Copper in Architecture

CDA
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Copper Application Data

Clear Coatings on Copper Alloys

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Summary & Overview

The natural weathering of copper is a direct result of the mild corrosive attack of airborne sulfur compounds, principally stemming from the combustion of fossil fuels.

As natural weathering proceeds, the exposed copper surface changes in hue. During the initial weeks of exposure, radical color changes often take place and are soon replaced by relatively uniform russet-brown shades.

As weathering progresses, the metal surface darkens and continues to change color gradually until equilibrium is reached resulting in either a dark brown color or a blue-green patina. In industrial and seacoast atmospheres, the natural patina may form in five to seven years. In rural atmospheres, a patina may form in 10 to 14 years, while in arid locations, the patina may never form. This is because moisture is required for the chemical conversion processes necessary for patina formation. Exposed horizontal surfaces develop a patina more rapidly than sloping surfaces which, in turn, patinate more rapidly than vertical surfaces.

Frequently, it is desired to preserve the original salmon color of copper and arrest patina formation by applying a clear protective coating. Clear coatings are used to prevent the oxidation and tarnishing of copper, brass and bronze utilized in decorative areas, mainly interiors, as well as in architectural elements exposed to the environment.

A series of comprehensive tests was initiated by CDA to summarize the capabilities of commercially available coatings that meet federal EPA regulations for low Volatile Organic Compounds (VOC). All coating compounds tested were below 3.0 pounds per gallon VOC content, considered a relatively "low VOC" level. (The exception is Incralac by StanChem, an air dry solvent-based coating, which was used as a test standard.) Powder coatings contain zero VOC.

Coatings

The objective of the CDA program was to evaluate the relative performance of various US-produced, EPA-approved, commercially available clear coatings for a variety of properties when applied to copper, brass and bronze. Wherever applicable, ASTM test procedures were followed.

An industry-wide survey was undertaken with 700 questionnaires distributed. A total of 67 products were submitted with 22 selected for testing. Solvent-based Incralac, long an industry standard, was used as a control. Two types of coatings were tested: interior and exterior.

Three types of products were evaluated in this study:

- Liquid Coatings – Air Dry
- Liquid Coatings – Bake
- Powder Coatings – Bake

Liquid Coatings – Air Dry: All liquid coatings were applied using a spray gun. All panels were air dried for 7 days at 75° F and 50% relative humidity.

Liquid Coatings – Bake: All liquid coatings were applied using a spray gun. All panels were baked per manufacturers' instructions for 15-25 minutes at 300° F to 375° F.

Powder Coatings – Bake: All powder coatings were applied using a powder electrostatic spray gun. All panels were baked per manufacturers' instructions for 15-20 minutes at 340° F to 400° F.

Products Tested

The specific products included in this study with respective test locations are listed below:

Liquid Coatings – Air Dry

Product	Manufacturer	Polymer	Test Loc. Int.	Test Loc. Ext.
A-1. Incralac	StanChem	Acrylic	✔	✔
A-2. Tru-Glaze WB	DeVoe & Raynolds	Epoxy (2 Comp.)	✔	
A-3. AT 204	Perfection (Lilly)	Acrylic Urethane	✔	✔
A-4. Hydrolac 33A	Rhone-Poulenc	Acrylic	✔	✔
A-5. Sancure 847	Sanncor	Urethane	✔	✔
A-6. Sancure 815	Sanncor	Urethane	✔	✔
A-7. Sancure 898	Sanncor	Urethane	✔	✔
A-8. Plascron X605-0	Vanex	Acrylic		✔

Liquid Coatings – Bake

Product	Manufacturer	Polymer	Test Loc. Int.	Test Loc. Ext.
B-1. EPC-1391	Env. Protect Coating	Epoxy	✔	
B-2. 93023	Jamestown	Polyester	✔	
B-3. 92849	Jamestown	Acrylic		✔
B-4. KCB-217	Morton	Acrylic		✔
B-5. X5050	Vanex	Polyester	✔	

Powder Coatings – Bake

Product	Manufacturer	Polymer	Test Loc. Int.	Test Loc. Ext.
C-1. Evlast 1000/1C101	Evtech	Polyester/Urethane	✔	
C-2. Evlast 2000/2C102	Evtech	Epoxy	✔	
C-3. Vedco VP-188	Ferro	Polyester	✔	✔
C-4. Vedco VA-190	Ferro	Acrylic	✔	✔
C-5. Interpon 610/MZ001U	International	Polyester	✔	✔
C-6. Corvel 13-9028	Morton	Epoxy	✔	
C-7. Corvel 23-9030	Morton	Polyester	✔	
C-8. Everclear EFC 500-S9	O'Brien	Epoxy	✔	
C-9. Drylac 49/00270	Tiger	Polyester	✔	✔

Panel Preparation

All coatings were applied according to manufacturers' instructions at the recommended nominal film thicknesses. Each coating was applied to cleaned satin-finished sheets of the substrates listed below:

Copper – Alloy No. C11000
Brass – Alloy No. C26000
Bronze – Alloy No. C28000

The substrates were prepared for coating as follows:

1. Immersed in acetone.
2. Wiped with a cloth saturated with acetone.
3. Cleaned of tarnish using Scotch-Brite abrasive wheels.
4. Wiped clean and degreased with a solvent blend of 20% acetone, 5% butyl-acetate and 75% toluol.
5. Dried with a lint-free white cotton felt pad.
6. Blown clean with compressed air.

Test Procedures

The tests on all coatings were performed per ASTM standards (where appropriate) as follows:

General Coating Properties (copper panels only)

Gloss – ASTM D 523
Appearance – Visual ASTM D 714-56
Adhesion – ASTM D 3359
Hardness-Pencil – ASTM D 3363
Flexibility-Rod – ASTM D 522
Abrasion-Taber CS-10,500 g. – ASTM D 4060
Chemical Resistance – ASTM D 1308
Dry Time: Set-to-touch, Dry-hard, Dry-through – ASTM D 1640

Environmental Exposure

Kitchen Dishwasher – 50 cycles; observed after 25 cycles.
Heat Aging – 6 weeks at 158 F; observed after 4 and 6 weeks.
Thermal Cycling – 10 cycles.
Salt Fog – 300 hours, ASTM B 117; observed after 150 and 300 hours.

Exterior Exposure (exterior coatings only)

Accelerated Weathering – 900 hours, ASTM G 53; observed after 300, 600 and 900 hours.
Exterior Exposure – 9 months on 45° slope, south-facing in New York City; observed after 3, 6 and 9 months.

The following eight test procedures were used to determine the General Coating Properties:

Gloss – Relative intensities of incident and reflected light beams are measured. Using Federal Method No. 6101, light from a standardized source is projected on the coated surfaces and reflected to a photocell which indicates the intensity. Due to the high reflectivity of metallic substrates, the equipment is calibrated so that a Carrara glass standard registers a reading of only about half the normal value at the 60-degree angle. The gloss measured is largely an indication of the reflectivity of the metal surface, although changes in the coating can have an effect. Changes from the initial gloss reading indicate changes in the reflectivity of the coating-metal combination.

Appearance – The method used for evaluating appearance (other than color change) is generally patterned after ASTM D 714-56, "Evaluating Degrees of Blistering on Paints." A value of 10 indicates no defects, while zero designates complete failure. Blister size and population standards are found in the specification: a value of 9 is the smallest observable with the unaided eye, while 8, 6, 4, and 2 are progressively larger. Haze, checking and other defects are rated on a similar relative scale: the letters F, M, MD, and D refer to defect densities specified as few, medium, medium-dense and dense. For salt-fog exposure: the penetration of corrosion which may creep under the coating is rated and reported. Coatings containing inhibitors such as benzotriazole are normally capable of preventing the spread of corrosion or defects in the coating.

Adhesion – A 10x10 crosshatch of 100 1/32-inch squares was scribed on the surface of each coated test panel using a saw-toothed tool. Cellophane tape was pressed over the scribed areas and then lifted off. The number of squares remaining on the panel (100 maximum) is the measure of adhesion.

Hardness – A pencil scratch test was used. The hardness of the lead for which there is a transition from scratching or rupture of the coating to crumbling or writing with the lead is reported. The lead hardness scale from hard to soft is 7H, 6H, 5H, 4H, 3H, 2H, HF, HB, B, 2B, 3B. Hard coatings are usually more resistant to handling and wear, but not necessarily to chipping.

Flexibility – The coated panel is bent over a rod mandrel as described in ASTM D 522. The rod diameter over which the panel may be bent without cracking or spilling of the coating is reported (*e.g.*, 3/16-, 1/2-, or 1-inch; F indicates failure on the 1-inch rod). The smaller values indicate increasing tolerance for deformation.

Abrasion – The Taber Abrasion Test was run for 500 cycles using a CS10 Calibrase Wheel with a 500-gram load. The procedure is described in ASTM D 4060. Results are reported as weight loss in milligrams per 1,000 cycles. A low value indicates good resistance to abrasion.

Chemical Resistance – Samples are visually examined to detect changes after exposure to various chemical solutions for up to 24 hours. Cotton wads are saturated with the solutions and then held under watch glasses within glass rings on the surfaces of the coatings. Specimens are scored on appearance from 10 to 0, the high value indicating no change and the low value complete disintegration.

Dry Time – The air dry coatings are applied to glass panels and allowed to dry at 75 F and 50% relative humidity. The various stages and times of drying are determined by the use of the following procedures:

Set-to-touch – film is tacky but not transferrable to clean glass via touch.

Dry-hard – any impressions left by touch are removable by polishing with a soft cloth.

Dry-through – no impressions are left by touch.

The following procedures used test panel reactions to Environmental Exposure:

Kitchen Dishwasher – Panels are processed through the washing, rinsing and drying cycles of an automatic household dishwasher operating with water at about 140 F to 150 F. A low-pollution detergent (Electrasol) was added. Specimens were evaluated after 25 cycles.

Heat Aging – Panels were placed in a forced-air oven at 158 F and held at that temperature for 6 weeks. The panels were observed for changes at 4 weeks and evaluated after 6 weeks.

Thermal Cycling – Panels were heated in a forced-air oven to 350 F, held for 1/2 hour, and immediately cooled in a freezer to 10 F and held for 1 hour. The cycle was repeated 10 times.

Salt Fog – Panels were exposed to a mist made by atomizing 5 percent sodium chloride solution in distilled water, in accordance with ASTM B 117-64. Total exposure was 300 hours, with specimens evaluated after 150 hours.

The following procedures were used to determine how well the panels could withstand Exterior Exposure:

Accelerated Weathering – Following ASTM G 53, a fluorescent bulb weathering apparatus was used on a cycle of 4 hours of ultraviolet irradiation at 60 C followed by 4 hours of condensation at 50 C. Panels were evaluated after 300, 600 and 900 hours.

Outdoor Exposure – Panels were exposed on a roof in New York City, facing south and inclined at 45°. Panels were removed for evaluation after nine months exposure, sooner in a few cases where the coatings had obviously deteriorated and were no longer useful. Observations were made after 3, 6 and 9 months.

Inasmuch as some observations were subjective, they have been rated using the following ASTM Standardized Scoring System to avoid lengthy descriptions and to provide a degree of objectivity:

Score	Performance	or	Effect
10	Perfect		None
9	Excellent		Trace
8	Very good		Very slight
6	Good		Slight
4	Fair		Moderate
2	Poor		Considerable
1	Very poor		Severe
0	No value		Complete failure

Blistering was evaluated in accordance with ASTM D 714

Size		Frequency		
10	(no blisters)	—		
8	Very small	F	–	Few
6	Small	M	–	Medium
4	Moderate	MD	–	MediumDense
2	Large	D	–	Dense

Changes in color were evaluated visually by comparing the exposed coating to the unexposed coating on the same type of substrate. A score of 10 indicates no change in color. The initial color was evaluated by comparing the unexposed coating on copper to a clean, uncoated copper panel.

Note that no attempt has been made to assign a weight to any property inasmuch as the importance of any single property or group of properties depends upon the specific end use.

Test Results

Tables 1, **2** and **3** exhibit the total rating for resistance to the various exposures for the three metals: **Table 1, Copper C11000; Table 2, Brass C26000; Table 3, Bronze C28000.** Bold-faced entries indicate best performance within a test category.

For each exposure or test, a perfect score is indicated. This perfect score is derived from the test standards applied to a specific test multiplied by 10. For example, Heat Aging testing is reviewed against six standards: color change, appearance, gloss change, adhesion, hardness, flexibility. Each standard is rated from 0 to 10; therefore, all six standards have a potential perfect score for Heat Aging of 60.

Tables 4, **5** and **6** rate the tested coatings on a specific alloy in order of their performance for their respective grouping and application.

Table 1. Copper

Coating	Manufacturer	Type	General Properties	Environmental Exposure: Dish-washer	Heat Aging	Thermal Cycling	Salt Fog	Acceler-ated Weathering	Exterior Exposure (9months)	Overall Rating no Acceler-ated Weathering	Overall Rating w/ Acceler-ated Weathering
		PERFECT SCORE:	90	60	60	60	90	70	50	360	430
Liquid — Air Dry											
Incralac	StanChem	Acrylic	41	34	23	35	60	33	30	193	226
Tru-Glaze WB	DeVoe & Raynolds	Epoxy (2 comp.)	28	15	30	28	34	—	—	135	—
AT-204	Perfection	Acrylic/Urethane	37	39	32	28	54	23	21	190	213
Hydrolac 33A	Rhone-Poulenc	Acrylic	27	0	32	23	0	20	13	82	102
Sancure 847	Sanncor	Urethane	47	25	32	26	44	41	27	174	215
Sancure 815	Sanncor	Urethane	42	0	30	30	0	49	27	98	147
Sancure 898	Sanncor	Urethane	44	0	27	27	0	46	25	98	144
Plascron X605-0	Vanex	Acrylic	37	30	28	20	73	—	—	188	—
Liquid — Baked											
EPC - 1391ENV	Protective Coating	Epoxy	47	33	32	37	45	—	—	194	—
93023	Jamestown	Polyester	38	20	28	28	30	—	—	144	—
92849	Jamestown	Acrylic	19	0	25	32	26	40	18	102	142
KCB-217	Morton	Acrylic	38	30	28	32	49	30	29	177	207
X5050	Vanex	Polyester	34	0	28	35	47	—	—	144	—
Powder — Baked											
Evlast 1000/1C101	Evtech	Polyester/Urethane	42	32	35	28	40	16	27	177	193
Evlast 2000/2C102	Evtech	Epoxy	54	25	26	30	40	—	—	175	—
Vedco VP-188	Ferro	Polyester	45	30	28	30	38	18	34	171	189
Vedco VA-190	Ferro	Acrylic	38	30	28	32	38	44	27	166	210
Interpon 610/MZ001U	International	Polyester	38	32	28	21	40	34	27	159	193
Corvel 13-9028	Morton	Epoxy	47	30	35	31	42	—	—	185	—
Corvel 23-9030	Morton	Polyester	34	32	35	25	38	47	24	164	211
Everclear EFC 500-S9	O'Brien	Epoxy	33	25	28	23	42	—	—	151	—
Drylac 49/00270	Tiger	Polyester	33	25	28	28	42	33	27	189	222

Table 2. Brass

Coating	Manufacturer	Type	Environmental Exposure: Dish-washer	Heat Aging	Thermal Cycling	Salt Fog	Acceler-ated Weathering	Exterior Exposure (9months)	Overall Rating no Acceler-ated Weathering	Overall Rating w/ Acceler-ated Weathering
		PERFECT SCORE:	60	60	60	90	70	50	270	340
Liquid — Air Dry										
Incralac	StanChem	Acrylic	28	30	37	56	30	30	151	181
Tru-Glaze WB	DeVoe & Raynolds	Epoxy (2 comp.)	13	30	21	42	—	—	106	—
AT-204	Perfection	Acrylic/Urethane	27	25	26	45	20	22	123	143
Hydrolac 33A	Rhone-Poulenc	Acrylic	0	28	26	0	0	13	54	54
Sancure 847	Sanncor	Urethane	0	32	28	46	49	29	106	155
Sancure 815	Sanncor	Urethane	34	32	32	42	49	29	140	189
Sancure 898	Sanncor	Urethane	0	33	29	0	40	25	82	122
Plascron X605-0	Vanex	Acrylic	32	30	35	71	—	—	168	—
Liquid — Baked										
EPC - 1391	ENV Protective Coating	Epoxy	25	30	35	58	—	—	148	—
93023	Jamestown	Polyester	0	25	25	0	—	—	50	—
92849	Jamestown	Acrylic	0	28	30	0	10	13	58	68
KCB-217	Morton	Acrylic	21	28	28	64	30	29	141	171
X5050	Vanex	Polyester	0	28	30	43	—	—	101	—
Powder — Baked										
Evlast 1000/1C101	Evtech	Polyester/Urethane	30	30	32	45	25	36	137	162
Evlast 2000/2C102	Evtech	Epoxy	30	25	30	41	—	—	126	—
Vedco VP-188	Ferro	Polyester	30	30	32	39	33	36	131	164
Vedco VA-190	Ferro	Acrylic	29	25	35	39	37	29	128	165
Interpon 610/MZ001U	International	Polyester	28	26	32	45	25	34	131	156
Corvel 13-9028	Morton	Epoxy	32	30	32	47	—	—	141	—
Corvel 23-9030	Morton	Polyester	34	35	30	43	39	29	142	181
Everclear EFC 500S9	O'Brien	Epoxy	30	25	28	47	—	—	130	—
Drylac 49/00270	Tiger	Polyester	27	30	27	47	31	31	131	162

Table 3. Bronze

Coating	Manufacturer	Type	Environmental Exposure: Dish-washer	Environmental Exposure: Heat Aging	Environmental Exposure: Thermal Cycling	Environmental Exposure: Salt Fog	Acceler-ated Weathering	Exterior Exposure (9months)	Overall Rating no Acceler-ated Weathering	Overall Rating w/ Acceler-ated Weathering
		PERFECT SCORE:	60	60	60	90	70	50	270	340
Liquid — Air Dry										
Incralac	StanChem	Acrylic	30	30	34	42	16	27	136	152
Tru-Glaze WB	DeVoe & Raynolds	Epoxy	11	25	26	30	—	—	92	—
AT-204	Perfection	Acrylic/Urethane	25	28	28	45	21	24	126	147
Hydrolac 33A	Rhone-Poulenc	Acrylic	0	30	28	0	10	6	58	68
Sancure 847	Sanncor	Urethane	0	32	28	38	35	27	98	133
Sancure 815	Sanncor	Urethane	0	26	28	0	51	24	54	105
Sancure 898	Sanncor	Urethane	0	27	32	0	44	16	59	103
Plascron X605-0	Vanex	Acrylic	32	28	32	55	—	—	147	—
Liquid — Baked										
EPC - 1391	ENV Protective Coating	Epoxy	37	30	30	84	—	—	181	—
93023	Jamestown	Polyester	0	30	24	39	—	—	93	—
92849	Jamestown	Acrylic	0	30	28	23	0	16	81	81
KCB-217	Morton	Acrylic	28	30	23	61	25	27	142	167
X5050	Vanex	Polyester	0	28	30	51	—	—	89	—
Powder — Baked										
Evlast 1000/1C101	Evtech	Polyester/Urethane	32	30	30	45	23	32	137	160
Evlast 2000/2C102	Evtech	Epoxy	28	32	30	45	—	—	135	—
Vedco VP-188	Ferro	Poyester	32	28	30	43	26	33	133	159
Vedco VA-190	Ferro	Acrylic	32	32	32	49	13	34	145	158
Interpon 610/MZ001U	International	Polyester	24	26	32	43	30	31	125	155
Corvel 13-9028	Morton	Epoxy	30	26	28	49	—	—	139	—
Corvel 23-9030	Morton	Polyester	33	30	28	41	37	33	132	169
Everclear EFC 500S9	O'Brien	Epoxy	30	30	30	45	—	—	135	—
Drylac 49/00270	Tiger	Polyester	30	32	27	43	30	27	132	162

Table 4. Copper — Order of Performance (*= Equal)

Overall Interior Coatings	Overall Exterior Coatings
Liquid – Air Dry	
1. Incralac	1. Incralac
2. AT 204	2. Sancure 847
3. Plascron X605-0	3. AT 204
4. Sancure 847	4. Sancure 815
5. Tru-Glaze WB	5. Sancure 898
*6. Sancure 815	6 Hydrolac 33A
*6. Sancure 898	
7. Hydrolac 33A	
Liquid – Bake	
1. EPC-1391	1. KCB-217
2. KCB-217	2. 92849
*3. 93023	
*3. X5050	
4. 92849	
Powder – Bake	
1. Drylac 49/00270	1. Drylac 49/00270
2. Corvel 13-9028	2. Corvel 23-9030
3. Evlast 1000/1C101	3. Vedco VA-190
4. Evlast 2000/2C102	4. Evlast 1000/1C101
5. Vedco VP-188	5. Vedco VP-188
6. Vedco VA-190	
7. Corvel 23-9030	
8. Interpon 101MZ001U	
9. Everclear - EFC 500S9	

Table 5. Brass — Order of Performance (*= Equal)

Overall Interior Coatings	Overall Exterior Coatings
Liquid – Air Dry	
1. Plascron X605-0	1. Sancure 815
2. Incralac	2. Incralac
3. Sancure 815	3. Sancure 847
4. AT-204	4. AT-204
*5. Tru-Glaze WB	5. Sancure 898
*5. Sancure 847	6. Hydrolac 33A
6. Sancure 898	
7. Hydrolac 33A	
Liquid – Bake	
1. EPC-1391	1. KCB-217
2. KCB-217	2. 92849
3. X5050	
4. 92849	
5. 93023	
Powder – Bake	
1. Corvel 23-9030	1. Corvel 23-9030
2. Corvel 13-9028	2. Vedco VA-190
3. Evlast 1000/1C101	3. Vedco VP-188
*4. Vedco VP-188	* 4. Evlast 1000/1C101
*4. Interpon 610/MZ001U	* 4. Drylac 49/00270
*4. Drylac 49/00270	5. Interpon 610 /MZ001U
5. Everclear EFC 50059	
6. Vedco VA-190	
7. Evlast 2000/2C102	

Table 6, Bronze — Order of Performance (*= Equal)

Overall Interior Coatings	Overall Exterior Coatings
Liquid – Air Dry	
1. Plascron X605-0	1.Incralac
2. Incralac	2. AT-204
3. AT-204	3. Sancure 847
4. Sancure 847	4. Sancure 815
5. Tru-Glaze WB	5. Sancure 898
6. Sancure 898	6. Hydrolac 33A
7. Hydrolac 33A	
8. Sancure 815	
Liquid – Bake	
1. EPC-1391	1. KCB-217
2. KCB - 217	2. 92849
3. 93023	
4. X5050	
5. 92849	
Powder – Bake	
1. Vedco VA-190	1. Corvel 23-9030
2. Corvel 13-9028	2. Drylac 49/00270
3. Evlast 1000/1C101	3. Evlast 1000/1C101
*4. Evlast 2000/2C102	4. Vedco VP-188
*4. Everclear EFC 50059	5. Vedco VA-190
5. Vedco VP-188	6. Interpon 610MZ001U
*6. Corvel 23-9030	
*6. Drylac 49/00270	
7. Interpon 610/MZ001U	

Summary

The results of this test program indicate that different coatings are superior for different applications or end uses. Therefore, users of these data must prioritize their needs when selecting a coating for a specific application.

General Coating Properties

This testing was performed on copper substrates only. The results of these tests indicate that six of the seven Air Dry products are competitive with or superior to the Incralac control when all of the properties evaluated are combined. In addition, four of the five Liquid – Bake coatings (Sample B-3, an acrylic based material, rated the lowest) and all of the Powder Coatings are superior to Incralac.

Kitchen Dishwasher Use

This test procedure was designed to evaluate the relative potential of each of the coatings on copper alloys likely to be subjected to dishwasher use. Of the Air Dry coatings tested, only Sample A-8, an acrylic based polymer system, was competitive with Incralac for use on all three metal substrates, namely copper, brass and bronze. None of the Liquid – Bake coatings was competitive with Incralac on an overall basis; whereas, all of the Powder Coatings were, overall, either competitive with or superior to Incralac.

Heat Aging and Thermal Cycling

These tests were designed to compare the performance of the coatings in applications where heat is a factor. Only one Air Dry coating, the A-8 Acrylic, was equivalent in overall performance to Incralac. All of the Liquid – Bake coatings were inferior to Incralac. Of the Powder Coatings, Sample C-1 (a polyester-urethane), Sample C-3 (a polyester), Sample C-4 (an acrylic) and Samples C-7 and C-9 (both polyesters) were equivalent to or superior to Incralac.

Salt Fog (Corrosion) Resistance

Copper metals are frequently exposed in environments that are harsh and corrosive. The salt fog test was used to simulate those conditions. Sample A-8, the acrylic, was the only Air Dry coating superior to Incralac. Sample A-3, the acrylic-urethane Air Dry coating, was equivalent to Incralac. None of the Liquid – Bake coatings or Powder Coatings was equal to Incralac for resistance to salt fog.

Exterior Exposure

Sample A-7 (an air dry urethane), Sample B-4 (a baked acrylic), Sample C-1 (a polyester-urethane), Sample C-4 (an acrylic) and Samples C-3, C-5, C-7 and C-9 (all polyesters) are all equivalent to or superior to Incralac for resistance to weathering as determined by exposure to an urban environment for nine months.

Conclusions

It is apparent from the results of this study that there is a clear Air Dry coating essentially equivalent to Incralac in its ability to protect copper, brass and bronze in an interior environment. This product is System A-8, an acrylic based polymer. It is not, however, recommended for exterior use.

Another Air Dry coating, Sample A-5, is equivalent to Incralac for exterior durability; however, it is somewhat inferior to Incralac for interior applications.

As a class, the Powder Coatings are, overall, equivalent to Incralac for both interior and exterior applications. The epoxy based powder coatings, however, are not recommended for exterior applications.

Research and development of clear coatings is constantly ongoing by the various manufacturers. Specifiers are cautioned to verify the latest available technical and performance data from manufacturers to insure compatibility with their intended use.

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