DX-3300

Product Presentation
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Ultra Chemical Resistance Sealant & Coating

Ultra Chemical Resistance Sealant & Coating

SELECTION & SPECIFIC DATA

Generic Type

Cycloaliphatic Amine-Cured Novolac Epoxy

Description

DX-3300 is a densely cross-linked, 100% solids, novolac epoxy coating that provides superior long-term chemical resistance and corrosion protection against a wide range of acids, salts and strong caustics. The outstanding adhesion properties of DX-3300 make it ideal for use on marginally-prepared substrates while delivering maximum performance. DX-3300 has outstanding adhesion to previously epoxy-coated substrates and provides an extended recoat window. DX-3300 is a spray-able, industrial strength, long term protection system designed for metal and concrete substrates. DX-3300's high cross-link density protects surfaces with ultimate chemical resistance within the aggressive environments of the petroleum industry. The solids content and morphology make DX-3300 an excellent tank, vessel, pipe & internal lining system, that withstands high heat and abrasive conditions. DX-3300 is an ideal self-levelling product for concrete repair and long term protection.

Product Features & Benefits

- *Excellent thermal compatibility with steel and concrete*
- *Low permeation rate for tank lining service*
- *Solvent free – 100% solids*
- *Quick return-to-service – 24 hours at 77°F (25°C) for hydrocarbon immersion service*
- *Single-coat application*

Recommended Uses

- *High-temperature immersion tank lining*
- *Crude oil storage to 350°F (177°C)*
- *Floor and chemical trenches in process areas*
- *Secondary containment areas*
- *Bulk petroleum storage tank lining*
- *Process equipment supports and pads exposed to acids*
- *Truck loading and unloading pads*

Internal pipeline and vessel linings

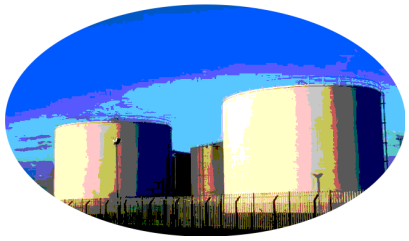
ABOUT DYNESIC PRODUCTS

Dynesic Technologies produces advanced adhesives, sealants and coatings which are specifically designed to protect surfaces with superlative strength and longevity while being easy to apply, safe for the user and for the environment. Dynesic products are 100% solids, contain no solvents and are free of VOC's. Dynesic's industrial maintenance novolac sealants and coatings provide excellent chemical and heat resistance, especially for immersion service. These high strength product systems bond both mechanically and chemically to the substrate, delivering excellent wear resistance in the harshest environments and long term corrosion protection.

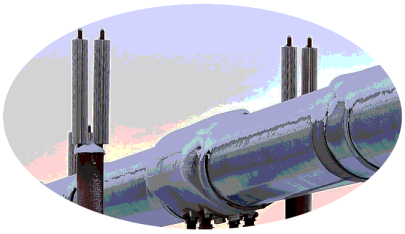
Dynesic Technologies will continue to pursue the finest materials for it's products maintaining a firm resolve to protect and rebuild infrastructures throughout the world. Dynesic Technologies makes a special commitment to it's customers and the environment. Dynesic products do not mix with water and do not release chemicals into the atmosphere.

"Our commitment to your health and the world we live in."

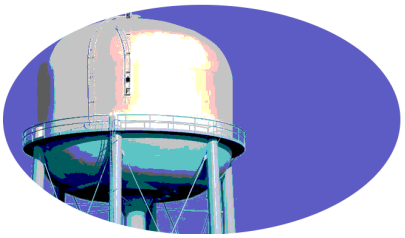
DX-3300 INDUSTRIES SERVED



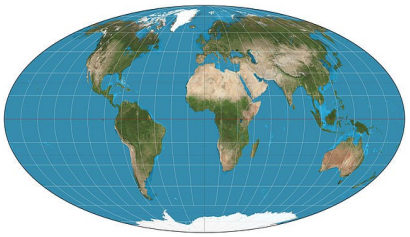
Storage Tanks
Acid resistant lining for steel and concrete, secondary containment, high abrasion resistant applications, ultra chemical resistance properties.



Oil & Gas
Tank and pipeline, secondary containment, leak repair, high temperature, CUI coating under insulation, heat exchangers.



Water and Wastewater
Clarifiers, collection systems, digesters, head works, lift stations, manholes, secondary containment, tank linings, and ceramic epoxy for ductile iron pipe.



Worldwide Industrial Novolac Coating
Corrosion protection for steel and concrete structures, tank linings, secondary containment, metal repair, polymer concrete.

DX-3300 PHYSICAL PROPERTIES

Property	***Test Method***	***Typical Value***
Compressive Strength, 5 days ambient	ASTM C-109	10,000 - 13,000 psi
Hardness, 3 days ambient	ASTM D-2240	87-90 Shore
Gloss Level		High Gloss
Pull-off Adhesion, 30 mils DFT	ASTM-4541	
Bare Steel		>3,000 psi
Dry Adhesion, 5 days ambient		>3,000 psi
Tabor Abrasion, 30 mils DFT 1,000 cycles/1 kilogram	ASTM D-4060-95	25-35 mg loss
Glass Transition Temperature	DSC	58 - 62°C (ambient 5 days)
Abrasion Resistance	ASTM D 4060, CS-17	69 mg loss
Exterior Exposure		Exposed in Florida facing no effect on film integrity or adhesion - 45°F South for 3 years
Humidity Resistance		ASTM D 2247, 1000 Hours - No effect on film integrity or adhesion. Less than 1/32’ rust creepage at scribe. Less than 0.5% rusting at edges.

Property	***Test Method***	***Typical Value***
Impact Resistance	ASTM D 2794	80 inch-pounds
Moisture Permeability	ASTM D 96	0.06 Perms
Salt Fog Resistance	ASTM B 117,2000 Hours - No effect on film integrity or adhesion. Less than 1/16' undercutting at scribe. Less than 0.5% rusting at edges.	
Tensile Strength	ASTM D 2379	2,550 psi
Flexural Strength (Yield Strength)	ASTM D 790	9,000 psi
Hardness (Durometer)	ASTM D 2240 (Type D)	85
Water Immersion	ASTM D 1308, 2 Years	No effect
		72 - 75°C (heat cured)

DX-3300 CHEMICAL RESISTANCE

Ammonium Hydroxide	(38% Hydrogen Chloride content)	Phosphoric Acid to 100%
Aromatic & Aliphatic Solvents	Hydrofluoric Acid up to 8%	Potassium Hydroxide
Black Liquor	Hydrogen Sulfide	Salts
Butyl Acetate	Lithium Chloride	Sodium Hydroxide
Butyl Carbitol	MEK	up to 10.5%
Chlorinated Solvents	MSEA	Sulfides
(except Methylene Chloride)	Mineral Acids	Sulfuric Acid up to 98%
Chlorides	Nitric Acid up to 10%	White Liquor
Chromic Acid up to 30%	(Many) Organic Acids	Water - Fresh, waste,
Hydrochloric Acid up to 100%	Phosphates	non-potable

- *Resistant to all types of crude oil and refined petroleum products.*
- *Resistant to inorganic acids and alkalis.*

DX-3300 HANDLING

Mix Ratio, by Volume	3 Parts Resin/1 Part Hardener
Working Life 200 gram mass	40 minutes @ 25°C (77°F)
Color	Gray, Beige, Light Blue
Consistency	Flowable Liquid
Thinner	Acetone or Xylene
Clean-Up	MEK

APPLICATION EQUIPMENT GUIDELINES

Listed below are general equipment guidelines for the application of this product. Job site conditions may require modifications to these guidelines to achieve the desired results.

Spray Application (General)

This is a 100% solids coating and may require adjustments in spray techniques. Wet film thickness is easily and quickly achieved. The following spray equipment has been found suitable and is available from manufacturers such as Binks, DeVilbiss and Graco.

Airless Spray Plural Component

Tip Size: 0.025 – 0.029 in reversible type
Diameter of Part A Fluid Line: 1/2 in ID
Diameter of Part B Fluid Line: 3/8 in ID
Spray Line: 1/2 in ID x 50 feet maximum
Diameter of Whip: 1/4 – 3/8 in ID
Length of Whip: 20 ft
Power Pump Ratio: 56:1 or greater
Static Mixer: 2 x 1/2 in ID x 12 in long behind mixing valve
Part A Temperature: 130°F – 135°F (54°C – 57°C) in reservoir tank
Part B Temperature: 90°F – 95°F (32°C – 35°C) in reservoir tank

Airless Spray Single Leg or Hot Pot

Pump Size: 56:1 or greater

Hose Length/Diameter: 50 ft x 3/8''
Whip Length/Diameter: 10 ft x 1/4''
Tip Size: 0.023 in – 0.027 in
Output: 5600 – 7000 psi filter removed

** Part A resin and Part B hardener should be heated individually to 75 – 85°F before mixing so product will atomize properly in delivering paint to the substrate. Mixed product should be sprayed within 20 minutes after mixing.*

Brush & Roller (General)

Multiple coats may be required to obtain desired appearance, recommended dry film thickness and adequate hiding. Avoid excessive re-brushing or re-rolling. For best results, tie in within 10 minutes at 75°F (24°C).

Brush	Use a medium bristle brush.
Roller	Use a short-nap synthetic roller cover with phenolic core.

SUBSTRATES & SURFACE PREPARATION

All	Surfaces must be clean, dry and free of contaminants.	
Steel	**Immersion:**	SSPC-SP10 Near-White Metal Blast with angular profile of 2.5 – 3.5 mils.
	Non-immersion:	SSPC-SP6 1.5 – 3.0 mils SSPCSP2 or SP3 are suitable cleaning methods for mild environments.
Concrete/CMU	New Concrete must be cured 28 days at 75°F (24°C) and 50% relative humidity or equivalent. Prepare surfaces in accordance with ASTM D4258 Surface Cleaning of Concrete and ASTM D4259 Abrading Concrete. Voids in concrete may require surfacing. Mortar joints should be cured a minimum of 15 days.	

** Dynesic DX-1100 primer must be applied prior to application on concrete surfaces.*
** For previously painted surfaces contact Dynesic Technical Service Department.*

CURE SCHEDULE & RE-COAT WINDOW

TEMPERATURE	***To Touch***	***Hard Dry***	***Recoat Window***
10°C (50°F)	8 hours	36 hours	Up to 7 days
25°C (77°F)	3 - 4 hours	24 hours	Up to 7 days
60°C (140°F)	1 - hours	6 - 8 hours	Up to 4 hours

- *Return to service - aqueous/hydrocarbon immersion*
- *If an additional coat is required, surface must be abraded to create a slight profile to maximize adhesion.*

PACKAGING, HANDLING & STORAGE

Shelf Life	Part A: 12 months at 75°F (24°C) Part B: 12 months at 75°F (24°C)
** When kept at recommended storage conditions and in original unopened containers.*	
Shipping Weight (Approximate)	1 Gallon Kit: 13 lbs. (6kg) 4 Gallon Kit: 55 lbs. (25 kg) 200 Gallon Drums Kit: 2,560 lbs. (1,164 kg)
Storage Temperature & Humidity	40° – 110°F (4° – 43°C) 0 – 100% Relative Humidity
Storage	Store in a dry, well-ventilated area, indoors. Maintain products in original packaging and sealed until ready for use. Avoid exposure to direct sunlight or extreme temperatures.

DX-3300 REFERENCES

Halliburton Energy Services *
PO Box 3
Houston TX 77001-003
Inspection and repair of containment structures.
Contact: Joe Elkin, real estate div.
719-869- 5771

Weatherford Artificial Lift Systems Inc * (Manufacturing Center)
3445 N. Marksheffel Road
Colorado Springs, Colorado 80922
USA
Chemical Containment repairs
Contact Tom Miller 713-574-1090

Atmel Corporation *
1150 East Cheyenne Mt. Blvd.
Colorado Springs, CO 80906
Repair of chemical distribution area, plant floors, cooling towers, chemical storage tanks and containments
Contact: Ron Mills 719 -540-1310

Colorado Springs Utilities
700 South Conejos Street
Colorado Springs, CO 80903
Repair & Coating of cooling tower basins and Zero discharge facility
Contact: Victor Smith, 719-448-8582

Western Forge Tool *
4607 Forge Road
Colorado Springs, CO 80907
Lining and repair of treatment tanks, coating plating plant floors
Contact: Andrew Maycock, 719-598-5070 ext. 2204

Paul Sundberg, President
PAMAS Enterprises, Inc.
524 Pleasant St
Colorado Springs, CO 80904-2112

Siemens Water Technologies Colorado Springs Plant
1335 Ford Street
Colorado Springs, CO 80915
Containment Lining and Concrete repair
Coating of treatment tanks & chemical loading dock
Contact: John Moderow: 719-219-2003

Houston TX Plant
10875 Kempwood Dr,
Houston, TX - 713-460-0900
Coating of chemical off loading dock

Synthis Manufacturing *
Monument, Colorado
Contact: facility Manager,
719-481-5300
Plating room floor and tanks

LSI Logic
Colorado Springs, CO
Chemical Distribution Area

Goodyear Aviation
Colorado Springs, CO
Chemical Distribution Area

Excel Energy *
Denver, CO
Treatment areas, rebuilding concrete

* *temperature sensitive tank and containment liners*

DX-3300 OUTSOURCED TESTING INFORMATION

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EXECUTIVE SUMMARY

- Five coated test panels were subjected to an autoclave test under the following conditions: 300°F at 250 psig for 4 days, exposed to 5% NaCl (water phase), 1:1 kerosene: toluene (organic phase), and sour gas (5% H_2S, 5% CO_2, balance CH_4, – gas phase).
- The coatings tested were identi- fied by Client as panels 24, 84, 300, 301 and 302.
- All of the panels were free of blisters after exposure to autoclave test conditions.
- The adhesion of the coatings varied from excellent to poor. Coating 302 had the best adhesion with A ratings in all three phases. Coating 24 showed excellent adhesion in the water and hydrocarbon phases (A ratings) but somewhat lower adhesion in the gas phase (C rating). Coating 84 had B ratings in the gas and hydrocarbon phases, whereas it showed better resistance to the prying action in the water phase with an A rating. Coatings 300 and 301 had good adhesion in the water phase (A rating), but showed poor adhesion in the gas and hydrocarbon phases (C or D rating), which may be due to the severe foaming of the coating at the steel interface.
- Impedance measurements were taken on the coating films before and after exposure to autoclave conditions. The measurements are used as an assessment of the coating films' barrier properties and associated loss of barrier properties from exposure to autoclave conditions. All of the coatings had excellent pre-run impedances with Log Z > 10. Post-run impedances varied among the coatings, from poor to good with Log Z ranging from 5.8 to 11.2. Coating302 had the best pre and post-run impedance overall with the coating retaining high impedance after the autoclave test Log Z = 11.1. Coating 84, 300 and 301 also showed good impedance performance with Log Z> 10 before and after testing in all phases. Coating 24 had relatively low post-run impedance values in the water phase (Log Z = 9.8, 9.5) compared to the other coatings. The pre-test impedance was also slightly lower than other coatings (Log Z = 10.4).
- Coating 302 showed the best overall performance, based on being blister free, retaining excellent adhesion, and high retained impedance. The performance of this coating would be expected to be reliable under the testing conditions. Coating 84 had the next best performance, with no blister, good adhesion and good barrier properties.

**** Coating 302 is Dynesic Technologies' DX -3300.***

DX-3300 OUTSOURCED TESTING INFORMATION

Total Asset Integrity Management

1. INTRODUCTION

RAE Engineering was requested by client to perform four autoclave and Electrochemical Impedance Spectroscopy (EIS) tests to evaluate organic coatings and provided.

Four autoclave tests at 250°F/1,000 psig. 300°F/1,000 350°F/1,000 psig and 300°F/250 psig are to be implemented in this work. This report covers the results of the fourth test conducted at 300°F and 250 psig only. Other re- ports will be submitted individually after the specific tests are completed.

2. SAMPLE & TEST METHODS

Test Panels

Coated test panels numbered 24, 84, 300, 301 and 302 were received from client. A set of control panels was also received and used as untested controls for determination of pre-test adhesion, impedance, and color.

Evaluation Procedures

2.2.1. Test Method: NACE TM0 185— Evaluation of Internal Plastic Coatings for Corrosion Control of Tubular Goods by Autoclave Testing. Details as noted in the following.

2.2.2. Equipment: Teflon-lined 1-litre autoclave, heated with an oil bath, equipped with a pressure transducer and thermocouple.

2.2.3. Test Conditions:

Temperature:	300°F
Pressure:	250 psig
Gas Phase:	5% hydrogen sulfide (H_2S) 5% carbon dioxide (CO 2) 90% methane (CH_4)
Organic Phase:	50% Kerosene, 50% toluene
Aqueous Phase:	5% NaCl

2.2.4. Release Procedure:
Cool the autoclave from 300°F to 100°F over approximately 3 hours; the pressure drops from 256 to 108 psig. Release the pressure uniformly to ambient at no more than 13 psig/ minute (actual was an average of 11 psig/minute)

2.2.5. Test Duration: 4 days at temperature and pressure.

2.2.6. Pre–Test Analysis: Film thickness, adhesion, color, EIS Impedance at 0.1 Hz after a 48 hour soak in 5% NaCl

2.2.7. Post– Test Analysis: Film thickness, adhesion, blistering, color change, foam, undercreep, impedance at 0.1 Hz in water, hydrocarbon, and gas phases after 48 hour soak in 5% NaCl at 73°F (23°C).

2.8. Adhesion Analysis: A Parallel scribe method was used, as follows. Two cuts, 1/8 inch apart, are cut through the coating to base metal with an abrasive disc on a Dremel Tool. The adhesion of the coating be tween scribe marks is evaluated by prying with a utility knife. Adhesion is evaluated within one hour after the panels are removed from the autoclave. The following scale is used to rate the adhesion:

Rating	Description
A	No change/ no disbondment
B	Slight Change of Adhesion (>50% still attached)
C	Moderate Loss of Adhesion (<50% still attached)

DX-3300 OUTSOURCED TESTING INFORMATION

Total Asset Integrity Management

D	Severe loss of adhesion
E	Disbondment

2.2.9. Blistering: Blistering was rated using ASTM D714, "Evaluating Degree of Blistering of Paints". This is a pictorial standard, based on blister size and density.

2.2.10. Under Film Creep: Undercreep from the bare edge of the panel is reported in mm.

2.2.11. Foam: Foam was determined by cutting through the coating film thickness at an angle between 45 and 30 Degrees. The foam size and density is assessed in the context of film thickness according to the following key:

F	Few	**S**	Small
M	Medium	**M**	Medium
MD	Medium-dense	**L**	Large
D	Dense	**N**	None

2.2.12. Color Change: Based on NACE TM0185. Staining will not be considered a color change.

N	No change	**M**	Moderate change
S	Slight change	**SE**	Severe change

2.2.13. Microscopy: Tested panels were examined under a stereomicroscope to gain additional information.

2.2.14. EIS: EIS (Electrochemical Impedance Spectroscopy) is a laboratory method for evaluating the protectiveness of organic coatings. EIS provides a quantitative measurement of the barrier properties of a coating and is related to the permeability of the coating to water and electrolyte. The higher the impedance of a coating, the lower its permeability to corrosive species, and hence the more protective the coating. EIS does not evaluate the adhesion of the coating; that property must be evaluated by a different method.

Experimentally, impedance of a coating is determined as a function of the frequency of an applied AC voltage. The data consists of a Bode plot of Log Z versus Log F, where Z is impedance in ohms cm2 and f is frequency in Hertz (0.05 Hz to 100 khz). From the Bode plot, Log Z at 0.1 Hz is determined by interpolation.

The Log Z value at 0.1 Hz is tabulated and used as the basis of comparison between coatings, or for monitoring the change of a coating as a function of exposure time to a test environment. Selection of Log Z at 0.1 Hz is somewhat arbitrary, but represents a compromise between speed of analysis and selection of a frequency at which differences in coating performance can be relatively determined.

Anticipated performance of a coating based on Log Z is shown below in the Figure, which is derived from a large literature of a laboratory and fieldwork.

In the autoclave test the procedure consists of measuring the impedance of each coating before and after exposure to autoclave conditions. Pre-test is a baseline, against which post-run values are compared to assess deterioration. Post-run measurements are made in the water, hydrocarbon, and gas phase areas of the test panels.

DX-3300 OUTSOURCED TESTING INFORMATION

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Corrosion Protection of Organic coatings

Increasing Corrosion Protection →

Poor | Protection Begins | Good | Excellent

4 | 6 | 8 | 10

Coating Impedance, Log Z (Z in ohms CM² @ 0.1 Hz at 73°F (23°C).

3 REFERENCES

NACE TM0185— Evaluation of internal Plastic Coatings for Corrosion Control of Tubular Goods by Autoclave Testing.

4 RESULTS

The results are presented in Table 1 and figures 1 and 2

BLISTERING AND DISBONDMENT

After exposure to autoclave test conditions, none of the coatings showed evidence of blistering in any of the three test phases.

ADHESION

The adhesion of the coatings varied from excellent to poor. Coating 302 had the best adhesion with A ratings in all phases. Coating 24 showed good adhesion in the water and hydrocarbon phases (A ratings) but somewhat lower adhesion in the gas phase (C Rating). Coating 84 had B ratings in the gas and hydrocarbon phases, whereas is showed better resistance to the prying action in the water phase with an A rating. Coatings 300 301 had poor adhesion in the gas and hydrocarbon phases (C or D rating), which may due to the severe foaming of the coating at the steel interface.

UNDERCREEP, FOAM AND COLOR EXCHANGE

None of the coatings showed undercreep from the edge of the panel.

Variable amounts of small foam cells with a range of density were observed in the coatings, which are reported in Table 1. Both coatings 300 and 301 had lots of foam cells in the coating.

Varying degrees of color change were observed, which is typical for tank lining products in autoclave testing. The color change can be seen in the pictures in Figure 2.

DX-3300 OUTSOURCED TESTING INFORMATION

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COATING IMPEDANCE

The coatings all had excellent pre-test impedances (**Log Z > 10**) with Log Z ranging from 10.4 to 11.6. Post-test impedances were variable, ranging from 5.8 to 11.2.

Coating 302 had the best pre and post-run impedance compared to the other coatings. The impedance was virtually unchanged by the autoclave test conditions. Coating 84, 300 and 301 also showed excellent impedance performance with Log Z > 10 in all phases before and after autoclave exposure.

Coating 24 had relatively low post-run impedance in the water phase (Log Z = 5.8) and good but relatively lower impedance in the gas and hydrocarbon phases (Log Z = 9.8, 9.5) compared to other coatings.

Some of the coatings showed post-run impedances that were higher than the pre-test impedances. The higher impedance (or reduced permeability) may be due to additional curing or chemical-physical changes after exposure to autoclave test conditions.

5 CONCLUSIONS

Coating 302 had the best overall performance, taking into account blistering, adhesion, and impedance. This coating also had excellent pre-test performance.

Based on the data it would be anticipated to provide reliable corrosion protection under the testing conditions.

Coating 84 had the next best performance, with no blistering, good adhesion and good barrier properties.

**** Coating 302 is Dynesic Technologies' DX -3300.***

dynesic Technologies, Inc.

15230 Surveyor Blvd., Addison, TX 75001
Phone: 972-692-0962, **www.dynesic.com**

Table 1 - Autoclave Test Results, 300°F , 250 psig, 4 days

Test date: May 23, 2008
Client: Dynesic Technologies, Inc.
Quote#: 08-0638
Duration: 96 hours

Conditions: 300°F, 250 psig
Water phase: 5% NaCl
HC Phase: 50% kerosene, 50% toluene
Gas phase: 5% CO_2, 90% CH_4,

Release temp: 100°F
Release press: 108 psig
Release time: 10 minutes
Release rate: 11 psig/min

Autoclave results 300°F

Coating/Sample/Phase			Dry Film Thickness Control/test (mils)	Adhesion NACE TMO 185	Blistering ASTM D714	Undercreep NACE TMO 185	Foam	Color Change TMO 185	Log Impedance @ 0.1 Hz (0.2 (Ohm cm^2)	Comments
24	2	Baselinc	12.0	A			SF		10.4	No blisters
	1	Water	14.1	A	None	None	SF	M	5.8	in all 3 phases.
		h.c	13.1	A	None	None		M	9.5	
		Gas	11.9	C	None	None		M	9.8	
84	2	Baselinc	13.5				SM		11.4	No blisters
	1	Water	9.9	A	None	None		SE	10.7	in all 3 phases.
		h.c	12.8	B	None	None		SE	10.5	
		Gas	16.8	B	None	None		S	11.0	
300	2	Baselinc	17.4	A			SMD		11.5	No blisters
	1	Water	16.8	A	None	None		SE	10.7	in all 3 phases.
		h.c	15.1	D	None	None		SE	10.5	
		Gas	19.2	C	None	None		S	11.1	
	2	Baselinc	33.2	B			SMD		11.6	No blisters
	1	Water	31.5	A	None	None		SE	10.6	in all 3 phases.
301		h.c	27.5	D	None	None		SE	10.5	
		Gas	29.0	D	None	None		S	11.1	
	2	Baselinc	11.6	A			SE		11.1	No blisters
	1	Water	21.2	A	None	None		SE	11.1	in all 3 phases.
302		h.c	22.6	A	None	None		SE	11.2	
		Gas	18.8	A	None	None		M	11.1	

**** Coating 302 is Dynesic Technologies' DX -3300.***

TEST PANELS - OUTSOURCED TESTING INFORMATION

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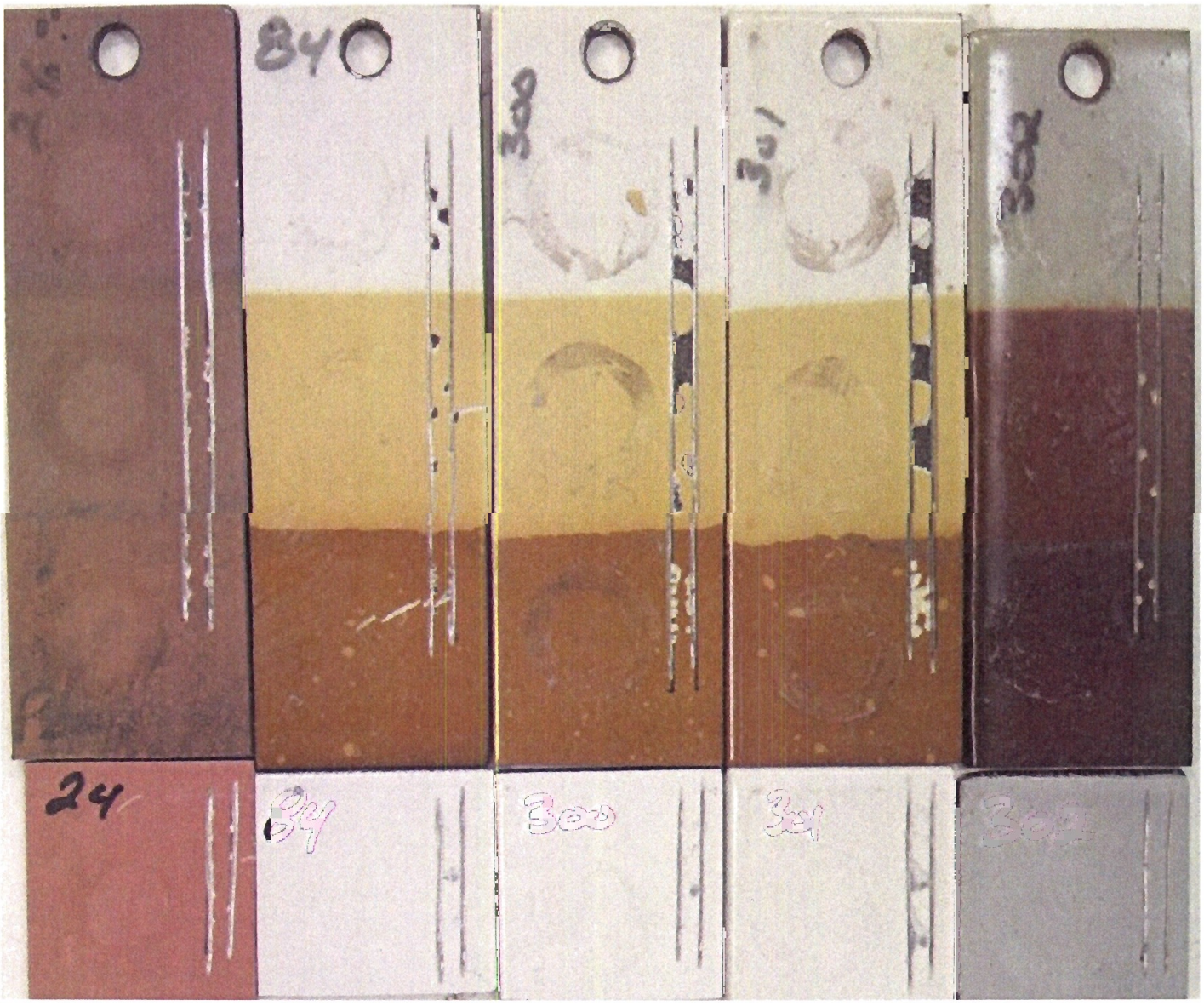
Figure 2a. Control (bottom) and Tested (top) Panels
Left to Right: Panel 24, 84, 300, 301 and 302



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**** Coating 302 is Dynesic Technologies' DX -3300.***

SUMMARY CHART - OUTSOURCED TESTING INFORMATION

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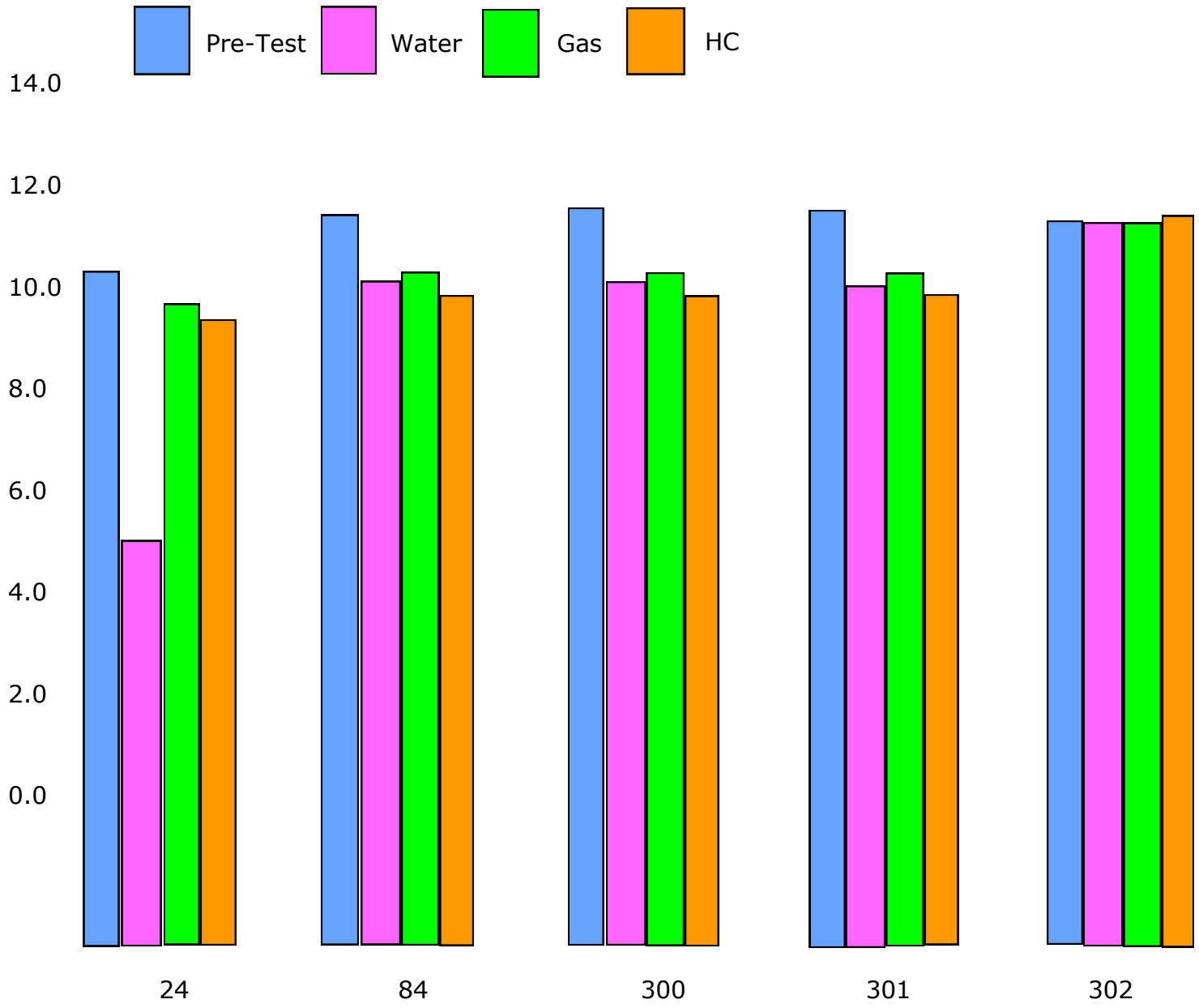
RAE

Log Z (Z @ 0.1) Hz)

Figure 1. Summary of EIS Results



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