

ANCAMIDE[®] 805**Curing Agent****DESCRIPTION**

Ancamide 805 curing agent is the lowest viscosity variant in the 800-series of polyamide curing agents. It is a highperformance polyamide designed for use with standard epoxy resins. Ancamide 805 provides a cost effective method of achieving high-solids / low VOC, ambient-cure epoxy coatings.

Ancamide 805 curing agent distinguishes itself from typical high solids epoxy curing agents in that it is plasticizer-free. Special features of Ancamide 805 systems include rapid dry times, good flexibility, excellent barrier properties and good film appearance.

TYPICAL PROPERTIES

Property	Value	Unit	Method
Appearance	Amber Liquid		
Colour	7	Gardner	ASTM D 1544-80
Viscosity @ 77°F	2,300	cP	ASTM D 455-83, Brookfield RV, Spindle 27
Amine Value	420	mg KOH/g	Perchloric Acid Titration
Specific Gravity @ 77°F	0.99		ASTM D 1475-85
Flash Point	>200	°F	Seta flash closed cup
Equivalent Wt/{H}	124		
Recommended use Level	66	phr,(EEW=190)	

ADVANTAGES

- Low viscosity
- Good flexibility
- Fast dry
- Plasticizer and benzyl alcohol-free
- Good corrosion resistance
- Supplied at 100% solids
- DOT noncorrosive

APPLICATIONS

- Ultra-high solids marine, industrial maintenance and OEM coatings
- Adhesives and sealants
- Concrete primers and paints

SHELF LIFE

At least 24 months from the date of manufacture in the original sealed container at ambient temperature. Store away from excessive heat and humidity in tightly closed containers.

STORAGE AND HANDLING

Refer to the Safety Data Sheet for Ancamide 805 curing agent.

TYPICAL CURE SCHEDULE

2-7 days at ambient temperature.
Films can be force-dried or baked to accelerate cure.

TYPICAL HANDLING PROPERTIES *

Property	Value	Unit	Method
Mixed Viscosity	4,400	cP	ASTM D 455-83, Brookfield RV, Spindle 52
Gel Time (150g mix @ 77°F)	60	min	Techne GT-4 gelation timer
Thin Film Set Time @ 77°F	6.5	h	

TYPICAL PERFORMANCE PROPERTIES

(7 days cure @ 77°F)	Value	Unit	Method
Glass Transition Temperature	158	°F	ASTM D 3418-82
Compressive Strength @ Yield	11,500	psi	ASTM D 2240-86
Compressive Modulus	2.81x10 ⁵	thousand psi	ASTM D 2240-86
Tensile Strength	8,400	psi	ASTM D 638-86
Tensile Modulus	1.29x10 ⁵	thousand psi	ASTM D 638-86
Tensile Elongation at break	8.2	%	ASTM D 638-86
Flexural Strength	14,300	psi	ASTM D 790-86
Flexural Modulus	4.46x10 ⁵	thousand psi	ASTM D 790-86

* Ancamide 805 curing agent formulated with standard Bisphenol-A based (DGEBA, EEW=190) epoxy resin.

SUPPLEMENTARY DATA

ANCAMIDE 800-SERIES POLYAMIDE CURING AGENT COMPARISON

TABLE 1: VISCOSITY REDUCTION CURVES HIGH EQUIVALENT WEIGHT POLYAMIDES

Handling Properties	Unit	Ancamide 801	Ancamide 805
Curing agent viscosity	cP	14,000	2,300
Mixed Viscosity w/ LER	cP	15,600	4,400
Equivalent weight		145	124
Use level	phr	76	66
Tensile strength	psi	7,250	8,400
Tensile modulus	psi	312,000	129,000
Tensile elongation @ break	%	4.1	8.2
Flexural strength	psi	10,440	14,300
Flexural modulus	psi	356,000	446,000

EPOXY RESIN SELECTION AND USE LEVEL: Ancamide 805 is designed for use with bisphenol A based liquid epoxy resins such as DER 331 or Epon 828 resins. The best balance of properties is obtained at 1:1 stoichiometry (66 phr). A small increase (15%) in epoxy resin will result in slightly improved corrosion resistance, along with slightly slower dry times, and slightly reduced solvent resistance. A small increase (15%) in Ancamide 805 curing agent will result in slightly faster dry times, slightly improved solvent resistance, and slightly reduced corrosion resistance. Epoxy modifiers can be used to enhance specific properties such as solids content, dry speed, pot life, or flexibility as described below in Table 2.

TABLE 2: EFFECTS OF SELECTED RESINS AND MODIFIERS ON ANCAMIDE 805 PERFORMANCE

Modifier	Use Level	Benefits	Limitations	Examples
Solid Epoxy	30-60%	Faster dry Longer pot life Higher impact resistance	Higher VOC content Lower volume solids	DER 671X75 Epon 1001X75
Epoxy Diluent	10-20%	Higher solids Lower VOC Longer pot life	Slower dry Lower physical strength	Epodil 742 Reactive Diluent Epodil 748
Flexible Epoxy	20-40%	Higher impact resistance Improved adhesion	Reduced solvent resistance Lower physical strength	Epon 872X75 Heloxy 505

SOLVENT SELECTION: Ancamide 805 curing agent, like other polyamides, highly soluble in hydrogen bonding solvents such as butyl alcohol. Epoxy resin is highly soluble in polar solvents such as glycol ethers and ketones. Ancamide 805 and liquid epoxy resins are soluble in aromatic solvents when mixed. However, as pot life progresses and molecular weight increases, stronger solvents may be needed to maintain good solubility. Alkyl aromatic alcohols such as benzyl alcohol or propylene glycol phenyl ether (PPh) will improve the compatibility of Ancamide 805 with epoxy resin, thereby minimizing any induction time.

For maximum corrosion resistance, the solvent system should be predominantly hydrophobic. Ester solvents and ketones should be packaged with the epoxy resin to avoid unwanted side reactions with Ancamide 805. Solvents, such as MPK and PM, can be used to meet HAPS compliance, and exempt solvents, such as Oxsol 100 and acetone, can be used to reduce or eliminate VOCs

STARTING POINT SOLVENT COMPOSITION:

Aromatic Solvent 30-60% (toluene, xylene, high flash naphtha, Oxsol 100, etc.)

Polar Solvent 10-30% (MPK, MIBK, PM, diacetone alcohol, acetone, etc.)

Alcohol 20-40% (n-butanol, IPA, benzyl alcohol, PPh, etc.)

PIGMENT SELECTION: Extender pigments should be of relatively low oil absorption and free of soluble salts. Recommended extender pigments include wollastonites, magnesium silicates (talcs), barium sulfate and ceramic microspheres (Zeeospheres). Prime pigments such as red iron oxide and titanium dioxide should be incorporated at Levels which provide adequate hiding. Use of anticorrosive Pigments should be based primarily on their effectiveness and stability. Heucophos ZPA (0.5-1.0 lb/gal) pigment has been particularly effective in Ancamide 805 based anticorrosive primers.

PIGMENT DISPERSANTS: Ancamide 805 curing agent is an efficient pigment wetter, therefore, no dispersant is needed when pigmenting the B-side of the formulation. When pigmenting the A-side (epoxy) of the formulation, pigment wetting agents such as Nuosperse 657, Disperbyk 101 and Anti-Terra U brands are recommended at use levels of 1.0 to 2.0% on total pigment weight.

THIXOTROPES: Optimum pigment stability and sag resistance have been achieved with fumed silicas such as Aerosil® R202 fumed silica or Cab-O-Sil TS-720 (0.5-1.0% based on total weight). Organoclays provide excellent pigment stability but do not produce the application rheology needed for sag control in high-solids Ancamide 805 curing agent based formulations.

FLOW AND LEVELING AGENTS: To improve the flow and leveling of Ancamide 805 based coatings, the following additives have been effective:

FC-430 (0.1-0.2% based on total weight)

Byk 354 (0.2-0.5% based on total weight)

Beetle 216-8 (1.0-3.0% based on total weight)

Surfynol® HS-40 (0.1-0.5% based on total weight).

PERFORMANCE PROPERTIES

ELECTROCHEMICAL IMPEDANCE SPECTROSCOPY (EIS): EIS is a relatively new technique for measuring the barrier properties of coatings. EIS experiments are typically 24 hours in duration and correlate well with long term Tests such as salt fog and adhesion. EIS tests are also insensitive to temperature so that low-temperature barrier properties can be accurately evaluated.

As shown in Figure 1, EIS involves exposing a coated steel panel to a salt water solution. A small AC voltage is applied to the steel panel. The electrical current that passes through the coating into the salt water is measured. By varying the frequency of the AC voltage, it is possible to separate and measure the water uptake of the coating (capacitance) and the resistance of the coating to sodium and chloride ion penetration (pore resistance).

Resistance (Log Modulus in ohm) is graphed vs. frequency to obtain a plot which measures both water uptake at high frequency and ion resistance at low frequency. A good barrier coating will exhibit low water uptake and high resistance to ion penetration, as illustrated in Figures 2 and 3.

FIGURE 1

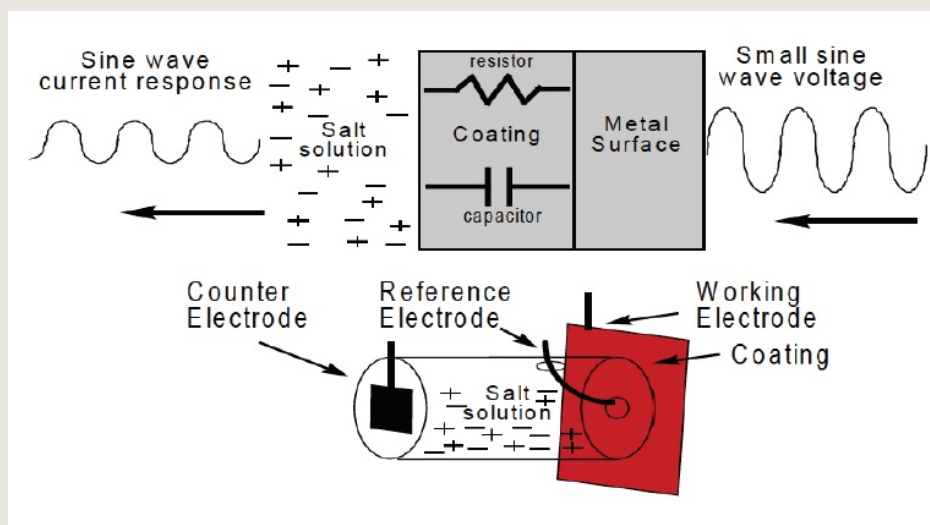
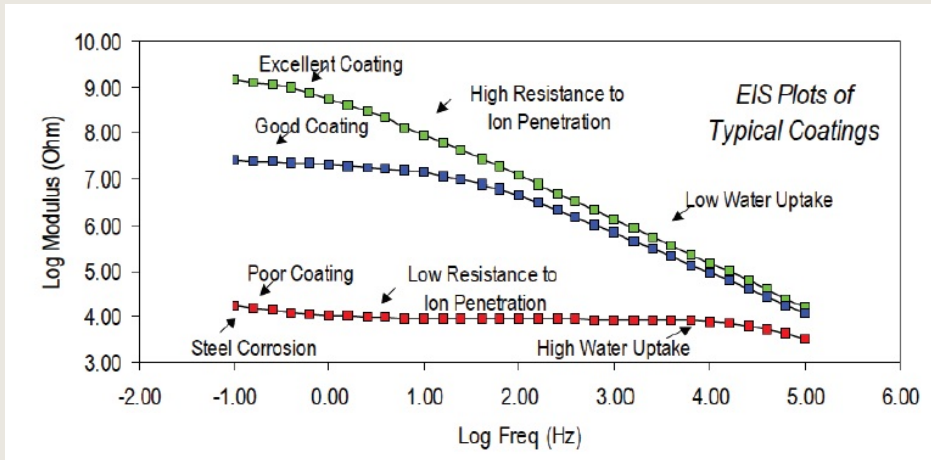
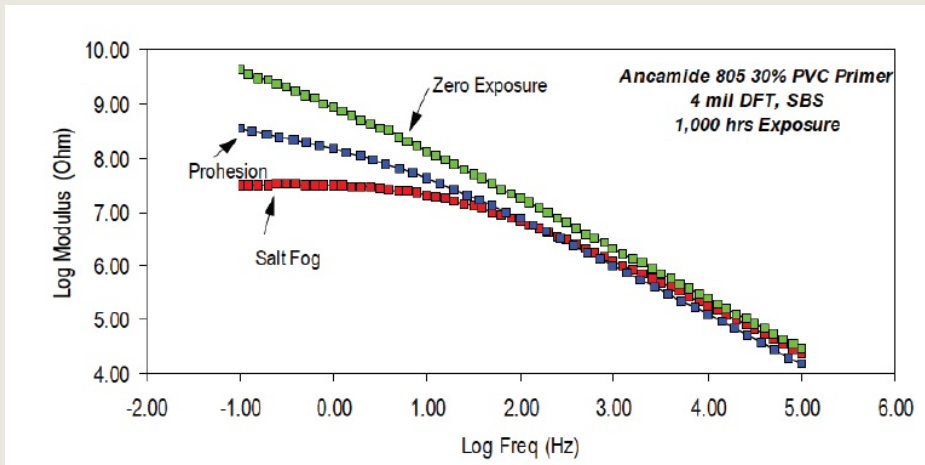


FIGURE 2: SAMPLE EIS PLOTS OF EXCELLENT, GOOD, AND POOR BARRIER COATING



EXPERIMENTAL RESULTS: Ancamide 805 curing agent based 30% PVC primer was spray applied (4 mil DFT) to shotblasted steel panels, cured 7 days at 72°F, then exposed to 1,000 hours of salt fog or prohesion. Panels were then immersed in a 1M NaCl solution for 24 hours and scanned over a frequency range of 105 ohms to 10⁻¹ ohms. Exposed panels were also evaluated in accordance with ASTM D 1654

FIGURE 3: EIS EVALUATION OF ANCAMIDE 805-BASED COATINGS



After 1,000 hours of accelerated weathering, the Ancamide 805 curing agent based primers still exhibit good barrier properties. The prohesion coating retains > 108 ohms resistance and the salt fog coating retains > 107 ohms of resistance. Both coatings exhibited good water resistance with the salt fog coating absorbing slightly more water than the prohesion coating as evidenced by the change in slope at high frequency.

ASTM D 1654 Evaluation - 1,000 hrs exposure

Salt Fog - Field 10 Scribe 9
 Prohesion- Field 10 Scribe 8

Both EIS and ASTM D 1654 evaluations indicate that Ancamide 805 curing agent based anticorrosive primers develop excellent barrier properties. The cured coatings are highly resistant to ion penetration and water uptake and effectively protect the steel substrate from corrosion.

FORMULATING FOR LOW TEMPERATURE CURE: Low temperature cure systems can be formulated by using Ancamide 805 curing agent in conjunction with Ancamine® 2505 curing agent. Ancamide 805 curing agent imparts adhesion, flexibility, corrosion resistance, and cost effectiveness to the system, while Ancamine 2505 curing agent delivers rapid cure, high chemical resistance, and good epoxy compatibility. By varying the ratio of Ancamide 805 to Ancamine 2505 curing agent, formulations can be tailored to cure at specific temperatures as illustrated in Table 3.

TABLE 3: LOW TEMPERATURE PROPERTIES OF ANCAMIDE 805 / ANCAMINE 2505 CURING AGENT BASED CLEARCOATS

	45°F cure				55°F cure				72°F cure			
	805	75% 805 25% 2505	50% 805 50% 2505	805	805	75% 805 25% 2505	50% 805 50% 2505	805	805	75% 805 25% 2505	50% 805 50% 2505	805
Tack Free (h)	>24	28	18	14	>24	14.5	8	6	8	7.5	7	5
Hard Dry (h)	>48	40	20	16	28	26	14	12	13	10	9	7
MEK rubs - 24 h	0	2	3	5	3	4	4	5	4	4	5	5
MEK rubs - 72 h	1	4	4	5	5	5	5	5	5	5	5	5
60° gloss	57	61	73	96	90	95	97	105	92	100	102	109

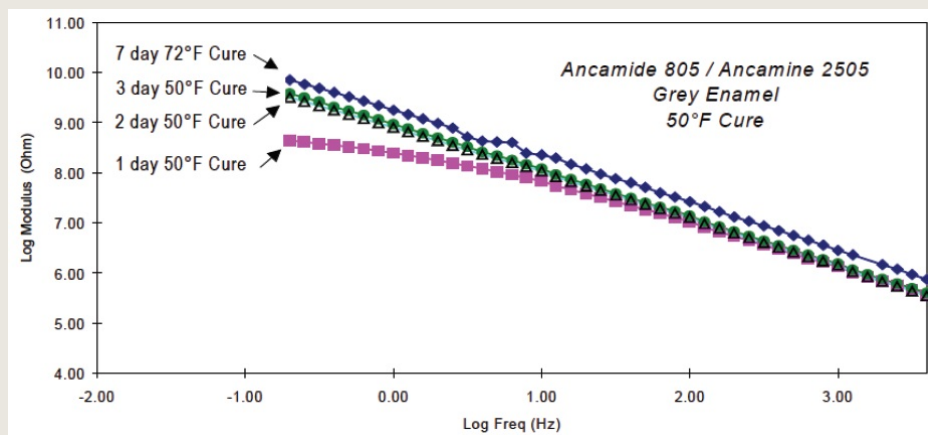
MEK ratings: 0 = soluble; 1 = hvy depression; 2 = mod. Depression; 3 = marring, sl. Depression; 4 = sl. Marring; 5 = no effect
 Clearcoats were conditioned at 45°, 55°, and 72°F; applied with zero induction, then cured at 45°, 55°, and 72°F.

EIS EVALUATION OF LOW TEMPERATURE CURE ENAMEL COATING: Paint and equipment were pre-conditioned at 50 °F. Paint was mixed, inducted 30 minutes, then applied by wirewound drawdown bar at 4 mil DFT. Coatings were cured at 50°F / 50% RH. After 1, 2, and 3-day cure, the coatings were scanned by EIS as illustrated in Figure 4.

After a 1-day cure at 50°F, the coatings exhibited good development of barrier properties. After a 2-day and a 3-day cure at 50 °F, the coatings exhibited excellent barrier properties with virtually no ion penetration to the substrate. Barrier properties after 2-3 day cure at 50°F were comparable to the properties obtained with a 7-day cure at ambient temperature.



FIGURE 4: EIS RESULTS AT LOWER TEMPERATURE



STARTING POINT FORMULATIONS

Formulations 1-5 show anticorrosive primers, a satin finish, a brown zero VOC coating and MilSpec 24441 formulations developed utilizing Ancamide 805 curing agent. Handling and performance properties follow each of the formulations.

FORMULATION 1: HIGH-SOLIDS ANTICORROSIVE PRIMER ANCAMIDE 805 CURING AGENT WITH LIQUID EPOXY RESIN

Part A	Pounds	Gallons
Liquid Epoxy (EEW 190)	294.16	30.38
Nuosperse 657	2.35	0.28
High flash naphtha	60.74	8.27
Wollastocoat 10ES	178.93	7.38
Red iron oxide	47.09	1.17
Heucophos ZPA	58.86	2.52
Part A TOTAL	642.13	50.0
Part B		
Ancamide 805	194.02	23.29
n-Butanol	18.84	2.79
Benzyl alcohol	28.25	4.18
Methyl propyl ketone	9.42	1.39
High flash naphtha	29.79	5.42
LVT 325 mesh talc	94.18	3.96
Zeeospheres 400	164.81	8.97
Part B TOTAL	549.29	50.0
Formulation TOTAL	1191.4	100.0

FORMULATION 1: HIGH-SOLIDS ANTICORROSIVE PRIMER

Formulation Attributes		Performance Attributes	
Weight Solids (%)	88	Mix ratio	1 : 1 (A : B)
Volume Solids (%)	80	Set-to-touch (h)	6
PVC (%)	30.0	Hard dry (h)	16
VOC (lb/gallon)	1.42	Direct impact (in-lb)	40
VOC (g/L)	170	Reverse impact (in-lb)	10
Mixed viscosity (cP)	1550	Pencil hardness	3H
Pot life (h)	3		
Resin stoichiometry	1:1		

FORMULATION 2: HIGH PVC ANTICORROSIVE PRIMER ANCAMIDE 805 CURING AGENT WITH LIQUID EPOXY RESIN

Part A	Pounds	Gallons
Liquid Epoxy (EEW 190)	225.0	23.20
Cabosil TS 720	8.0	0.51
Heucophos ZPA	98.0	4.19
Red Iron Oxide	70.0	1.68
Barytes	483.0	13.49
Aromatic	54.0	7.43
Diacetone Alcohol	25.0	3.19
Part A TOTAL	963.0	53.68
Part B		
Ancamide 805 Curing Agent	148.4	17.88
Texaphor 963	2.0	0.26
Byk 325	2.0	0.24
Zeospheres 400	70.0	3.82
TiPure R 900	20.0	0.6
Wollastocoat 10ES	200.0	8.26
Oxsol 100	31.0	2.77
Aromatic 100	49.5	6.81
n-Butanol	88.0	13.04
Part B TOTAL	610.9	53.68
Formulation TOTAL	610.9	53.68

* Aerosil® 202 may also be used.

FORMULATION 2: HIGH-PVC ANTICORROSIVE PRIMER

Formulation Attributes		Performance Attributes	
Weight Solids (%)	84	Mix ratio	1 : 1 (A : B)
Volume Solids (%)	69	Set-to-touch (h)	1.26
PVC (%)	44	Dry-to-touch (h)	6
VOC (lb/gallon)	2.09	Hard dry (h)	9
VOC (g/L)	250	Direct impact (in-lb)	36
Mixed viscosity (cP)	1200	Reverse impact (in-lb)	6
Pot life (h)	8	Pencil hardness	3H
Resin stoichiometry	1:1		



FORMULATION 3: ZERO-VOC BROWN FINISH ANCAMIDE 805 CURING AGENT WITH LIQUID EPOXY RESIN

Part A	Pounds	Gallons
Liquid Epoxy	350.0	36.08
Texaphor 963	2.0	0.26
Oxsol 100 (exempt solvent)	56.0	5.0
Chrome green oxide	50.0	1.13
Part A TOTAL	458.0	42.47
Part B		
Ancamide 805 Curing Agent	230.89	27.78
Cabosil TS 720	3.0	0.19
Byk 333	2.10	0.24
Red iron oxide	20.0	0.48
Wollastocoat 10ES	100.0	4.13
Barytes	50.0	1.40
Acetone (exempt solvent)	55.0	8.21
Part B TOTAL	460.99	42.43
Formulation TOTAL	918.99	84.90

* Aerosil® 202 may also be used.

FORMULATION 3: BROWN FINISH

Formulation Attributes	
Weight Solids (%)	88
Volume Solids (%)	84
PVC (%)	10
VOC (lb/gallon)	0
VOC (g/L)	2
Mixed viscosity (cP)	2400
Pot life (h)	1
Resin stoichiometry	1:1



FORMULATION 4: LOW-TEMPERATURE GRAY ENAMEL ANCAMIDE 805 AND ANCAMINE 2505 CURING AGENTS WITH LIQUID EPOXY RESIN

Part A	Pounds	Gallons
Liquid Epoxy (EEW 190)	377.4	39.0
Nuosperse 657	1.42	0.17
Byk 307	1.27	0.14
MPK	7.12	1.06
UL 20-31A Black Tint	1.75	0.24
High Flash Naphtha	22.00	2.99
Zeeospheres 400	118.27	6.44
Part A TOTAL	529.32	50.0
Part B		
Ancamide 805	117.01	14.16
Ancamide 2505	117.01	13.35
n-Butanol	47.50	7.03
PM Solvent	31.67	4.00
TiPure R 960	213.75	6.57
UL Black Tint (20-31A)	2.0	0.23
LVT 325 Mesh Talc	110.83	4.66
Part B TOTAL	635.10	50.0

FORMULATION 4: GRAY ENAMEL

Formulation Attributes		Performance Attributes	
Weight Solids (%)	88	Taber abrasion (mg wgt loss)	93
Volume Solids (%)	81	Direct impact (in-lb)	52
PVC (%)	22	Reverse impact (in-lb)	4
VOC (lb/gallon)	1.4	Pencil hardness	5H
VOC (g/L)	170	60° Gloss 72°F	104
Mixed viscosity (cP)	1400	60° Gloss 50°F	99
Pot life (h)	15	Set-to-touch 72°F (h)	2.5
Resin stoichiometry	1:1	Set-to-touch 50°F (h)	4.5
		Dry-to-touch 72°F (h)	5
		Dry-to-touch 50°F (h)	8
		Hard dry 72°F (hr)	10
		Hard dry 50°F	overnight



FORMULATION 5: MIL-P- 24441 COMPLIANT COATING ANCAMIDE 805 CURING AGENT WITH LIQUID EPOXY RESIN BLEND

Part A	Pounds	Gallons
Liquid Epoxy (EEW 190)	500.0	51.55
Disparlon NS-30	8.0	1.09
MP-44-26	100.0	4.29
Satintone #1	150.0	6.85
Oxsol 100	96.0	8.57
Aromatic 100	189.0	26.0
Part A TOTAL	1043.0	98.35
Part B		
Ancamide 805	329.8	39.69
Disparlon NS-30	8.0	1.09
TiPure R 960	100.0	3.10
MP-44-26	500.0	21.46
Yellow Iron Oxide	20.0	0.59
Phthalo Blue	1.0	0.06
Oxsol 100	69.0	6.16
n-Butanol	177.0	26.22
Part B TOTAL	1204.8	98.36
Formulation TOTAL	2247.8	196.71

FORMULATION 5: MILSPEC 24441 COATING

Formulation Attributes		Performance Attributes	
Weight Solids (%)	76	Mix ratio	1 : 1 (A : B)
Volume Solids (%)	65	Direct impact (in-lb)	96
PVC (%)	28	Reverse impact (in-lb)	28
VOC (lb/gallon)	2.09	Set-to-touch (h)	3
VOC (g/L)	250	Hard dry (h)	10
Mixed viscosity (cP)	1100		
Pot life (h)	7		
Resin stoichiometry	1:1		



APPENDIX

RESIN, PIGMENT AND ADDITIVE SUPPLIERS

Product	Supplier
Aerosil R202	Evonik
Anti-Terra	BYK Chemie
Barytes	Cimbar, England
Beetle 216-8	Cytec
Benzyl Alcohol	Kalama
Byk 325	BYK Chemie
Byk 333	BYK Chemie
Byk 354	BYK Chemie
Cabosil TS 720	Cabot
Chrome Green Oxide	Laporte Pigments
D.E.R. 331	Dow Chemical
Disparlon NS-30	King
Disperbyk 101	BYK Chemie
Epon 828	Shell
FC 430	3M
Heucophos ZPA	Heubach
LVT 325 Talc	Barett's Minerals, Inc.
MP-44-26	Specialty Minerals
Nuosperse 657	Creanova (formerly Hüls)
Oxsol 100	Oxychem
Phthalo Blue 248-3750	Sun
Red Iron Oxide 218M	Laporte Pigments
Satintone #1	Engelhard
Surfynol HS-40	Evonik
Texaphor 963 Henke	Henkel
TiPure R-900	DuPont
TiPure R-960	DuPont
UL 20-31A	Elementis (formerly Daniels)
Wollastocoat 10ES	NYCO
Yellow Iron Oxide 1101	Laporte Pigments
Zeeosphere 400	3M Company

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