS										
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES										
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER										
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	<1%	0	0	0	0	0				
TABLE 2, RATING # OF UNSCRIBED AREAS	9	10	10	10	10	10				
FINAL EVALUATION ONLY										
FINAL EVALUATION ONLY										

PANEL EVALUATION		DEVTRAN 224 / DEVTHANE 379										
CLIENT: U.S. ARMY CORPS OF ENG.												
EPOXY URETHANE PROGRAM												
DATE: 8/16/93												
EVALUATION HOURS: 2688												
COATING EVALUATION DATA												
TEST PANEL NUMBER	90	91	92	93	94	95						COMMENTS
ASTM D610 RUST GRADE	0	0	0	0	0	0						
ASTM D714 DEGREE OF BLISTERING, SIZE	6	4	6	2	4	4						All blistering on this set of panels is localized along scribe edges.
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	Dense	Med	Med	Med	Med	Dense						
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS												
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES												FINAL EVALUATION ONLY
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER												FINAL EVALUATION ONLY
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0	0	0	0	0	0						
TABLE 2, RATING # OF UNSCRIBED AREAS	10	10	10	10	10	10						

PANEL EVALUATION		DEVTRAN 224 / DEVTHANE 379									
CLIENT: U.S. ARMY CORPS OF ENG.											
EPOXY URETHANE PROGRAM											
DATE: 9/13/93											
EVALUATION HOURS: 3360-FINAL											
COATING EVALUATION DATA											
TEST PANEL NUMBER	90	91	92	93	94	95					
ASTM D610 RUST GRADE	0	0	0	0	0	0	Blistering is localized along scribe edges.				
ASTM D714 DEGREE OF BLISTERING, SIZE	6	4	6	2	4	4					
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	Dense	Med	Med	Med	Med	Dense					
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS											
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	1/16"	1/8"	1/64"	3/16"	1/8"	1/8"					
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	7	6	9	5	6	6					
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0	0	0	0	0	0					
TABLE 2, RATING # OF UNSCRIBED AREAS	10	10	10	10	10	10					
% Gloss Retention (average of all panels): 99.3% Yellowing Index: 81.5% yellowing											

US ARMY CORPS OF ENGINEERS		EPOXY / URETHANE PROGRAM	
COATING SYSTEM DATA			
COATING ID	HEMPADUR 4515/1987	HEMPATHANE 5521/1148	
MANUFACTURER	HEMPEL	HEMPEL	
VOLUME % SOLIDS	82%	53%	
VOC	1.5 LB/GAL (180 G/L)	3.8 LBS/GAL 450 G/L	
POT LIFE	3 HOURS AT 68F	2 HOURS AT 68F	
INDUCTION TIME	NONE	NONE	
DRYING TIME MINIMUM TO RECOAT	RECOAT 8 HOURS, 6 DAYS MAX.	8HRS TO TOUCH, 7 DAYS FULL CURE	
RECOMMENDED FILM THICKNESS, DRY	8 MILS DRY 10 MILS WET PER COAT	2 MILS DRY, 4 MILS WET	
MIXING RATIOS	1 PART A : 1 PART B	7 PARTS A : 1 PART B	
THINNING	5% MAX WITH NO. 0846 THINNER	0808/0888 5% MAX.	
APPLICATION DATA			
DATE/TIME	4/13/93 @ 8:00 AM	4/14/93 @ 9:00 AM	
RH	55%	60%	
TEMPERATURE	72F	73F	
SUBSTRATE CONDITION	SSPC VIS.1-C	HEMPADUR 4515-1987	
COATING BATCH NUMBERS	A: UH2820323 B: UH1030166	A: UH392086 B: UH4320918	
THINNING	5% WITH NO. 0846 THINNER	NONE	
EQUIPMENT	BINKS CONVENTIONAL	BINKS CONVENTIONAL	
NUMBER OF COATS	1	1	
SAG INDEX	20 MILS	9 MILS	
DRY FILM THICKNESS, MILS			
SAMPLE 39	10.1 MILS	1.7 MILS	TOTAL
SAMPLE 40	7.75 MILS	1.9 MILS	11.8 MILS
SAMPLE 41	7.10 MILS	1.9 MILS	9.6 MILS
SAMPLE 42	7.90 MILS	1.5 MILS	9.0 MILS
SAMPLE 43	8.00 MILS	1.9 MILS	9.4 MILS
SAMPLE 44	7.10 MILS	2.2 MILS	9.9 MILS
			9.3 MILS

PANEL EVALUATION	HEMPADUR 4515-1987 / HEMPETHANE 5521-1148									
CLIENT: U.S. ARMY CORPS OF ENG. EPOXY URETHANE PROGRAM										
DATE: 5/10/93										
EVALUATION HOURS: 336										
COATING EVALUATION DATA										
TEST PANEL NUMBER	39	40	41	42	43	44				
ASTM D610 RUST GRADE	0	0	0	0	0	0				
ASTM D714 DEGREE OF BLISTERING, SIZE	0	0	0	0	0	0				
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0	0	0	0	0	0				
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS										
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES										
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER										
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0	0	0	0	0	0				
TABLE 2, RATING # OF UNSCRIBED AREAS	10	10	10	10	10	10				
FINAL EVALUATION ONLY										
FINAL EVALUATION ONLY										

PANEL EVALUATION	HEMPADUR 4515-1987/HEMPATHANE 5521-1148
CLIENT: U.S. ARMY CORPS OF ENG. EPOXY URETHANE PROGRAM DATE: 5/24/93 EVALUATION HOURS: 672	
COATING EVALUATION DATA	
TEST PANEL NUMBER	39 40 41 42 43 44
ASTM D610 RUST GRADE	0 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, SIZE	0 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0 0 0 0 0 0
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS	
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0 0 0 0 0 0
TABLE 2, RATING # OF UNSCRIBED AREAS	10 10 10 10 10 10
FINAL EVALUATION ONLY FINAL EVALUATION ONLY	

PANEL EVALUATION	HEMPADUR 4515-1987 / HEMPETHANE 5521-1148									
CLIENT: U.S. ARMY CORPS OF ENG. EPOXY URETHANE PROGRAM										
DATE: 8/16/93										
EVALUATION HOURS: 2688										
COATING EVALUATION DATA										
TEST PANEL NUMBER	39	40	41	42	43	44				
ASTM D610 RUST GRADE	0	0	0	0	0	0				
ASTM D714 DEGREE OF BLISTERING, SIZE	4	4	4	6	2	2				
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	Med	Med	Med-Den	Med	Med	Dense				
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS										
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES										
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER										
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0	0	0	0	0	0				
TABLE 2, RATING # OF UNSCRIBED AREAS	10	10	10	10	10	10				
	FINAL EVALUATION ONLY									
	FINAL EVALUATION ONLY									

PANEL EVALUATION	HEMPADUR 4515-1987 / HEMPATANE 5521-1148
CLIENT: U.S. ARMY CORPS OF ENG.	
EPOXY URETHANE PROGRAM	
DATE: 9/13/93	
EVALUATION HOURS: 3360	
COATING EVALUATION DATA	
TEST PANEL NUMBER	39 40 41 42 43 44
ASTM D610 RUST GRADE	0 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, SIZE	4 4 4 6 2 2
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	Dense Dense Dense Dense Dense Dense
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS	
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	1/32" 1/16" 1/8" 1/32" 1/8" 1/8"
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	8 7 6 8 6 6
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0 0 0 0 0 0
TABLE 2, RATING # OF UNSCRIBED AREAS	10 10 10 10 10 10
% Gloss Retention (average of all panels) : 99.3% Yellowing Index: 75.1% yellowing	
COMMENTS Blistering is localized along scribe edges.	

US ARMY CORPS OF ENGINEERS		EPOXY / URETHANE PROGRAM	
COATING SYSTEM DATA			
COATING ID	INTERGARD H.S., UNIVERSAL EPOXY	INTERTHANE	
MANUFACTURER	PORTER INTERNATIONAL	PORTER INTERNATIONAL	
VOLUME % SOLIDS	80% +/- 2%	57% +/- 2%	
VOC	1.6 LB/GAL (192 G/L)		
POT LIFE	4 HOURS AT 75F	10 HOURS AT 75F	
INDUCTION TIME	15 MIN AT 75F	NONE	
DRYING TIME MINIMUM TO RECOAT	6 HOURS	24 HOURS AT 75F	
RECOMMENDED FILM THICKNESS, DRY	4-8 MILS DRY / 6-10 MILS WET	1.5-2.0 DRY 3-5 WET	
MIXING RATIOS	4 PARTS A : 1 PART B BY VOLUME	KIT	
THINNING	THINNER #T-44 AT 6% MAX.	GTA415	
APPLICATION DATA			
DATE/TIME	4/19/93 @ 8:00 A.M.	4/20/93 @ 8:00 A.M.	
RH	60%	58%	
TEMPERATURE	74F	73F	
SUBSTRATE CONDITION	SSPC VIS. -1C	N/A	
COATING BATCH NUMBERS	A: UHA10993C B: UHA13313C	NOT LEGIBLE	
THINNING	6%	NONE	
EQUIPMENT	BINKS CONVENTIONAL	BINKS CONVENTIONAL	
NUMBER OF COATS	1	1	
SAG INDEX	13 MILS THINNED 6%	6 MILS	
DRY FILM THICKNESS, MILS			
SAMPLE 13	6.3 MILS	3.6 MILS	TOTAL
SAMPLE 14	6.9 MILS	2.7 MILS	9.9 MILS
SAMPLE 15	6.5 MILS	2.6 MILS	9.6 MILS
SAMPLE 16	6.0 MILS	3.5 MILS	9.1 MILS
SAMPLE 17	5.7 MILS	3.2 MILS	9.5 MILS
SAMPLE 18	5.3 MILS	4.7 MILS	8.9 MILS
			10.0 MILS

PANEL EVALUATION	INTERGARD H.S. UNIVERSAL EPOXY/INTERTHANE
CLIENT: U.S. ARMY CORPS OF ENG. EPOXY URETHANE PROGRAM	
DATE: 5/10/93	
EVALUATION HOURS: 336	
COATING EVALUATION DATA	
TEST PANEL NUMBER	13 14 15 16 17 18
ASTM D610 RUST GRADE	0 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, SIZE	0 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0 0 0 0 0 0
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS	
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	FINAL EVALUATION ONLY
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	FINAL EVALUATION ONLY
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0 0 0 0 0 0
TABLE 2, RATING # OF UNSCRIBED AREAS	10 10 10 10 10 10

PANEL EVALUATION	INTERGARD H.S. UNIVERSAL EPOXY/INTERTHANE
CLIENT: U.S. ARMY CORPS OF ENG. EPOXY URETHANE PROGRAM DATE: 5/24/93 EVALUATION HOURS: 672	
COATING EVALUATION DATA	
TEST PANEL NUMBER	13 14 15 16 17 18
ASTM D610 RUST GRADE	0 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, SIZE	0 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0 0 0 0 0 0
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS	
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0 0 0 0 0 0
TABLE 2, RATING # OF UNSCRIBED AREAS	10 10 10 10 10 10
FINAL EVALUATION ONLY	
FINAL EVALUATION ONLY	

PANEL EVALUATION	INTERGARD H.S. UNIVERSAL EPOXY/INTERTHANE
CLIENT: U.S. ARMY CORPS OF ENG. EPOXY URETHANE PROGRAM DATE: 7/19/93 EVALUATION HOURS: 2016	
COATING EVALUATION DATA	
TEST PANEL NUMBER	13 14 15 16 17 18
ASTM D610 RUST GRADE	0 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, SIZE	0 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0 0 0 0 0 0
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS	
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	FINAL EVALUATION ONLY
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	FINAL EVALUATION ONLY
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0 0 0 0 0 0
TABLE 2, RATING # OF UNSCRIBED AREAS	10 10 10 10 10 10
COMMENTS	

PANEL EVALUATION	INTERGARD H.S. UNIVERSAL/INTERTHANE									
CLIENT: U.S. ARMY CORPS OF ENG. EPOXY URETHANE PROGRAM										
DATE: 9/13/93										
EVALUATION HOURS: 3360 - FINAL										
COATING EVALUATION DATA										
TEST PANEL NUMBER	13	14	15	16	17	18				
ASTM D610 RUST GRADE	0	0	0	0	0	0	Blistering has occurred only along the scribe edges throughout the exposure period.			
ASTM D714 DEGREE OF BLISTERING, SIZE	0	6	0	0	0	8				
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0	Few	0	0	0	Few				
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS										
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	1/32"	1/64"	1/64"	0	1/64"	1/64"				
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	8	9	9	10	9	9				
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0	0	0	0	0	0				
TABLE 2, RATING # OF UNSCRIBED AREAS	10	10	10	10	10	10				
% Gloss Retention (average of all panels): 94.1%										
Yellowing Index: 80.6% more yellow										

US ARMY CORPS OF ENGINEERS		EPOXY / URETHANE PROGRAM	
COATING SYSTEM DATA			
COATING ID	SURFACE TOLERANT EPOXY	HI SOLIDS POLYURETHANE	
MANUFACTURER	SHERWIN-WILLIAMS	SHERWIN-WILLIAMS	
VOLUME % SOLIDS	80% +/- 2%	65% +/- 2%	
VOC	1.45 LB/GAL (174 G/L)	2.40 LB/GAL (289 G/L)	
POT LIFE	4 HOURS AT 77F	4 HOURS AT 77F	
INDUCTION TIME	15 MIN AT 77F	NONE	
DRYING TIME MINIMUM TO RECOAT	18 HOURS	RECOAT: 18HRS FULL CURE: 10 DAYS	
RECOMMENDED FILM THICKNESS, DRY	6 MILS DRY / 7 MILS WET	2 MILS DRY / 4.5 MILS WET	
MIXING RATIOS	6 PARTS A : 1 PART B	4 PARTS A : 1 PART B	
THINNING	R2K4 XYLENE AT 10% MAX.	R7K69 AT 15% MAX	
APPLICATION DATA			
DATE/TIME	4/10/93 @ 10:00 A.M.	4/14/93 @ 10:00 AM	
RH	52%	56%	
TEMPERATURE	72F	73F	
SUBSTRATE CONDITION	SSPC VIS. 1-C	N/A	
COATING BATCH NUMBERS	A: T2592 B: 1592	A: 620-4978 B: 630-4281	
THINNING	R2K4 XYLENE AT 5%	NONE	
EQUIPMENT	BINKS CONVENTIONAL	BINKS CONVENTIONAL	
NUMBER OF COATS	1	1	
SAG INDEX	8 MILS THINNED 5%	5 MILS	
DRY FILM THICKNESS, MILS			
SAMPLE 27	6.5 MILS	3.4 MILS	9.9 MILS
SAMPLE 28	7.6 MILS	3.3 MILS	10.9 MILS
SAMPLE 29	6.5 MILS	3.5 MILS	10.0 MILS
SAMPLE 30	6.4 MILS	2.4 MILS	8.8 MILS
SAMPLE 31B	7.2 MILS	2.9 MILS	10.1 MILS
SAMPLE 32B	6.0 MILS	2.6 MILS	8.6 MILS
1ST COAT		2ND COAT	
TOTAL		TOTAL	

PANEL EVALUATION	SURFACE TOLERANT EPOXY/HI-SOLIDS POLYURETHANE									
CLIENT: U.S. ARMY CORPS OF ENG.										
EPOXY URETHANE PROGRAM										
DATE: 5/10/93										
EVALUATION HOURS: 336										
COATING EVALUATION DATA										
TEST PANEL NUMBER	27	28	29	30	31B	32B				
ASTM D610 RUST GRADE	0	0	0	0	0	0	There was no visible effect on any panel in this set after 336 hours of exposure.			
ASTM D714 DEGREE OF BLISTERING, SIZE	0	0	0	0	0	0				
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0	0	0	0	0	0				
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS										
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES							FINAL EVALUATION ONLY			
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER							FINAL EVALUATION ONLY			
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0	0	0	0	0	0				
TABLE 2, RATING # OF UNSCRIBED AREAS	10	10	10	10	10	10				

PANEL EVALUATION	SURFACE TOLERANT EPOXY/HI-SOLIDS POLYURETHANE									
CLIENT: U.S. ARMY CORPS OF ENG. EPOXY URETHANE PROGRAM										
DATE: 7/19/93										
EVALUATION HOURS: 2016										
COATING EVALUATION DATA										
TEST PANEL NUMBER	27	28	29	30	31B	32B				
ASTM D610 RUST GRADE	0	0	0	0	0	0	Blistering on Panel 32B is still localized along the			
ASTM D714 DEGREE OF BLISTERING, SIZE	0	0	0	0	0	8	scribe edges.			
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0	0	0	0	0	Med.				
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS										
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES										
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER										
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0	0	0	0	0	0				
TABLE 2, RATING # OF UNSCRIBED AREAS	10	10	10	10	10	10				
FINAL EVALUATION ONLY										
FINAL EVALUATION ONLY										

PANEL EVALUATION	SURFACE TOLERANT EPOXY/HI-SOLIDS POLYURETHANE						COMMENTS
CLIENT: U.S. ARMY CORPS OF ENG. EPOXY URETHANE PROGRAM DATE: 9/13/93 EVALUATION HOURS: 3360-FINAL							
COATING EVALUATION DATA							
TEST PANEL NUMBER	27	28	29	30	31B	32B	Blisters have occurred only along the scribe edges throughout the testing period.
ASTM D610 RUST GRADE	0	0	0	0	0	0	
ASTM D714 DEGREE OF BLISTERING, SIZE	0	0	0	8	0	8	
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0	0	0	Few	0	Few	
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS							
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	1/32"	0	1/32"	1/32"	0	1/64"	
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	8	10	8	8	10	9	
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0	0	0	0	0	0	
TABLE 2, RATING # OF UNSCRIBED AREAS	10	10	10	10	10	10	
% Gloss Retention (average of all panels): 38.3%							Yellowing Index: 53.2% more yellow

EPOXY / URETHANE PROGRAM

US ARMY CORPS OF ENGINEERS

COATING SYSTEM DATA

COATING ID.....
 MANUFACTURER.....
 VOLUME % SOLIDS.....
 VOC.....
 POT LIFE.....
 INDUCTION TIME.....
 DRYING TIME MINIMUM TO RECOAT.....
 RECOMMENDED FILM THICKNESS, DRY.....
 MIXING RATIOS.....
 THINNING.....

MACROPOXY ALUMINUM
 SHERWIN WILLIAMS (COOK)
 80%
 1.5 LB/GAL (175 G/L)
 40 MIN @ 75F
 15 MIN @ 75F
 RECOAT 18-24 HOURS
 6 MILS DRY, 7 MILS WET
 1 PART A : 2 PARTS B BY VOLUME
 250-C-357 (XYLENE)

ACROTHANE
 SHERWIN WILLIAMS (COOK)
 61% +/- 2%
 2.88 LB/GAL (346 G/L)
 1.5 HOURS @ 75F
 NONE
 7 DAYS FULL CURE
 1-2:2.5 DRY, 2.5-4:0 WET
 7 PARTS A : 1 PART B
 5% MAX WITH #A19 THINNER

APPLICATION DATA

DATE/TIME.....
 RH.....
 TEMPERATURE.....
 SUBSTRATE CONDITION.....
 COATING BATCH NUMBERS.....
 THINNING.....
 EQUIPMENT.....
 NUMBER OF COATS.....
 SAG INDEX.....

4/10/93 @ 9:00 AM
 51%
 72F
 SSPC VIS. 1-C
 A: 38-199101040/1-017 B: 3819912052164
 10% WITH 250-C-357 XYLENE
 BINKS CONVENTIONAL
 1
 12 MILS

4/11/93 @ 10:30 AM
 55%
 72F
 MACROPOXY
 A: 38199115507 B: 700c505
 NONE
 BINKS CONVENTIONAL
 1
 6 MILS

DRY FILM THICKNESS, MILS

SAMPLE 45	5.0 MILS	2.1 MILS	TOTAL	7.1 MILS
SAMPLE 46	5.1 MILS	2.1 MILS		7.2 MILS
SAMPLE 47	5.4 MILS	1.8 MILS		7.2 MILS
SAMPLE 48	5.8 MILS	2.9 MILS		8.7 MILS
SAMPLE 49	5.8 MILS	2.2 MILS		8.0 MILS
SAMPLE 50	5.9 MILS	2.1 MILS		8.0 MILS

1ST COAT

5.0 MILS
 5.1 MILS
 5.4 MILS
 5.8 MILS
 5.8 MILS
 5.9 MILS

2ND COAT

2.1 MILS
 2.1 MILS
 1.8 MILS
 2.9 MILS
 2.2 MILS
 2.1 MILS

PANEL EVALUATION	MACROPOXY ALUMINUM - ACROTHANE
CLIENT: U.S. ARMY CORPS OF ENG. EPOXY URETHANE PROGRAM DATE: 5/10/93 EVALUATION HOURS: 336	
COATING EVALUATION DATA	
TEST PANEL NUMBER	45 46 47 48 49 50
ASTM D610 RUST GRADE	0 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, SIZE	0 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0 0 0 0 0 0
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS	
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	FINAL EVALUATION ONLY
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	FINAL EVALUATION ONLY
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0 0 0 0 0 0
TABLE 2, RATING # OF UNSCRIBED AREAS	10 10 10 10 10 10
COMMENTS	

PANEL EVALUATION	MACROPOXY ALUMINUM / ACROTHANE										
CLIENT: U.S. ARMY CORPS OF ENG.											
EPOXY URETHANE PROGRAM											
DATE: 8/16/93											
EVALUATION HOURS: 2688											
COATING EVALUATION DATA											
TEST PANEL NUMBER	45	46	47	48	49	50					COMMENTS
ASTM D610 RUST GRADE	0	0	0	0	0	0					All blistering is along the scribe edges.
ASTM D714 DEGREE OF BLISTERING, SIZE	4	4	4	2	4	2					
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	Dense	Med	Dense	Med	Med	Med					
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS											
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES											FINAL EVALUATION ONLY
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER											FINAL EVALUATION ONLY
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0	0	0	0	0	0					
TABLE 2, RATING # OF UNSCRIBED AREAS	10	10	10	10	10	10					

PANEL EVALUATION	MACROPOXY ALUMINUM / ACROTHANE									
CLIENT: U.S. ARMY CORPS OF ENG. EPOXY URETHANE PROGRAM DATE: 9/13/93 EVALUATION HOURS: 3360-FINAL										
COATING EVALUATION DATA										
TEST PANEL NUMBER	45	46	47	48	49	50				
ASTM D610 RUST GRADE	0	0	0	0	0	0	0 All blistering is localized along the scribe edges.			
ASTM D714 DEGREE OF BLISTERING, SIZE	4	4	4	2	4	2				
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	Dense	Dense	Dense	Dense	Dense	Dense				
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS										
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	7/64"	3/64"	5/64"	9/64"	5/64"	3/64"				
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	6	7	6	5	6	7				
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0	0	0	0	0	0				
TABLE 2, RATING # OF UNSCRIBED AREAS	10	10	10	10	10	10				
% Gloss Retention (average of all panels): 70.3%	Yellowing Index: 94.1% yellowing									

US ARMY CORPS OF ENGINEERS		EPOXY / URETHANE PROGRAM	
COATING SYSTEM DATA			
COATING ID	EPTCP ALUMINUM	VHSA POLYURETHANE	
MANUFACTURER	SIGMA COATINGS	SIGMA COATINGS	
VOLUME % SOLIDS	80% +/- 2%		
VOC	2 LBS/GAL (239.6 G/L)	3.10 LB/GAL (371.5 G/L)	
POT LIFE	6 HOURS AT 68F	4 HOURS AT 68F	
INDUCTION TIME	NONE	NONE	
DRYING TIME MINIMUM TO RECOAT	5 HOURS	12HRS MIN 5 DAYS @ 77F FULL CURE	
RECOMMENDED FILM THICKNESS, DRY	5-8 MILS DRY	2-3 MILS DRY	
MIXING RATIOS	3.35:1 BY VOL 5.66 BY WT.	4.88 : 1 BY VOLUME 5.25:1 BY WT	
THINNING	10% MAX. WITH #9192 THINNER	6% MAX WITH #91-88 THINNER	
APPLICATION DATA			
DATE/TIME	4/19/93 @ 8:00 AM	4/19/93 @ 4:00 PM	
RH	65%	64%	
TEMPERATURE	75F	76F	
SUBSTRATE CONDITION	SSPC VIS. -1C	EPTCP ALUMINUM	
COATING BATCH NUMBERS	A: 232-052 B: 136-023	A: 035-023 B: 088-112	
THINNING	10% WITH #91-92 THINNER	NONE	
EQUIPMENT	CONVENTIONAL	BINKS CONVENTIONAL	
NUMBER OF COATS	1	1	
SAG INDEX	14 MILS	7 MILS	
DRY FILM THICKNESS, MILS			
SAMPLE 57	5.3 MILS	4.3 MILS	9.6 MILS
SAMPLE 58	6.0 MILS	3.4 MILS	9.4 MILS
SAMPLE 59	6.9 MILS	4.5 MILS	11.4 MILS
SAMPLE 60	8.1 MILS	4.0 MILS	12.1 MILS
SAMPLE 61	5.9 MILS	3.7 MILS	9.6 MILS
SAMPLE 62	7.0 MILS	3.2 MILS	10.2 MILS
1ST COAT		2ND COAT	
5.3 MILS		4.3 MILS	
6.0 MILS		3.4 MILS	
6.9 MILS		4.5 MILS	
8.1 MILS		4.0 MILS	
5.9 MILS		3.7 MILS	
7.0 MILS		3.2 MILS	
TOTAL		TOTAL	
9.6 MILS		9.6 MILS	
9.4 MILS		9.4 MILS	
11.4 MILS		11.4 MILS	
12.1 MILS		12.1 MILS	
9.6 MILS		9.6 MILS	
10.2 MILS		10.2 MILS	

PANEL EVALUATION	EPTCP ALUMINUM / VHSA POLYURETHANE FINISH										
CLIENT: U.S. ARMY CORPS OF ENG. EPOXY URETHANE PROGRAM DATE: 5/24/93 EVALUATION HOURS: 672											
COATING EVALUATION DATA											
TEST PANEL NUMBER	57	58	59	60	61	62					
ASTM D610 RUST GRADE	0	0	0	0	0	0					
ASTM D714 DEGREE OF BLISTERING, SIZE	0	0	0	0	0	0					
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	0	0	0	0	0	0					
ASTM D 1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS											
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES											
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER											
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0	0	0	0	0	0	0	0	0	0	
TABLE 2, RATING # OF UNSCRIBED AREAS	10	10	10	10	10	10	10	10	10	10	
FINAL EVALUATION ONLY											
FINAL EVALUATION ONLY											

PANEL EVALUATION	EPTCP ALUMINUM / VHSA POLYURETHANE						COMMENTS
CLIENT: U.S. ARMY CORPS OF ENG. EPOXY URETHANE PROGRAM DATE: 7/19/93 EVALUATION HOURS: 2016							
COATING EVALUATION DATA							
TEST PANEL NUMBER	57	58	59	60	61	62	
ASTM D610 RUST GRADE	0	0	0	0	0	0	
ASTM D714 DEGREE OF BLISTERING, SIZE	6	8	0	6	6	8	All blistering is localized along scribe edges.
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	Few	Few	0	Few	Med	Few	
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS							
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES							FINAL EVALUATION ONLY
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER							FINAL EVALUATION ONLY
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	0	0	0	0	0	0	
TABLE 2, RATING # OF UNSCRIBED AREAS	10	10	10	10	10	10	

PANEL EVALUATION	EPTCP ALUMINUM / VHSA POLYURETHANE
CLIENT: U.S. ARMY CORPS OF ENG. EPOXY URETHANE PROGRAM DATE: 8/16/93 EVALUATION HOURS: 2688	
COATING EVALUATION DATA	
TEST PANEL NUMBER	57 58 59 60 61 62
ASTM D610 RUST GRADE	0 0 0 0 0 0
ASTM D714 DEGREE OF BLISTERING, SIZE	6 0 0 6 6 4
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	Med 0 0 Med-Den Med Few
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS	
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES	
MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER	FINAL EVALUATION ONLY
RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED	FINAL EVALUATION ONLY
TABLE 2, RATING # OF UNSCRIBED AREAS	10 10 10 10 10 10
COMMENTS Blistering is along the scribe edges only.	

PANEL EVALUATION	EPTCP ALUMINUM / VHSA POLYURETHANE FINISH																																																								
CLIENT: U.S. ARMY CORPS OF ENG. EPOXY URETHANE PROGRAM DATE: 9/13/93 EVALUATION HOURS: 3360																																																									
COATING EVALUATION DATA																																																									
TEST PANEL NUMBER	57 58 59 60 61 62																																																								
ASTM D610 RUST GRADE	0 0 0 0 0 0																																																								
ASTM D714 DEGREE OF BLISTERING, SIZE	6 8 4 6 6 4																																																								
ASTM D714 DEGREE OF BLISTERING, FREQUENCY	Med Med Med Med Med Med																																																								
ASTM D1654 EVALUATION OF PAINTED OR COATED SPECIMENS SUBJECTED TO CORROSIVE ENVIRONMENTS MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED TABLE 2, RATING # OF UNSCRIBED AREAS																																																									
<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>TEST PANEL NUMBER</th> <th>57</th> <th>58</th> <th>59</th> <th>60</th> <th>61</th> <th>62</th> <th>COMMENTS</th> </tr> </thead> <tbody> <tr> <td>MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>TABLE 2, RATING # OF UNSCRIBED AREAS</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>% Gloss Retention (average of all panels): 92.1%</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>% Yellowing Index: 86.7% yellowing</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>		TEST PANEL NUMBER	57	58	59	60	61	62	COMMENTS	MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES								MEAN CREEPAGE FROM SCRIBE, TABLE 1, RATING NUMBER								RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED								TABLE 2, RATING # OF UNSCRIBED AREAS								% Gloss Retention (average of all panels): 92.1%								% Yellowing Index: 86.7% yellowing							
TEST PANEL NUMBER	57	58	59	60	61	62	COMMENTS																																																		
MEAN CREEPAGE FROM SCRIBE, TABLE 1, INCHES																																																									
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RATING OF UNSCRIBED AREAS, TABLE 2, % FAILED																																																									
TABLE 2, RATING # OF UNSCRIBED AREAS																																																									
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Appendix C: Commercial Item Description of a Coating System for Minimally Prepared Atmospheric Steel–Aluminum Epoxy Mastic

Abstract

This commercial item description covers the requirements for a high build aluminum pigmented epoxy coating system. The product shall be suitable for application at temperatures of 40 °F (4.4 °C) and above to minimally prepared rusted and/or painted ferrous metal substrates. Wide latitude is afforded the formulator provided the product meets the specification requirements when tested as described herein. The coating shall not contain lead, chromium, cadmium, or chlorinated solvents. In addition to the manufacturer's standard label, the product shall be labeled with the title and number of this commercial item description.

Salient Characteristics

The coating shall comply with the following requirements.

Application Properties¹

The coating shall not sag, run, or streak when applied by brush, spray, or roller at the manufacturer's recommended thickness.

Appearance of the Dried Paint Film²

The dried paint film shall have no visible cracks or fractures.

¹ The coating shall be applied at the manufacturer's recommended film thickness by brush, roller, and conventional and airless spray.

² The applied paint shall be inspected under 30X magnification after drying for 1 week.

Dry Time³

The coating shall dry hard in not more than 16 hours.

Pot Life⁴

The viscosity of the mixed coating shall not increase by more than 10 Krebs units (KU) in 3 hours.

Intercoat Adhesion⁵

When tested as specified, the coating shall exhibit no intercoat delamination.

Accelerated Corrosion Resistance⁶

None of the six test panels shall blister adjacent to the scribe earlier than the inspection at 2688 hours. No more than 1, 4, and 6 test panels shall blister adjacent to the scribe at 2688, 3360, and 4032 hours respectively. For all six test panels, the average numerical blister rating for the area adjacent to the scribe shall not be less than 6.5. The blister rating shall be the average of the sum of the average numerical ratings for frequency and size. Frequency ratings shall be converted as follows: 10 = none, 8 = few, 6 = medium, 4 = medium dense, 2 = dense, 0 = total. Any blistering not immediately adjacent to the scribe shall be cause for rejection. The average rust rating for the six panels and the minimum rust rating for any one test panel shall not be less than 9.0. The rust undercut rating for any panel shall not be less than 6.0 and the average rust undercut rating for all six panels shall be greater than 6.0. The sum of the average rust, blister, and undercut scores shall not be less than 23.0.

³ The time to dry hard shall be determined for the epoxy coating applied at the recommended film thickness in accordance with ASTM D 523-89.

⁴ The initial viscosity of a 1-qt (0.095 L) sample of thoroughly mixed coating shall be determined by ASTM D 562. The viscosity shall be measured a second time after 3 hr.

⁵ Two successive coats of the test material shall be spray-applied to the designated dry film thickness. The applied paint shall be cured and aged at 70 to 75 °F (21 to 24 °C) and 50 ±10 percent relative humidity for 72 hr between coats and for 7 days after the application of the second coat. A sharp knife shall be used to produce two parallel scribes through the coating approximately 1 in. long and 1/4-in. apart. A third scribe shall be made perpendicular to and through the parallel scribes. The knife shall be used to determine the intercoat adhesion by attempting to delaminate the second coat from the first along the perpendicular scribe.

⁶ The corrosion resistance of the aluminum epoxy mastic system shall be evaluated using this test procedure.

Volatile Organics⁷

The volatile organic content of the mixed and thinned coating shall not exceed 350 g/L.

Preparation of Test Specimens

Pre-rusted test specimens measuring 3.0 x 9.0 x 0.125 in. shall be prepared in accordance with SSPC Coatings Test Panel Preparation Specification No. 1, *Uncontaminated Rusted Steel* (SSPC Draft Specification No. 2, January 1995).

Application of Paint System

The first coat of aluminum epoxy mastic shall be spray-applied to the recommended dry film thickness and allowed to cure for 18 to 24 hours at 72 ± 2 °F (22 ± 1 °C) and 50 ± 5 percent relative humidity. The second coat of epoxy shall be spray applied and allowed to dry for a minimum of 7 days prior to testing. Prior to exposure, test panels shall be scribed in accordance with ASTM D1654 such that the coating is uniformly removed down to the substrate along the entire length of the scribe.

Cyclic Test Exposure

Six test coupons of the aluminum epoxy coating system shall be exposed in accordance with ASTM G 85, Annex A5, and ASTM G 53 with the following modifications and conditions. The concentration of the dilute salt solution shall be 0.4 percent ammonium sulfate and 0.05 percent sodium chloride. The salt spray temperature shall be 30 °C and the dry-off temperature 40 °C. The UV-condensing cabinet shall use UV-A bulbs and be run at 60 °C during the 4h UV cycle and at 50 °C during the 4h condensation cycle. Samples shall be exposed alternately for 1 week in the G 53 cabinet followed by 1 week in the G 85 cabinet for a total of 4032h.

Inspection and Evaluation of Test Coupons

The coatings shall be evaluated for rusting, blistering, and rust undercutting at the scribe in accordance with ASTM D610, SSPC-Vis. 2, ASTM D714, and ASTM D1654. A transparent grid overlay shall be used to enhance the results of the visual examination. Panels shall be evaluated after 332, 672, 1344, 2016, 2688, 3360, and 4032 hours of exposure, except that undercutting at the scribe shall only be determined after 4032 hours.

⁷ The VOC content of the mixed, ready-to-apply material shall be determined in accordance with USEPA method 24.

Quality Assurance

Responsibility

Unless otherwise specified, the contractor is responsible for the performance of all inspection requirements specified herein. The Government reserves the right to perform any of the inspections set forth when deemed necessary to assure that the material conforms to the prescribed requirements.

Inspection

Sampling shall be in accordance with ASTM D 3925. Testing shall be conducted in a Government-approved testing facility using the manufacturer's designated dry film thickness applied in the recommended number of coats. Generally this system will be applied in two coats with a total dry film thickness of 8 to 14 mils. Failure to meet any requirement specified herein shall be cause for rejection.

1. First article inspection when specified shall include all tests of salient characteristics, and may be standard production material from the supplier's current inventory.
2. Quality conformance inspection shall include all of the requirements specified herein with the exception of the provisions for accelerated corrosion resistance and volatile organics unless otherwise specified.
3. Coatings shall be subject to inspection for requalification purposes every 3 years, or at which time that the product is reformulated. The requirements shall be the same as for first article inspection.

Certification

The contractor shall certify, and maintain substantiating evidence, that the products conform to the producer's own specifications, standards, and quality assurance practices. The Government reserves the right to require proof of such conformance prior to first delivery and thereafter as may be otherwise provided for by the contract.

Packaging

Materials shall be packaged and marked as specified in ASTM D 3951. The manufacturer of the material shall provide material safety data sheets and instructions for application of the product.

Further Notes

Note 1

This coating system is primarily for use on hand- or power tool-cleaned exterior steel substrates in normal or industrial atmospheres. It may also be used for interior areas that are dry or subject to high humidity and condensation. In some cases this system may be used to overcoat existing coating systems as a means of extending their service life. An assessment of the current coating condition and the application of a test patch of the proposed overcoat material must be conducted before scheduling the painting contract. Higher grades of surface preparation, such as commercial blast cleaning, may be selected at the discretion of the specifier. Commercial blast cleaning may be appropriate for complete removal of a heavily deteriorated coating system. Grades of surface preparation higher than SP-6 will not significantly improve the performance of the coating system and do not warrant the added expense.

Note 2

At least 6 months should be allowed for the qualification of any manufacturers brand of aluminum epoxy mastic paint. Because of the long time necessary to qualify coatings, the purchaser should consider selecting a previously qualified coating.

Suggested Sources

Source	Product
Carboline 350 Hanley Industrial Court St. Louis, MO 63144	Carbomastic 15LO
Carboline 350 Hanley Industrial Court St. Louis, MO 63144	Carbomastic 90 Aluminum
Devoe Coatings Company 4000 DuPont Circle Louisville, KY 40207	Bar Rust 239
Sherwin-Williams 101 Prospect Ave., NW Cleveland, OH 44115-1075	Epoxy Mastic Aluminum II

Appendix D: Commercial Item Description of a Coating System for Minimally Prepared Atmospheric Steel–Epoxy Primer/Urethane Topcoat

Abstract

This paint system consists of a commercially available epoxy mastic primer and urethane topcoat produced by a single manufacturer and marketed for use as a system. The coating system is suitable for use on minimally prepared rusted and/or painted ferrous metal substrates. Wide latitude is afforded the formulator, provided the system meets the requirements as specified herein. The coatings shall not contain lead, chromium, cadmium, or chlorinated solvents. As a minimum, the topcoat shall be available in white, black, grey, and safety yellow. Qualification testing shall be performed on systems using the white topcoat.

Salient Characteristics

The coating system shall comply with the following requirements when tested.

Application Properties¹

The primer and topcoat shall not sag, run, or streak when tested as specified.

Appearance of the Dried Paint Film²

When tested as specified the primer shall have no visible cracks.

¹ The primer and topcoat shall be applied by brush, roller, and conventional and airless spray at the manufacturer's recommended thicknesses.

² The dried coatings shall have a smooth uniform appearance. A dried film of the epoxy primer shall exhibit no cracks or fractures when examined under 30X magnification.

Dry Time³

The primer shall dry-hard in less than 8 hours and the topcoat in less than 6 hours.

Pot Life⁴

The viscosities of the mixed primer and mixed topcoat shall not increase by more than 10 Krebs units (KU) over a 4-hr period.

Intercoat Adhesion⁵

When tested as specified, the topcoat shall show no intercoat delamination from the primer.

Volatile Organics⁶

The volatile organics content of the ready to apply primer and topcoat shall not be greater than 350 g/L and 420 g/L respectively.

Cyclic Corrosion Test⁷

No more than two panels shall exhibit blistering adjacent to the scribe after 1344 and 2016 hours of testing. No more than four panels shall exhibit blistering adjacent to the scribe after 2688 and 3360 hours of testing. The average of the sum of the final numerical blister ratings shall not be less than 8.0. The blister rating shall be the average of the sum of the average numerical ratings for frequency and size. Frequency ratings shall be converted as follows: 10 = none, 8 = few, 6 = medium, 4 = medium dense, 2 = dense, 0 = total. Blistering not immediately adjacent to the scribe shall be cause for rejection. The final rust rating for each of the six test panels shall be 10. No single test panel shall have a rust undercut rating of less than 5.0

³ The time to dry-hard shall be determined for the primer and topcoat applied at the recommended film thicknesses in accordance with ASTM D 1640-83 (Reapproved 1989).

⁴ The viscosity of 1-qt samples of epoxy primer and urethane topcoat shall be determined immediately after mixing and 4 hours later in accordance with ASTM D 562-82 (Reapproved 1990).

⁵ The primer/topcoat system shall be spray applied to the recommended film thickness. The primer shall be air dried for 72 hours at 72 ± 2 °F (22 ± 1 °C) and 50 ± 5 percent relative humidity prior to application of the topcoat. The topcoat shall be allowed to dry 7 days prior to testing. A sharp knife shall be used to produce two parallel scribes through the coating approximately 1 in. long and 1/4-in. apart. A third scribe shall be made perpendicular to and through the parallel scribes. The knife shall be used to determine the intercoat adhesion by attempting to delaminate the urethane topcoat from the epoxy primer along the perpendicular scribe.

⁶ The volatile organic content of the primer and topcoat shall be determined in accordance with the requirements of USEPA Method 24.

⁷ The corrosion resistance of the epoxy/urethane coating system shall be evaluated using this test procedure.

and the average scribe rating for the six test panels shall not be less than 7.0. The sum of the average blister, rust, and undercut ratings shall not be less than 25.0.

Preparation of Test Specimens

Prerusted test specimens measuring 3.0 x 9.0 x 0.125 in. shall be prepared in accordance with SSPC Coatings Test Panel Preparation Specification No. 1, *Uncontaminated Rusted Steel* (SSPC Draft Specification No. 2, January 1995).

Application of Paint System

The primer shall be spray-applied to the recommended dry film thickness and allowed to cure for 18 to 24 hours at 72 ± 2 °F (22 ± 1 °C) and 50 ± 5 percent relative humidity. The topcoat shall be spray applied and allowed to dry for a minimum of 7 days prior to testing. Prior to exposure test panels shall be scribed in accordance with ASTM D 1654 such that the coating is uniformly removed down to the substrate along the entire length of the scribe.

Cyclic Test Exposure

Six test coupons of the epoxy/urethane coating system shall be exposed in accordance with ASTM G 85, Annex A5, and ASTM G 53 with the following modifications and conditions. The concentration of the dilute salt solution shall be 0.4 percent ammonium sulfate and 0.05 percent sodium chloride. The salt spray temperature shall be 30 °C and the dry-off temperature 40 °C. The UV-condensing cabinet shall use UV-A bulbs and be run at 60 °C during the 4h UV cycle and at 50 °C during the 4h condensation cycle. Samples shall be exposed alternately for 1 week in the G 53 cabinet followed by 1 week in the G 85 cabinet for a total of 3360h.

Inspection and Evaluation of Test Coupons

The exposed test coupons shall be evaluated for rusting, blistering, and rust undercutting at the scribe in accordance with ASTM D 610, SSPC Vis. 2, ASTM D 714, and ASTM D 1654 after 1344, 2016, 2688, and 3360 hours of exposure except that rust undercutting at the scribe shall only be rated at the completion of testing.

Quality Assurance

Responsibility

Unless otherwise specified, the contractor is responsible for the performance of all inspection requirements specified herein. The Government reserves the right to perform any of the inspections set forth when deemed necessary to assure that the material conforms to the prescribed requirements.

Inspection

Sampling shall be in accordance with ASTM D 3925. Testing shall be conducted in a Government-approved testing facility using the manufacturer's designated dry film thickness applied in the recommended number of coats. Generally this system will be applied in two coats with a total dry film thickness of 8 to 14 mils. Failure to meet any requirement specified herein shall be cause for rejection.

1. First article inspection when specified shall include all tests of salient characteristics, and may be standard production material from the supplier's current inventory.
2. Quality conformance inspection shall include all of the requirements specified herein with the exception of the provisions for accelerated corrosion resistance and volatile organics unless otherwise specified.
3. Coatings shall be subject to inspection for requalification purposes every 3 years, or at which time that the product is reformulated. The requirements shall be the same as for first article inspection.

Certification

The contractor shall certify, and maintain substantiating evidence, that the products conform to the producer's own specifications, standards, and quality assurance practices. The Government reserves the right to require proof of such conformance prior to first delivery and thereafter as may be otherwise provided for by the contract.

Packaging

Materials shall be packaged and marked as specified in ASTM D 3951. The manufacturer of the material shall provide material safety data sheets and instructions for application of the product.

Further Notes

Note 1

This coating system is intended primarily for use on hand- or power tool-cleaned exterior steel substrates exposed to rural or industrial atmospheres where finish colors other than aluminum are desired. It may also be used for interior surfaces that are dry or subject to high humidity and condensation. In some cases this coating system can be used to overcoat existing coating systems as a means of extending their service life. An assessment of the current coating condition and the application of a test patch of the proposed overcoat material must be conducted to determine the viability of the overcoat option. Higher grades of surface preparation, such as SSPC-SP 6, *Commercial Blast Cleaning*, may be selected at the discretion of the specifier. SP 6 may be appropriate for the complete removal of a deteriorated coating system. Better grades of surface cleaning than SP 6 will not significantly improve the performance of the coating system and do not warrant the higher cost.

Note 2

At least 6 months should be allowed for the qualification of any manufacturer's system. Because of the long time period required for qualification, the Contractor should consider selecting a previously qualified system.

Suggested Sources

Source	Product
Carboline 350 Hanley Industrial Court St. Louis, MO 63144	Primer: Carbomastic 90 Topcoat: Carbothane 134HS
Carboline 350 Hanley Industrial Court St. Louis, MO 63144	Primer: Carbomastic 15LO Topcoat: Carbothane 134HS
International /Courtalds Coatings 6001 Antoine Houston, TX 77210-4806	Primer: Intergard H.S. Universal Epoxy Topcoat: Interthane
Sherwin-Williams 101 Prospect Ave, NW Cleveland, OH 44115-1075	Primer: Surface-Tolerant Epoxy Topcoat: Hi Solids Polyurethane

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