



HIGH-PERFORMANCE ADDITIVES

— for — Demanding Coating Systems



FLOORING

COIL

AUTOMOTIVE

PACKAGING

MARINE

AEROSPACE

**LIGHT/HEAVY DUTY
INDUSTRIAL**

AGRICULTURAL

**SEALANTS/
ADHESIVES**

PRODUCTS

King Industries, Inc. is a leader in additive development for the **paint and coatings industry** and a global supplier of specialty chemicals. King offers a broad range of high performance catalysts, corrosion inhibitors, rheology modifiers, resin modifiers and surface control additives used in a variety of applications including automotive, aerospace, flooring and general industrial. With over 80 years of experience, King has the technical service and knowledge to assist you in reaching specific requirements for your formulation.

Solutions Through Chemistry

	Description	Chemistry	Applications
NACURE® & K-CURE® Catalysts pages 3-5	Acid and blocked acid catalysts for amino thermoset coatings.	DNNSA, DNNDISA, DDBSA, p-TSA and proprietary acids.	<i>Amino crosslinked systems to reduce cure schedule and improve film properties.</i>
K-KAT® Tin-Free Catalysts pages 6-9	Non-tin catalysts for 2K PU, blocked isocyanate systems and silane functional polymers.	Metal compounds based on zinc, bismuth, zirconium and proprietary complexes.	<i>2K PU, blocked isocyanate and silane functional coatings to replace DBTDL.</i>
K-PURE® Catalysts for Epoxy Systems pages 10-11	Catalysts for epoxies and electronic applications.	Based on sulfonic, hexafluoroantimonate or triflic acid and other novel catalysts.	<i>Epoxy / hydroxyl and anhydride systems. Cycloaliphatic epoxies, glycidyl ester and ether resins.</i>
K-FLEX® & K-POL® Specialty Resins & Modifiers pages 12-25	Resin modifiers for improved hardness and flexibility.	Polyester polyols, urethane diols and acetoacetate functional modifiers.	<i>Melamine / urea crosslinked, 2K urethane coatings and cast elastomers.</i>
NACORR® Corrosion Inhibitors pages 26-27	Liquid organic corrosion inhibitors for waterborne and solventborne systems.	Zinc, calcium, amine, barium, magnesium and sodium sulfonates.	<i>Alkyd polyester and urethane coatings for primary or synergistic corrosion protection.</i>
K-STAY® Rheology Modifiers pages 28-29	Pourable liquid thixotropes for pigmented systems. Imparts anti-sag and anti-settle.	Overbased calcium sulfonates.	<i>Polyester, acrylic and alkyd / melamine systems. 2K urethanes and epoxies.</i>
K-SPERSE® Dispersants page 30	High efficiency dispersants for solventborne systems.	Monomeric metal sulfonates and polymeric wetting and dispersing agents.	<i>Epoxies, polyesters, acrylics, alkyds and polyurethanes for highly effective dispersing.</i>
DISPARLON® Thixotropes & Surface Control pages 31-43	Highly effective additives for surface control and thixotropy.	Polyamides and oxidized olefins / polyurethane hybrids.	<i>Where superior shear thinning, anti-sag, stability and high gloss are needed.</i>

NACURE catalysts are best selected after the end use application and performance criteria have been determined. Clear definition of the end use will allow for easier crosslinker selection and proper catalyst selection, which will ultimately create specific performance results. *Table 1* below is a selection tool to help pair the correct catalyst to the crosslinker. In addition, King also offers catalysts for benzoguanamine and phenolic crosslinkers.

Table 1 - Catalyst Selection

NACURE Selection

Amino Crosslinker Type	Trademarks*	Applications**	Best NACURE	
Fully Methylated High Solids (HS)	Resimene 745	Coil Topcoat	1051, 1323, XC-311	Strong Acid Catalysts
	Resimene 747	Coil Primer	1051, 1419, XC-300	
	Cymel 301	Can Exterior	155, 3525	
	Cymel 303LF	Can Interior	5925	
	Luwipal 066	General Industrial	155, 3525, 2500	
	Melcross 03	Appliance	3525, 1953	
Fully Alkylated Mixed Ether (HS)	Resimene 751, 755	Coil Topcoat	1051, 1323, XC-311	Strong Acid Catalysts
	Cymel 1116, 1133	Coil Primer	1051, 1419, XC-300	
	Luwipal 052	Auto Topcoat	5076, 5225, 2500	
	Melcross 11	Auto Basecoat	155, 3525, 2500, XC-320	
	CCP MR-2133	Auto Primer	155, 3525	
Highly Butylated Low-Med Solids	Resimene 881, 891	Metal Decoration	155, 3525	Strong Acid Catalysts
	Cymel 1156	Auto Topcoat	5076, 5225, 2500	
	Luwipal 044	Wood	155	
	Melcross 22	Plastic	155, X49-110	
	Setamine 19			
Highly Methylated High Imino	Resimene 717	Auto Basecoat	XC-235, 4575	Weak Acid Catalysts
	Resimene 718	General Industrial	4054, 4167	
	Cymel 325	Wood	XC-235, 4000	
	Cymel 327	Plastic	4000	
	Luwipal 072	Paper	4000	
	Luwipal 073	Can Interior		
	Melcross 27			
	CCP MR-625			
Partially Methylated Polymeric	Resimene 730	General Industrial	4054, 4167	Weak Acid Catalysts
	Resimene 741	Wood	XC-235, 4000	
	Cymel 370	Plastic	4000	
	Cymel 373	Paper	4000	
	Luwipal 069			

*The registered trademarks above are listed on page 4.

**The applications listed in the table above are those commonly associated with the crosslinker type in the previous column.

Acid Strength - Strong acid catalysts are generally used for fully methylated, fully alkylated and highly butylated amino crosslinkers. Weak acid catalysts can be used for highly methylated, partially methylated and phenolic crosslinkers.

Hydrophilic Catalysts - Benefits include faster and lower temperature curing in systems crosslinked with the more monomeric melamines like HMMM. They are typically water soluble and are well suited for waterborne applications.

Hydrophobic Catalysts - Benefits include good water and salt spray resistance properties. They are soluble in a wide range of solvents, including non-polar aromatic and aliphatic solvents.

NACURE Hydrophobicity by Acid Type*					
Hydrophilic	p-TSA	DDBSA	DNND5A	DNNSA	Hydrophobic
	2500	5225	155	1051	
	2547	5528	3525	1323	
		5076	X49-110	1419	

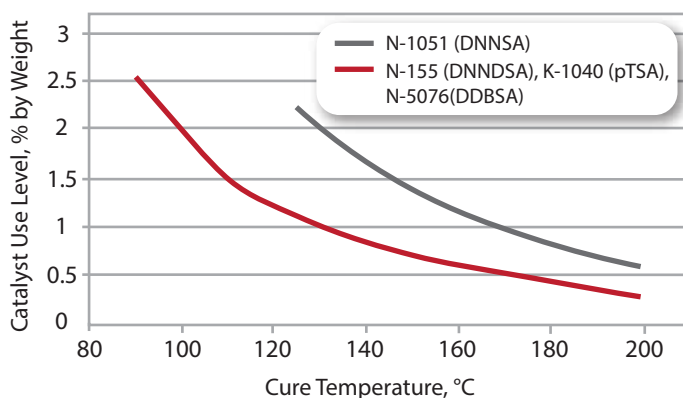
*King also offers phosphates

NACURE										
Product	% Active	Min. Cure	Attributes / Uses	Auto	Can	Coil	Wood	Paper	Industrial	
DNNSA	155	55%	RT	General purpose catalyst. Excellent adhesion. Excellent water, detergent and salt spray resistance.						
	3525	25%	120°C	Blocked. Excellent solubility, good salt spray resistance and adhesion properties.						
	X49-110	25%	90°C	Blocked. Best overall properties of the DNNSA catalysts with excellent corrosion resistance and adhesion.						
p-TSA	2107	25%	90°C	Blocked. Ideal for textured coatings. Good metal mark resistance.						
	2500	25%	80°C	Blocked. Low temperature cure with excellent stability. Excellent color.						
DNNSA	1051	50%	RT	Best water and corrosion resistance. Good overbake and telegraph resistance. For high temperature applications.						
	1323	21%	150°C	Blocked. For high temperature applications. Excellent solubility. Good package stability.						
	1419	30%	150°C	Blocked. For high bake applications with good salt spray, detergent and boiling water resistance. Excellent adhesion.						
	1557	25%	150°C	Resolves solvent popping in thick films. Excellent humidity and detergent resistance.						
DDBSA	5076	70%	RT	Complies with FDA 21 CFR Sec. 175.300 (b) (3) xii & xiii (a&b) and EC directive 10/2011. Fast cure						
	5225	25%	120°C	Blocked. Best solubility in high solids enamels with good performance in aliphatic solvents.						
	5528	25%	120°C	Blocked. Broad solubility and excellent color stability.						
	5925	25%	120°C	Blocked. Complies with FDA 21 CFR Sec. 175.300 (b) (3) xii & xiii (a&b)						

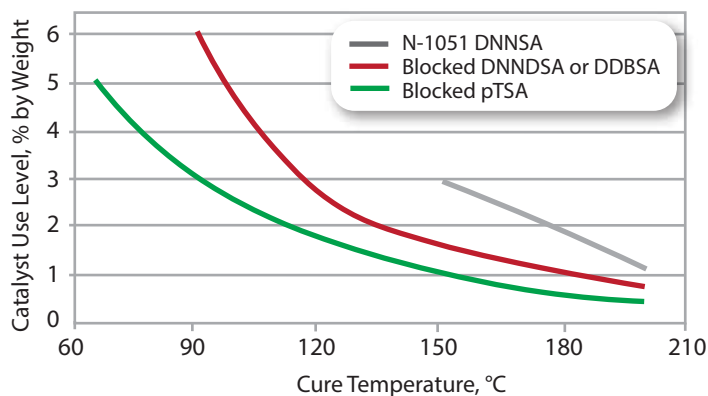
NACURE										
Product	% Active	Min. Cure	Attributes / Uses	Auto	Can	Coil	Wood	Paper	Industrial	
PHOSPHATE	4000	100%	80°C	A weak acid catalyst with broad solubility, good package stability and adhesion.						
	4054	50%	80°C	A weak acid catalyst with excellent solubility and water resistance compared to other phosphates.						
	4167	25%	80°C		Blocked. Neutralized weak acid catalyst with good solubility, water resistance and excellent stability.					
	4575	25%	100°C	Blocked. Amine neutralized catalyst with high gloss and superb storage stability with polymeric amino resins.						
NEW PRODUCTS	XC-296B	28%	200°C	An acid catalyst designed for use in solventborne epoxy-free can coatings based on polyester/phenolic resin systems.						
	XC-300	25%	150°C	Provides long storage stability for consistent cure response needed with basic pH anti-corrosive pigments.						
	XC-320	50%	110°C		Formulated for water based systems to reduce cure temperature of amino crosslinked systems.					

R = Repair P = Primer BC = Basecoat CC = Clearcoat I = Interior
W = Waterborne MC = Monocoat TC = Topcoat E = Exterior

Acid Catalysts - Typical Use Levels



Blocked Catalysts - Typical Use Levels



References (pages 2-4)

1. Resimene	Preferre Melamines
2. Cymel	ALLNEX
3. Luwipal	BASF

4. Melcross	P&ID Co.
5. CCP MR	CCP
6. Setamine	Nuplex

K-KAT® catalysts are metal compounds designed for accelerating the crosslinking reaction of isocyanates with polyols. In addition to replacing tin catalysts, K-KAT catalysts offer a wide range of **performance advantages**.

Benefits include an improved pot life/cure time relationship, less gassing in the presence of water (humidity), improved cold temperature cure response, catalysis of secondary hydroxyl groups, and **excellent film properties**.

A summary of the main attributes and properties of the K-KAT product line can be seen in the table below. Additional benefits can be found within the performance examples in the following pages.

Organometallic Catalyst for Polyurethane Coatings, Polysiloxanes, Adhesives and Foams

	Typical Attributes / Properties
Bismuth Carboxylate <i>Recommended for 2K SB and 1K SB blocked isocyanate polyurethane coatings and rigid foam</i>	• Alternative to tin in PU coatings • Reactivity comparable to tin catalysts • Non-yellowing • Excellent gloss retention • Catalyzes secondary hydroxyl groups
Bismuth Complex <i>Recommended for rigid PU foam</i>	• High efficiency for fast cure with low dosage • Excellent hydrolytic stability for prolonged shelf stability • Effective at low-temperature
Zirconium Chelate <i>Recommended for 2K SB, and high solids polyurethane coatings</i>	• Reduced outgassing in PU systems • Effective in cold and humid conditions • Good pot life with 2,4-Pentanedione
Aluminum Chelate <i>Recommended for 2K SB polyurethane coatings</i>	• Best pot-life extension with 2, 4-Pentanedione • Balance extended pot-life with fast cure speed
Zinc Carboxylate <i>Recommended for 2K polyurethane elastomers, 1K blocked isocyanate polyurethane and foam</i>	• Hydrolytically stable • FDA 175.300 compliant for food packaging • Sustained back-end activity • Blocked isocyanates • Back-end, surface cure
Zinc Complex <i>Recommended for 2K WB and SB polyurethane coatings, 1K blocked isocyanate systems, PU foam</i>	• Excellent hydrolytic stability • Latent activity • Good versatility • Effective for moisture-cured systems
Potassium <i>Recommended for 2K WB polyurethanes and PIR foams</i>	• Water soluble • Effective for ambient cure • Trimerization of isocyanates

Performance Advantages

○ Good ◐ Very Good ● Excellent — Not Recommended

K-KAT										
	Product	Use % (TRS)	Attributes	Hydrolytically stable	Back-end active	Front-end active	Latent (extends pot life)	Efficient (low dosage)	Selective (less gassing)	Low temp. active
BISMUTH	XK-651	0.1 - 2.5	Bi-carboxylate with proprietary hydrophobic ligand technology for superior hydrolytic stability vs conventional Bi-carboxylates	◐	○	●	—	●	◐	●
POTASSIUM	XK-4019	0.5 - 2.0	TBD	●	●	○	○	—	◐	—
ZIRCONIUM	6212	0.3 - 2.0	Zr-chelate with exceptional selectivity, effective in extreme cold and/or humid conditions, also useful for prepolymer synthesis	—	○	◐	○	◐	●	●
	4205	1.0 - 2.0	Zr-chelate with ability to extend pot life (latent activity) and excellent selectivity	○	○	—	●	○	●	◐
ALUMINIUM	5218	1.0 - 2.0	Al-chelate that provides best balance of fast dry time with long pot life when used with 2,4-pentanedione*	○	◐	○	●	○	◐	○
ZINC	XK-661	0.2 - 1.0	Zn-amine complex with exceptional hydrolytic stability, effective in WB 2K PU, also useful in 1K moisture cure urethanes	●	●	○	◐	○	○	○
	XK-4018	0.1 - 1.0	Zn-based catalyst with excellent overall balance of performance, especially effective for Sn-replacement with MEKO-blocked NCO	●	—	●	—	●	○	●
MIXED METALS	XK-672	0.1 - 1.0	Effective for Sn-replacement in 1K PU blocked NCO, meets requirements of FDA 21 CFR 175.300	●	●	○	◐	○	◐	○
	XK-604	0.1 - 0.5	Formulated mixed metal-carboxylate with latent activity in 100% NV 2K PU, especially for Hg-replacement in aliphatic elastomers	◐	◐	○	◐	○	◐	◐

*When using with 2,4 pentanedione, add the 2,4 PD first with agitation, then add K-KAT 5218, typically dosed at 1:1 ratio with 2,4 PD



K-KAT XK-651 is a novel bismuth carboxylate that exhibits improved hydrolytic stability compared to other bismuth carboxylate catalysts. The study below shows the excellent stability of K-KAT XK-651 when water is present in the formula.

2K PU Hydrolytic Stability Study

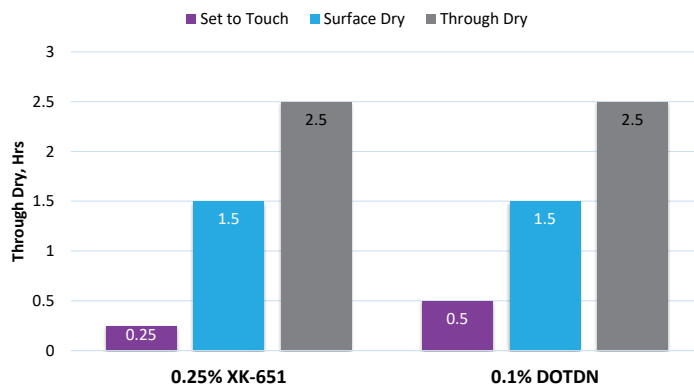
Conditions	Polyol spiked with 0.1% water
Metal Levels	Competitor Bismuth = 0.2% Bi on TRS K-KAT XK-651 = 0.2% Bi on TRS

The pictures to the right demonstrate the outstanding hydrolytic stability of K-KAT XK-651 when compared to a competitor's bismuth carboxylate at 1 day and 30 days of ambient storage.

Formulators Note

K-KAT XK-651 combines superior hydrolytic stability with more efficient catalysis, achieving faster dry times with less reactivity drift on aging. K-KAT XK-651 is the preferred bismuth catalyst for conditions in which moisture may be present.

K-KAT® XK-651 vs. Tin



System: Aliphatic 2K Polyurethane
• Acrylic polyol/HDI Trimer
• 1-1.5 mil DFT
• Ambient Cure (25°C/50% RH)

After 24 hours



K-KAT XK-651
Clear

Competitor Bismuth
Hazy

After 30 days



K-KAT XK-651
Clear

Competitor Bismuth
Settling

Pot life and gloss vs. DBTDL - 2K WB

K-KAT XK-661 is a novel non-tin catalyst recommended for 2K waterborne coatings. It has excellent hydrolytic stability, which improves gloss retention and exterior durability. K-KAT XK-661 delivers superior pot life and gloss retention vs. tin, as seen in the study below where panels were coated with aged paint.

2K Waterbased Acrylic Isocyanate Clear Coat

Substrate:	Bonderite 1000
Cure:	30 minutes @ 80°C + 1 week ambient
Catalyst Levels:	DBTDL = 0.04% on TRS K-KAT XK-661 = 0.06% on TRS
Dry film thickness:	0.7 mil

Better Pot Life Stability = Better Gloss Retention

Gloss of panels coated with aged paint



2 hours with DBTDL
Loss of Gloss
Gloss 60° = 30.3



3 hours with **K-KAT XK-661**
Retains Gloss
Gloss 60° = 95.8

Study 15k-12

K-KAT® XK-672 is an effective catalyst for the reaction of isocyanates and polyols for the production of urethane coatings. It also meets FDA 21 CFR 175.300 requirements.

King Industries offers multiple tin-free products for the reaction of blocked isocyanates and polyols in 1K polyurethane systems. The following study is designed to demonstrate typical properties of tin-free catalysis in 1K blocked isocyanate coating systems. The use of K-KAT catalysts can lead to improved coating performance with respect to film hardness and MEK resistance.

1K Blocked NCO System

Materials	Description	MEKO-Blocked	CPL-Blocked
Joncryl ¹ 504	Acrylic Polyol	45.89	44.53
PM Acetate	Solvent	9.38	9.10
Aromatic 150	Solvent	3.89	3.78
Isopropanol	Solvent	2.89	2.81
DISPARLON® L-1984N	Flow & Leveling Agent	0.29	0.28
DESMONDUR® 3175A	MEKO-Blocked Isocyanate	37.66	-
DESMONDUR® BL 3272 MPA	CPL-Blocked Isocyanate	-	39.50
Total		100.00	100.00

NCO:OH = 1.08

Test Protocol

Substrate: Iron-Phosphate Treated Steel

Catalyst Levels: 0.5% (MEKO), 1% (CPL)
as supplied on TRS

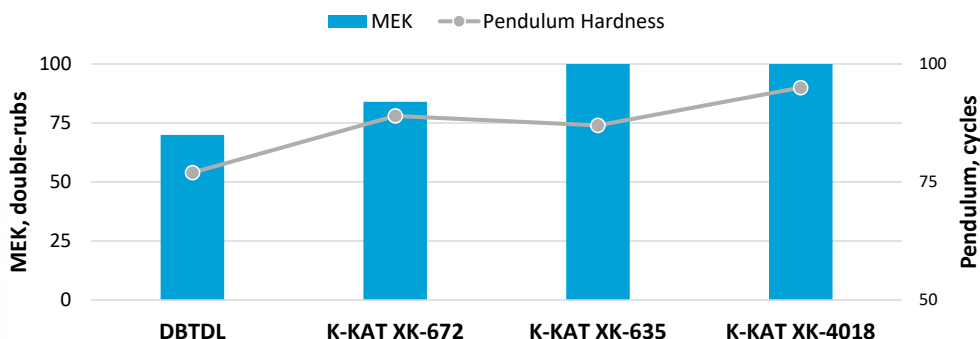
Cure Schedule: 20min. at 140°C (MEKO), 170°C (CPL)

Dry Film Thickness: 1.1mil (27.9µm)

K-KAT XK-672, XK-626, and XK-633 are FDA-approvable catalysts and compatible with FDA-approvable resins and coatings systems. (These products meet FDA 21 CFR 175.300 requirements.)

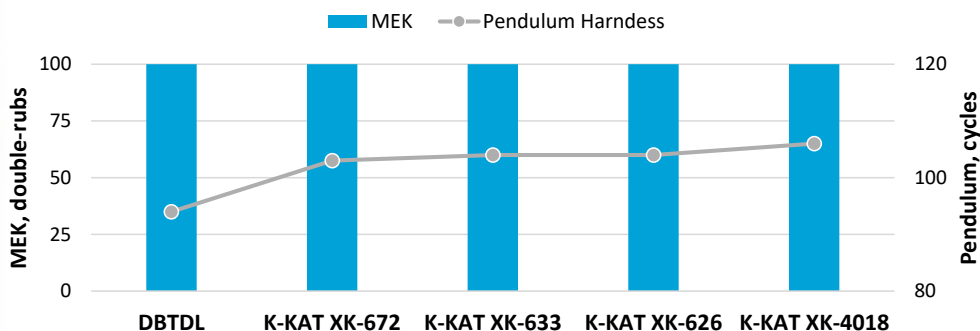
MEKO-Blocked Isocyanate Film Properties

K-KAT vs. DBTDL



CPL-Blocked Isocyanate Film Properties

K-KAT vs. DBTDL

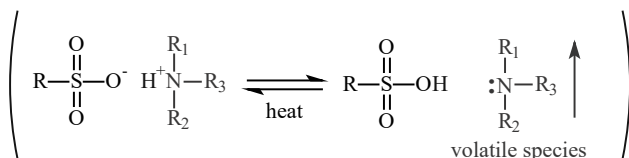


Study 25K-05T

K-PURE TAG and CXC blocked acids are particularly effective for accelerating and lowering the activation temperature of stable, one component systems based on; aminoplast, glycoluril, siloxane, silanol and phenoxy condensation reactions as well as epoxy homopolymerization and co-polymerization with polyols, vinyl ethers, oxetane and anhydride resins. Blocking techniques and features are described below.

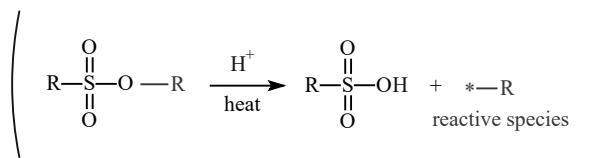
Amine Blocked Acids

Solubility in water and polar solvents
Broad activation temperature range
Volatile by-product



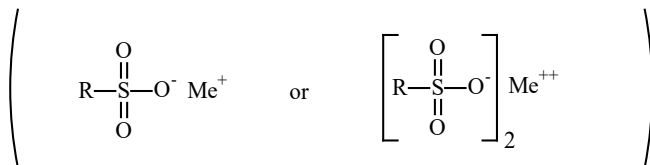
Covalently Blocked Acids

No volatile by-products
Narrower solubility range (hydrophobic)
Solventbased



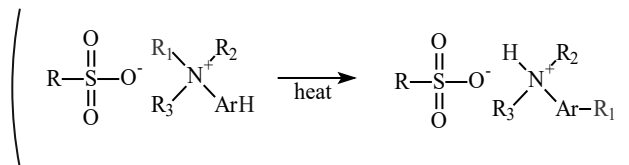
Metal Blocked Acids

Mono and divalent metals
Surface active compounds
Hydrophobic and hydrophilic
Corrosion inhibition with catalytic behavior



Quaternary Blocked Acids

Broad control over activation range
100% solids - white powders
Narrower solubility range (hydrophobic)
No volatile component



		Blocking Type	Min. Activation Range, °C *	Attributes
SbF₆	CXC-1612	Quaternary	80-110	Powder, most efficient product, lowest temperature
TPFB	CXC-1821	Quaternary	80-110	Powder, non antimony alternative to 1612
TFSI	CXC-1802-60	Quaternary	80-120	Liquid, 60% active in PGMEA
OTf	CXC-1614	Quaternary	100-150	Powder, mid-range activation temperature
	CXC-2689	Quaternary	130-170	Powder, mid-range activation temperature
	CXC-2691	Quaternary	170-190	Powder, high temperature TAG
Other	CXC-1756	Metal	110-130	Liquid, 2K epoxy systems
	CXC-1765	Metal	130-140	Liquid, 2K epoxy/acid anhydride reactions, low color

K-PURE CDR - Resin Modifiers

K-PURE resin modifiers offer formulators three core chemistries that can be used to improve mechanical properties, crosslinking density and resistance properties.

Core chemistries include unique ester diols with low molecular weight and very narrow molecular weight distribution, urethane diols with an aliphatic urethane backbone and an acetoacetate functional reactive diluent.

K-PURE CDR Type	Amino	Isocyanate	Silanol	Solvent	Solventless	Water	Epoxy*	Epoxy**
Ester Diols	✓	✓	✓	✓	✓	✓		✓
Urethane Diols	✓		✓	✓	✓	✓		
Acetoacetates	✓		✓				✓	

*Anionic **Cationic

Ester Diols

Improve Flexibility
Reduce Modulus

Urethane Diols

Improve Chemical Resistance
Improve Adhesion

Acetoacetates (AA)

Improve Adhesion
Improve Corrosion Resistance

		OH # / AN / EW	Viscosity Range, cPs	Tg	Adhesion	Toughness
Ester Diols	CDR-3314	225-245 (OH#)	10,000 - 12,000	High	Excellent	Best
	CDR-3315	132-145 (OH#)	4,000 - 5,000	Low	Good	Good
	CDR-3316	250-270 (OH#)	1,200 - 1,800	Med	Good	Best
	CDR-3441	135 (OH#) / 30 (AN)	40,000 - 60,000	Low	Best	Fair
Urethane	CDR-3317	340-360 (OH#)	150,000 - 300,000	High	Good	Good
AA	CDR-3320	190 (EW)	900 - 1,200	N/A	Best	Fair

K-PURE CDI - Corrosion Inhibitors

K-PURE corrosion inhibitors represents a broad range of core chemistries for the protection of ferrous and non-ferrous metals. Most common applications and system dependency are found below.

Sulfonic Acids

Potting Compounds
Cleaners & Strippers

Phosphate

Cleaners & Strippers
Adhesives
Potting Compounds

Amino Acid Derivatives

Cleaners & Strippers
CMP Slurries
Adhesives
Potting Compounds

	Oil	Solvent	Solventless	Water	Wax
Sulfonic Acid	✓	✓		✓	✓
Phosphate		✓	✓	✓	
Amino Acid		✓	✓	✓	
Triazole			✓	✓	
Acetoacetate			✓	✓	

Triazole Derivatives

Cleaners & Strippers
CMP Slurries
Wire
Adhesives
Potting

Acetoacetate

Adhesives
Potting Compounds

Metal Type

Ferrous

Ferrous & Soft Metals

Soft Metals

Ferrous & Soft Metals

Aluminum

K-PURE CDI Products

CDI-4301

CDI-4303
CDI-4310

CDI-4308

CDR-3320

CDI-4311

K-FLEX polyester resin modifiers are primarily used as co-reactants with acrylic, alkyd, epoxy and polyester binders with isocyanate or melamine crosslinkers. The low molecular weight and narrow molecular weight distribution (NMWD) of the K-FLEX polyesters allows the formulation of VOC compliant systems without exempt solvents, while also providing improved performance. Primary hydroxyl groups provide high reactivity for lower temperature cure. Typical modification levels are 5% to 15% on total resin solids.



Increase flexibility & maintain hardness

Higher crosslink density

Excellent durability properties

Improve adhesion

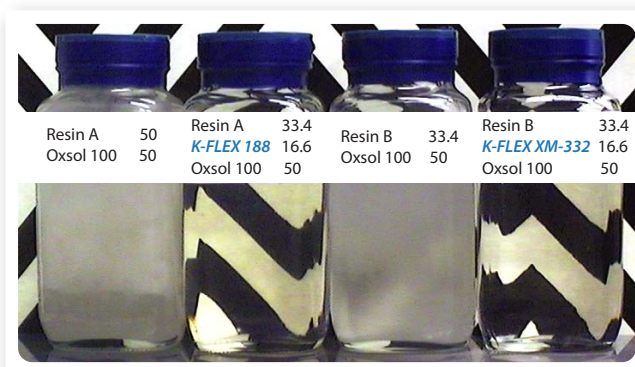
Compatibilization & Solubility

Most polyester resins have poor solubility in exempt solvents. Solubility in Oxsol¹ 100 and t-butyl acetate are particularly difficult.

K-FLEX polyester diols are soluble at 10-50% by weight in Oxsol 100, acetone, propylene carbonate, dimethyl carbonate and t-butyl acetate.

K-FLEX polyester diols are very effective at compatibilizing other resins to achieve solubility in these exempt solvents. This is demonstrated in the adjacent image with two commercial resins (A&B) and Oxsol 100.

The image below represents 33% replacements of polyester A&B to achieve solubility.



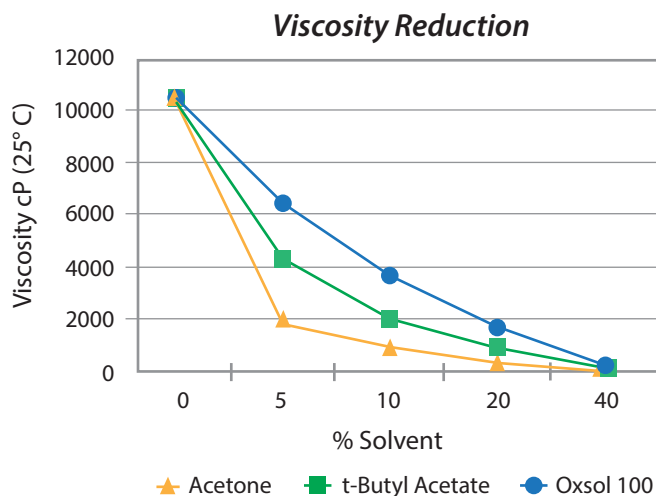
*K-FLEX compatibilization of other resins in Oxsol 100
Identical results when used in t-butyl acetate*

Viscosity Reduction - K-FLEX 188

K-FLEX diols provide efficient viscosity reduction with low levels of solvent due to their narrow molecular weight distribution.

Viscosity reduction of K-FLEX 188 with exempt solvents including Oxsol 100, t-butyl acetate and acetone are demonstrated in the graph to the right.

A spray viscosity is possible with K-FLEX 188 at about 90% solids in acetone or about 80% solids in t-butyl acetate. Ketones and esters are very efficient solvents for viscosity reduction of the K-FLEX polyester diols.



The formulation below demonstrates the performance of a **high solids 2K acrylic polyurethane** coating modified with **K-FLEX 188**, a light stable, high Tg (-32°C) polyester polyol. K-FLEX 188 modification is at 14% on TRS and VOC is reduced from 3.40 to 2.83 lbs./gal.

King Formulation API-17

Grind	Description	Weight %
Joncryl ² 906	Acrylic Resin	15.6
Titanium Dioxide	Pigment	71.3
MP Acetate	Solvent	12.7
K-SPERSE® 152	Dispersant	0.4

Component 1	Description	Acrylic Control	K-FLEX Modification
Grind	See Grind	36.8	40.5
Joncryl 906	Acrylic Resin	36.6	28.0
K-FLEX 188	Polyester Diol	-	6.2
1M-2P Acetate	Solvent	14.8	10.2
BYK ³ 310	Wetting Agent	0.1	0.1
Tinuvin ⁴ 123	HALS	0.3	0.3
Tinuvin 1130	UV Absorber	1.0	1.0
Catalyst	Metal Catalyst	0.1	0.1
Component 2			
Desmodur ⁵ N-3300	Isocyanate resin	10.3	13.6

Film Performance - Benefits

- Improved impact resistance
- Improved water resistance
- Major reduction in viscosity & VOC
- Maintained hardness
- Improved flexibility

 K-FLEX Modification: 14% based on TRS

Cure & Application Conditions

Cure Schedule: 30 minutes/80°C + 1 week ambient

Dry Film Thickness: 25µ (1.0-1.1 mils)

Substrate: Bonderite⁶ 1000

FILM PROPERTIES	Control	K-FLEX 188
MEK Resistance (2X Rubs)	100+	100+
Pendulum hardness, cycles	119	115
Reverse impact (image below)	<5	160+

Both the control and the modified system exhibited 100% crosshatch adhesion



K-FLEX diols have excellent solubility across a broad range of solvents including PC, DMC, TBA and PCBTF. Certain exempt solvents and resins were once incompatible with each other, resulting in poor appearance and poor performance. The addition of a K-FLEX polyester diol would compatibilize the resin and exempt solvent, resulting in improved film properties.

Formulation of API-17 on *Page 12* is based on conventional solvents. The VOC decreased from 3.40 to 2.83 lbs./gal with a 188 modification. The solvents in API-17 were replaced with exempt solvents to obtain a **zero VOC formulation** (API-18) described below. K-FLEX modification is at 14% on TRS.

King Formulation API-18

K-FLEX

Component 1	Description	Acrylic Control	XM-332
Grind (see API-18)*	Resin, TiO ₂ , Oxsol® 100	35.9	38.6
Joncryl 906-AC	Acrylic Resin	35.8	26.5
K-FLEX	Polyester Diol	-	6.0
Oxsol 100	Exempt Solvent	8.4	6.7
t-Butyl Acetate	Exempt Solvent	8.4	6.7
BYK 310	Wetting Agent	0.1	0.1
Tinuvin 123	HALS	0.4	0.4
Tinuvin 1130	UV Absorber	1.0	1.1
K-KAT® XK-635	Catalyst	0.1	0.1
Component 2			
Basonat ⁷ HI-100	Isocyanate Resin	9.9	13.7

* API-18 is similar to API-17 (*Page 12*), replacing Joncryl 906 with Joncryl 906-AC and MP Acetate with Oxsol 100



Cure & Application Conditions

Cure Schedule: 1 month ambient

Dry Film Thickness: 25μ

Substrate: Bonderite 1000

FILM PROPERTIES	Control	XM-332
Pendulum hardness, cycles	125	109
Pencil hardness	H-2H	2H-3H
Reverse impact, in-lbs	30-40	160+
Direct impact, in-lbs	110-120	160+

100% crosshatch adhesion & 100 MEK 2X Rubs (all films in API-18 Formulation)

Modification of this filled **100% non-volatile 2K polyurethane** floor coating formulation (PI-13) demonstrates higher hardness, tensile strength, elongation, elastic modulus, tear strength and improved gasoline and transmission fluid stain resistance. **K-FLEX** was added at 10% on TRS and it partially replaced the branched polyether-polyester triol and linear polyether diol, as can be seen in the images below.

King Formulation PI-13

Component 1	Description	Control	K-FLEX Modification
Sovermol® 750	Polyether/PE Triol	25.1	21.6
Sovermol 1052	Polyether Diol	10.7	7.4
K-FLEX	Polyester Diol	-	6.4
Efka ⁹ SI 2008	De-aerator	0.4	0.4
Barium Sulfate	Filler	35.8	35.4
Component 2			
Basonat HI-100	Isocyanate	27.9	28.7
K-KAT® 6212	Catalyst	0.1	0.1

Cure & Application Conditions**Cure Schedule:** 2 weeks ambient**Dry Film Thickness:** 3 mm**Substrate:** 2K PU castings

FILM PROPERTIES	Control	188
Shore D hardness	53	60
Tensile strength, psi	1,022	1,041
Elongation	40	50
Elastic modulus	5,951	5,013
Break/load - Die C, pli	43	76
Tear strength - Die C, psi	176	272
Taber abrasion, wear index	56	39
Crockmeter	6	3

Taber Abrasion and Crockmeter: Lower number = Better performance

K-FLEX**Gasoline Soak, 30 Hours****Control****K-FLEX XM-337**

10% on TRS

Transmission Fluid, 3 Day Spot Test

1 2 3
Exposure days
Control



1 2 3
Exposure days
K-FLEX XM-337

In the King formulation below (HS-19), **K-FLEX 188** polyol is used as a modifier to provide improved flexibility, hardness and chemical resistance of a high solids polyester/melamine coating. Additionally, the K-FLEX modified systems resulted in better water resistance and a major viscosity reduction.

K-FLEX

King Formulation HS-19

Material	Description	Control	18% on TRS	23% on TRS	34% on TRS
Polymac ¹⁰ HS 57-5776	Polyester Resin	66.2	47.2	40.7	29.0
Cymel ¹¹ 325	Melamine Crosslinker	23.4	26.8	28.8	32.1
K-FLEX 188	Polyester Diol	0.0	13.4	17.3	24.7
Methyl Ethyl Ketone	Solvent	5.2	6.3	6.6	7.1
2-Butoxy Ethanol	Solvent	5.2	6.3	6.6	7.1

Application Conditions

Coating Type: Polyester/Melamine

Cure Schedule: 15 minutes/121°C

Dry Film Thickness: 20-25µ

Substrate: Bonderite 1000

Catalyst: NACURE® 3327
0.75% on TRS

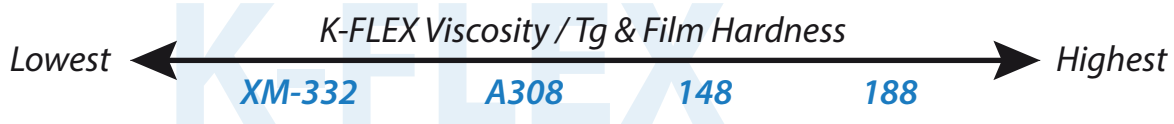
Film Performance - Benefits

- Improved impact resistance
- Reduced viscosity
- Maintained hardness
- Improved MEK resistance
- Better blushing resistance

CHARACTERISTICS	Control	K-FLEX 188 18% on TRS	K-FLEX 188 23% on TRS
HS 57-5776/K-188/Cymel 325	75/-/25	54/18/28	46/23/31
Total resin solids, weight %	75	75	75
Brookfield viscosity (cPs), 25°C	1000	440	340
FILM PROPERTIES			
Pencil hardness	H-2H	H-2H	H-2H
MEK Resistance (2X Rubs)	90	120	130
Crosshatch adhesion	100	100	100
Direct impact (in-lbs)	50-60	100-110	160+
Reverse impact (in-lbs)	5	30-40	140-150
Water soak, 360 hr @ 50°C	MD/9 Blushed	MD/9	MD/9

K-FLEX® polyester diols are presented in two different charts below. The top chart includes K-FLEX polyester diols with hydroxyl numbers between 220 to 265. These diols display a positive correlation between Tg, viscosity, film hardness, moisture resistance and exterior durability. These values tend to increase with increasing Tg.

		System	% Active	Hydroxyl # as Supplied	Viscosity 25°C (cP)	Tg	Attributes / Uses
	188	SB, WB	100%	230	10,000	-32	Improves flexibility while maintaining hardness. Also improves salt spray, humidity resistance and exterior durability. Most versatile.
	148	SB	100%	235	3,750	-42	Improves flexibility and gloss. Increases solids at lower viscosity. Good flow and leveling. Recommended for primers.
	A307	SB	100%	140	5,400	-50	Flexibility modifier with lower crosslinker demand.
	XM-332	SB	100%	265	400	-38	Lowest viscosity for lowest VOC. Softer films. Low temperature impact resistance.
	A308	SB	100%	260	1,500	-59	Medium hardness with great flexibility. Best for mar and scratch resistance.



K-FLEX® polyester diols can be used in solvent based (SB), waterborne (WB) or 100% non-volatile coatings, inks, adhesives, sealants and elastomer thermoset systems. This brochure will focus on the SB coatings market. Some of the top applications for K-FLEX polyester diols include:

Aerospace

Automotive

Flooring

Coil

Marine

Heavy Duty Maintenance

References (pages 9-16)

1. Oxsol	Makhteshim Agan
2. Joncryl	BASF
3. BYK	BYK
4. Tinuvin	BASF
5. Desmodur	Covestro

6. Bonderite	ACT
7. Basonat	BASF
8. Sovermol	BASF
9. Efka	BASF
10. Polymac	Polynt
11. Cymel	Allnex

The aliphatic urethane backbone of **K-FLEX Urethane Diols** provides excellent light stability. It also allows the incorporation of aliphatic urethane functionality without the use of isocyanates. The urethane diols are used primarily as modifiers for melamine and isocyanate crosslinked coatings. They are compatible with polyester, polyether, acrylic and alkyd resins.

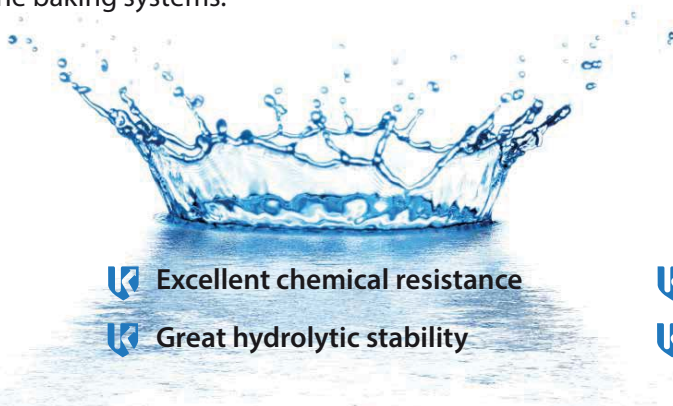
Amino Crosslinked Systems Prepolymer Synthesis Blocked Isocyanates

K-FLEX urethane diols are soluble in most polar organic solvents and in water. They are not soluble in more hydrophobic solvents like aliphatic or aromatic hydrocarbons. However, varying levels of hydrophobic solvents can be tolerated depending on the solubility parameters of the other solvents present.

Advantages in Waterborne Coatings

K-FLEX Urethane Diols reduce formulation viscosity while contributing reactive solids, enabling higher-solids enabling higher-solids systems without reliance on traditional volatile cosolvents.

Additionally, K-FLEX urethane diols enable the reduction or replacement of amine in the coating, resulting in lower VOC and faster cure of melamine baking systems.



Higher hardness

Excellent chemical resistance

Improved wet adhesion

Lower VOC (higher solids)

Great hydrolytic stability

Terrific gloss

K-FLEX		Hydroxyl #	Viscosity	Attributes / Uses
Product	Supplied	On Solids	25°C (cPs)	
UD-350W	88% active urethane diol in water for WB coatings	350	4,000	Higher solids, improved flow, gloss, hardness and resistance properties.
UD-320	82% active urethane diol for SB coatings	350	9,000	Increases application solids and hardness. Improves chemical resistance, exterior durability and hydrolytic stability.
UD-320-100	100% active urethane diol	350	7,000 at 50°C	Prepolymer synthesis. For water or solvent. Preparation of polyester urethanes.

Direct-to-Metal

Aminoplast Systems

Automotive

Appliances

Cabinetry

General Industrial

K-FLEX UD-350W is an aqueous solution of an aliphatic, low molecular weight urethane diol oligomer. It is recommended as a modifier for amino crosslinked water soluble and emulsified acrylic, alkyd, urethane and polyester resins. It is used to increase solids, increase crosslink density and to improve film/resistance properties and flow/leveling.

1K Clear WB Polyester/HMMM

	Material	%	%
Polymac WR 72-7203	Water Reducible Saturated Polyester	30.9	29.5
DMEA	Neutralizing Amine	2.4	2.2
Resimene 747	HMMM Crosslinker	5.8	8.2
K-FLEX® UD-350W	Urethane Diol	0.0	3.0
DISPARLON® AQ-7120	Flow/Leveling Agent	1.0	1.0
dH₂O	Deionized Water	59.9	56.2
	TOTAL	100.0	100.0
K-FLEX / PE / HMMM (Solid on TRS)		0.0/80.0/20.0	8.0/67.2/24.8
%TRS		29.00	32.9
%DMEA on TRS		8.16	6.58
pH		8.0 - 8.1	8.0 - 8.1
Viscosity, cP (25°C)		140 - 160 cP	140 - 160 cP

Substrate: Bare CRS

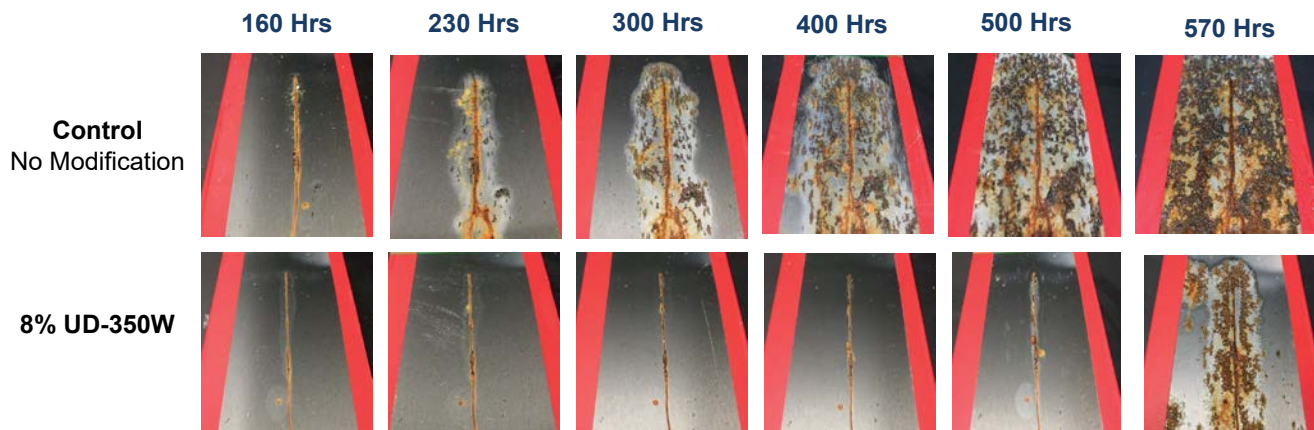
Bake Schedule: 150°C / 20 min

Dry Film Thickness: 1.0 - 1.2 mil (25.4 - 20.5 µm)

Catalyst: 2% NACURE 5528 as supplied on TRS

Data From #17M-21

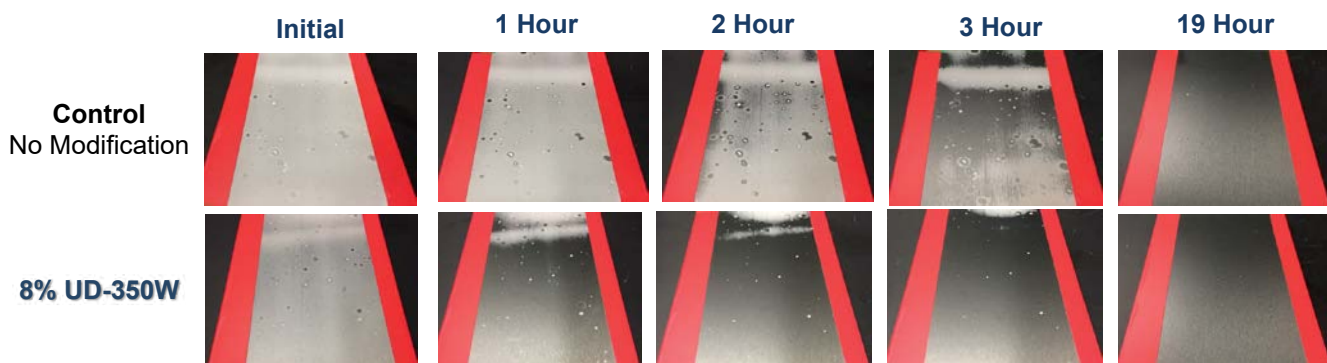
Salt Fog Resistance: 5% NaCl



Data From #17M-21

Cleveland Humidity Testing

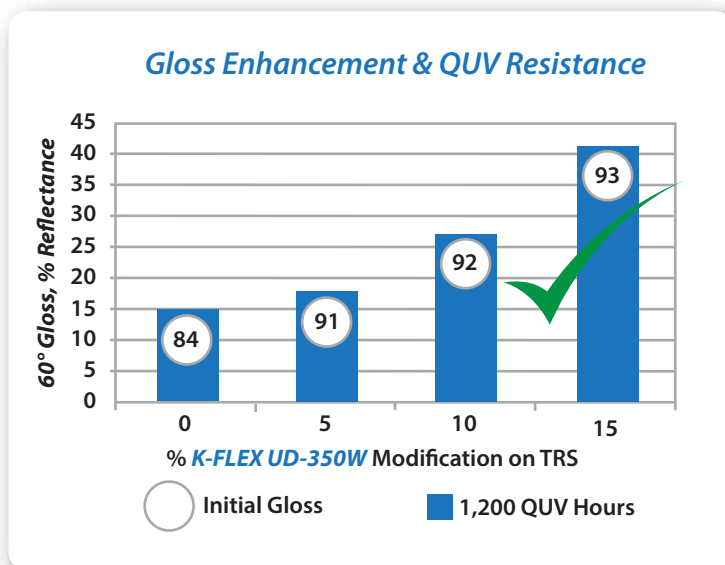
Recovery Following 140 Hrs Humidity Exposure



- Films exhibit severe haze following humidity exposure—films appear nearly white.
- Film appearance recovers over time—haze dissipates.
- UD modified films recovered significantly faster.

Data From #17M-21

K-FLEX UD-350W urethane diol provides improved wetting over various substrates, as well as improved flow and leveling. The end result is higher gloss waterborne coatings.



K-FLEX UD-350W - Waterborne Performance

The urethane backbone of the urethane diols provides excellent hydrolytic stability for long term storage in waterborne formulations. This excellent hydrolytic stability also provides improvements in the humidity, salt spray and boiling water resistance of fully crosslinked films. The results shown demonstrate these improvements in waterborne polyester/HMMM baking enamel.

King Formulation UDW 16		Humidity Resistance (350 hrs) 60° Gloss % Reflectance	Salt Spray Resistance (350 hrs) Blisters*	Salt Spray Resistance (350 hrs) mm Creep	Boiled Water Resistance (1 hour) Blisters*
HMMM Crosslinked Baking Enamel					
Polymac ⁵ WR 72-7203	Control	5	4D	2	8D
Water Reducible Polyester (UDW-16)	K-FLEX UD-350W % on TRS	59	4 F	1	10 No Attack

*Blister Rank (ASTM D714): 10 = no blister, 1 = large blister
D = Dense, M = Medium, F = Few



K-FLEX UD-320 is a high solids, aliphatic, low molecular weight urethane diol. It is soluble in polar organic solvents and has broad compatibility with acrylic, polyester and alkyd resins. When used to modify a 2-component polyurethane, it will increase hardness and flexibility.

K-FLEX UD-320 will increase the hardness and humidity resistance of a melamine crosslinked system. Typical applications include general industrial and automotive OEM coatings.

The formulation below illustrates the effect of K-FLEX UD-320 diol modification of a high solids automotive acrylic melamine coating. Benefits include higher solids, higher hardness and improved adhesion, chemical resistance, gloss and Florida exposure.

King Formulation UD-3 **K-FLEX**

Material	Description	Acrylic Control	K-FLEX UD-320 Modification	
			7%	13%
Acrylic Resin	Acrylic Resin	64.2	57.2	50.2
K-FLEX	Urethane Diol	-	5.2	10.3
HMMM	Crosslinker	20.9	22.8	24.7
NACURE® 5528	Blocked Catalyst	1.3	1.3	1.4
DISPARLON® L-1985-50	Leveling Agent	0.2	0.2	0.2
Xylene	Solvent	10.7	10.6	10.6
Methanol	Solvent	2.7	2.7	2.6
Total		100	100	100
Characteristics				
Acrylic / K-FLEX / MeI		69/0/31	61/7/32	52/13/35
60 min., 110°C % Solids		61.6	62.4	63.5
Viscosity, 25°C (cPs)		156	158	156

Cure & Application Conditions

Cure Schedule: 20 min / 120°C

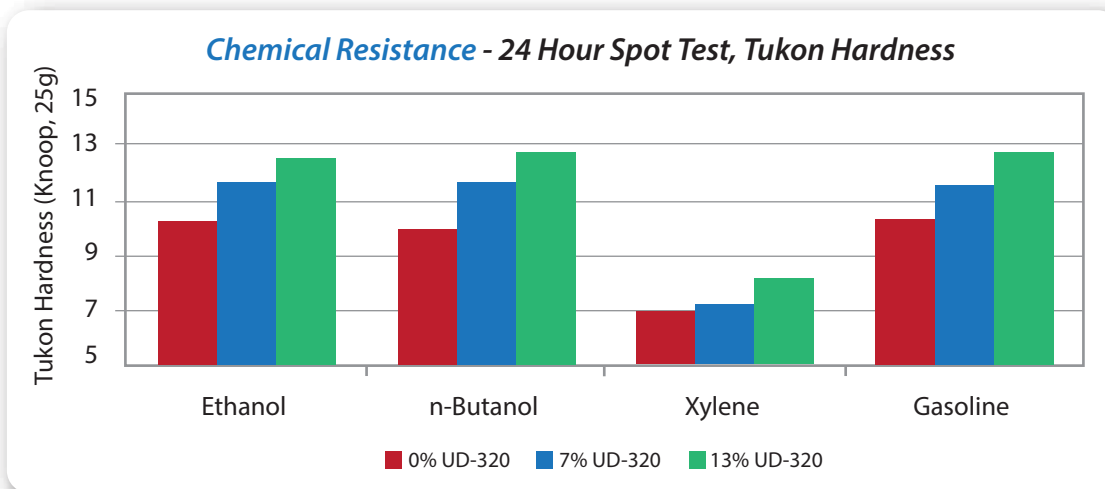
Dry Film Thickness: 37.5μ

Substrate: Iron Phosphated CRS

FILM PROPERTIES	Control	7%	13%	19%
Pencil Hardness, Cycles	F-H	F-H	H-2H	H-2H
% Crosshatch Adhesion	0	20	90	100
Reverse impact, in-lbs	10-20	10-20	10-20	20-40
Direct impact, in-lbs	10-20	40-60	40-60	60-80

The control formulation was modified with 7% and 13% **K-FLEX UD-320** for testing chemical resistance. With each modification level, we increased the melamine content slightly, to accommodate the high hydroxyl number of the K-FLEX UD-320.

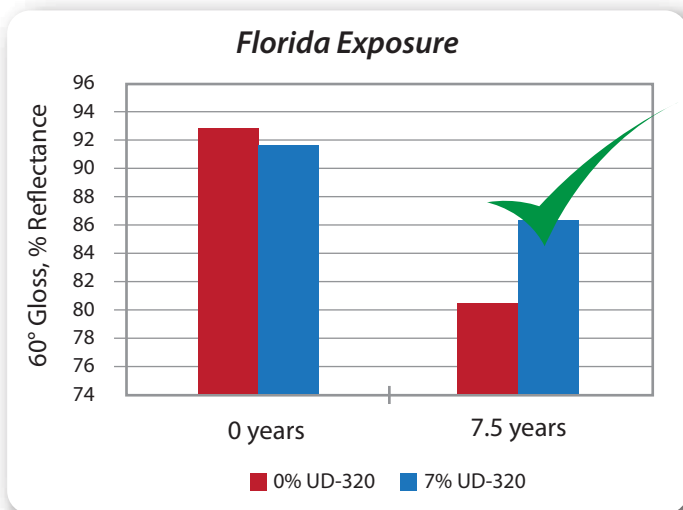
A 24 hour spot test was conducted to evaluate the chemical resistance to ethanol, n-butanol, xylene and gasoline. For each of these solvents tested, we see an improvement in the chemical resistance with a K-FLEX UD-320 modification. In addition, the chemical resistance increases with modification level.



Florida Exposure Study - Gloss Retention & Crack Resistance

60° Gloss Results - Florida Exposure (7.5 years)

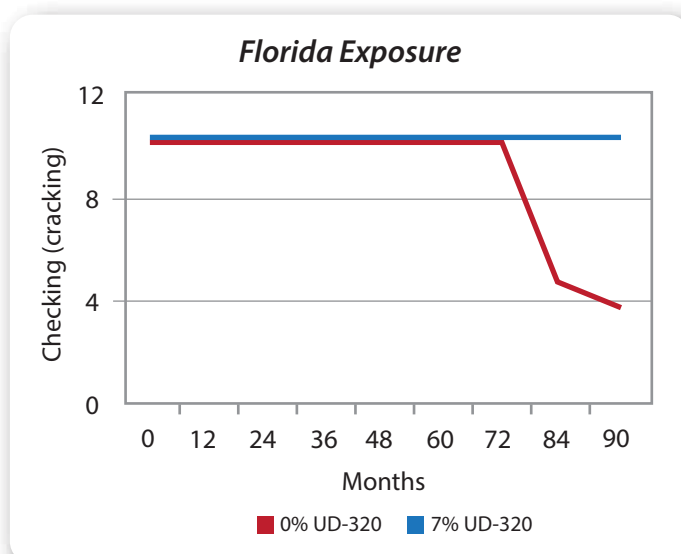
Modification with 7% **K-FLEX UD-320** drastically improved long term gloss stability in harsh environments as shown in the chart below.



Florida Exposure - Checking (crack) Resistance

The chart below demonstrates improved checking resistance with **K-FLEX UD-320** modification versus the acrylic control after 90 months (7.5 years) exposure in Florida at 5° South without UV stabilizers.

Modification at the 7% level provided the best overall cracking resistance.



References (pages 17-21)

1. Joncryl	BASF
2. AMP	Dow
3. Surfynol (Versum)	Air Products
4. Ti-Pure	Chemours

5. Polymac	Polynt
------------	--------

K-FLEX XM-B301 and **7301** are 100% active, low viscosity, acetoacetate functional resin modifiers with excellent compatibility in a wide range of resins. They can be used in solvent based and solventless systems and are primarily recommended for use in 2-component epoxy coatings and adhesives.

Modification of 2K epoxy systems with K-FLEX acetoacetate resin modifiers results in higher performance with reduced induction time, faster cure at low temperature (5°C), improved adhesion, salt spray and humidity resistance among other benefits.

 Reduced induction time

 Eliminates amine blushing

 Faster surface dry

K-FLEX				
Product	% Active	Eq. Weight (g/eq. weight)	Visc. 25°C (Cp)	Attributes / Uses
XM-B301	100%	220	1,100	Excellent performance in epoxy-polyamide primers. Excellent resin compatibility.
7301	100%	125	150	For high solids and waterborne applications to improve adhesion and corrosion resistance.

K-FLEX® XM-B301 - Performance in Epoxy Polyamide Coatings

XM-B301 is a low viscosity, acetoacetate functional reactive resin modifier offering excellent compatibility with a wide range of resins.

It is primarily recommended for use in 2K epoxy primers, but can also be used in systems with amino resins or polyisocyanates. Benefits include:

 Reduced induction time

 Viscosity and VOC reduction

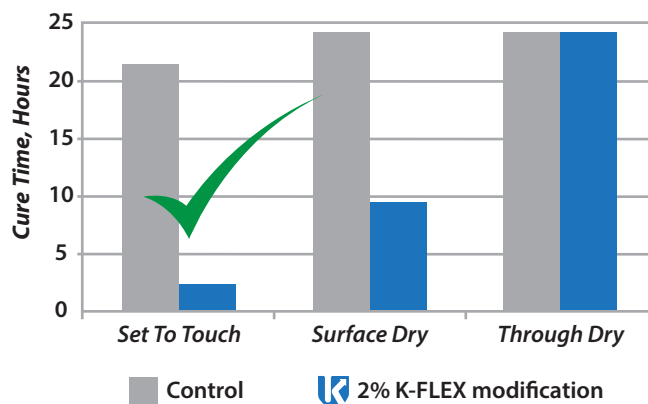
 Excellent low temp. cure response

 Excellent adhesion

 Eliminates popping & pinholes

Low Temperature Cure Response at 5°C

Araldite¹ GY-6010 / Epicure² 3292-FX60



Adhesion - 500 Hour Salt Fog



Control



**3.6% XM-B301
on epoxy solids**

Cure & Application Conditions

Cure Schedule: 3 weeks at 5°C

Dry Film Thickness: 3-5 mils

Substrate: Iron Phosphated Cold Rolled Steel

References (page 22)

1. Araldite	Huntsman Advanced Materials
2. Epicure	Hexion

K-POL 8211 is a unique, 100% active, aliphatic and saturated diol recommended for 2-component polyurethane coatings, elastomers and coatings formulated with amino crosslinking resins. It provides hard films with good flexibility. K-POL 8211 will provide lower VOC systems with improved toughness, high modulus and good exterior durability, plus excellent performance in thin film coatings.

K-POL 8211 can be used in a variety of applications including industrial maintenance, automotive OEM/ refinish, general industrial, urethane elastomers, adhesives and sealants.

This section will focus on K-POL 8211 performance in polyurethane floor coatings.

K-POL Performance - Polyurethane Floor Coating Study

Polyurethane floor coatings require good abrasion resistance, hardness, chemical resistance and stain resistance. They also require good mechanical properties like tensile strength, hardness, flexibility and tear resistance. A challenge for polyurethane coating formulators is to develop systems that meet these requirements with resin systems that have low viscosities without the use of volatile solvents.

Benefits of the addition of K-POL 8211 in a solventless 2K PU formulation include:

- Higher hardness
- Excellent flexibility
- Improved durability
- Higher modulus

Solventless Aromatic Clearcoat Study

The K-POL 8211 modified casting had significantly higher tensile stress, elastic modulus and hardness compared to the control. The combination of higher elastic modulus (stiffness) and higher stress (toughness) with similar strain (elongation) indicate the modified casting is stronger and more robust than the control casting.

Mechanical Properties

Properties	Control	8211
Stress at max, psi	474	762
Modulus, psi	637	1,266
Shore A	73	88
Shore D	25	42



Dog-bone sample used to test on Instron

Die C Tear Resistance (Instron)

K-POL® 8211 displayed tear strength that was double of the control system and about 5x the tear strength of the polycaprolactone diol PCL modified system.

Hot Tire Pickup

3 mm castings over concrete were tested by placing heated tire sections onto the surface with an applied load and storing the sample at 60°C for one hour.

All of the films had good resistance to hot tire pick up. None of the coatings adhered to the tire section. However, black tire marking and coating compression was more evident on the control film.

Properties	Break Load, pli*
Control	222
K-POL 8211, 10%	451
PCL Diol	86

*pli = pounds per linear inch

FILM PROPERTIES	Control	10% PCL* diol	K-POL 8211
Black Tire Marking	3	1	1
Coating Compression	1	0	0
Coating Integrity/ Film Lifting	0	0	0

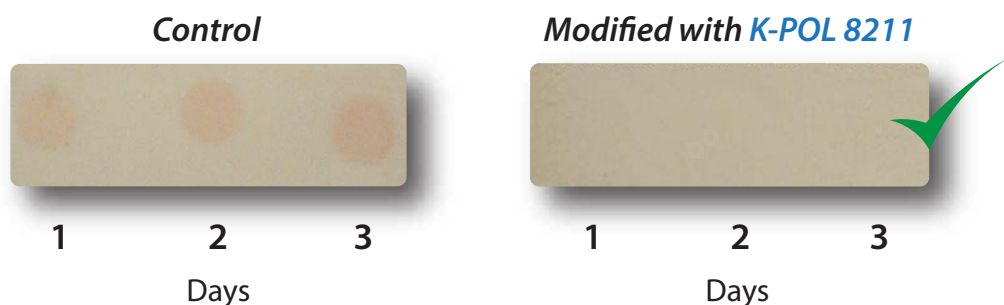
*PCL= polycaprolactone

0 = no effect 5 = severe damage

Solventless Aliphatic Filled Study

The following automobile transmission fluid stain test was conducted over a 3 day period. The transmission fluid was applied onto the surface of the castings as 3 drops with a diameter of approximately 7 mm. The drop was wiped off after 1, 2 and 3 days of exposure. Castings formulated with 10% K-POL 8211 did not stain.

Transmission Fluid, 3 Day Spot Test



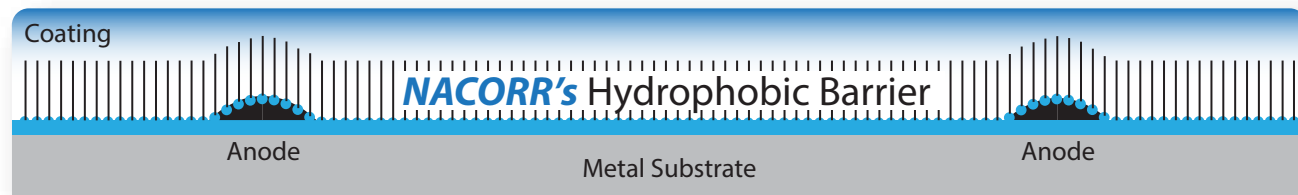
Gasoline Soak, 30 Hours

Disks cut from 3mm castings were immersed in gasoline for 30 hours. The gasoline caused severe damage to the control disk while the integrity of the K-POL modified disk was maintained.



NACORR consists of barium, calcium, zinc, magnesium and sodium sulfonates. NACORR molecules have a polar group and a long hydrophobic tail. NACORR prevents corrosion by two distinct mechanisms:

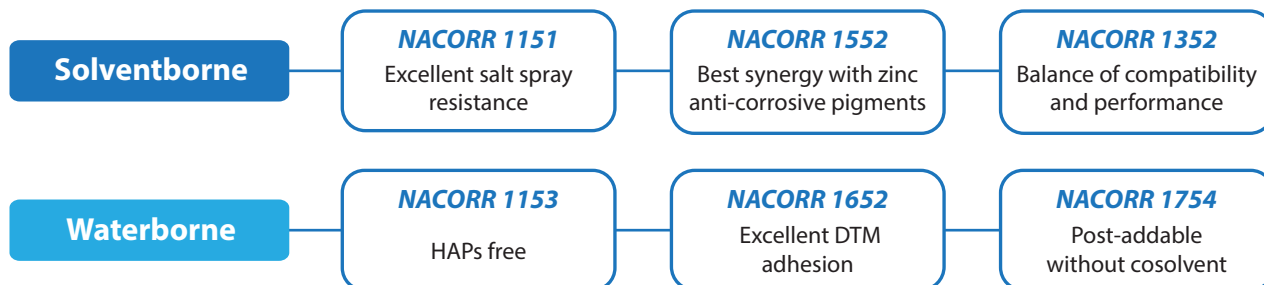
-  **Polar sulfonate group** - The polar sulfonate groups have a strong attraction to the metal substrate. This passivates the metal surface and prevents the formation of potential anodic sites.
-  **Hydrophobic tail** - The hydrophobic tail orients itself away from the metal substrate and prevents water from reaching it.



NACORR - Synergy with Anti-Corrosive Pigments

NACORR liquid organic corrosion inhibitors allow the formulation of anti-corrosive primers and direct to metal topcoats. Although they perform well on their own, NACORR products are also known for their synergy with anti-corrosive pigments to boost the salt spray resistance of the coating.

NACORR Selection Chart



NACORR Performance

Salt Spray, 500 Hour Performance
 Waterborne Acrylic Emulsion

Cleveland Humidity, 700 Hour Performance
 Baked Water Reducible Alkyd



Control



5% Anti-Corrosive Pigment (ACP)



5% ACP +
2% NACORR 1352



Control



ACP +
NACORR 1151



Formulators note Highly pigmented systems or pigments with high surface areas may require higher levels of NACORR.

Coating System

Best Practices: 2-4% on total weight

Solventborne

Post add with a mild mix or add to the mill base.

Water Reducible

With or without water
in the mill base

With Water: Post-add under high agitation, or if possible, remove water from base and add it to the letdown.

Without Water: Pre-mix NACORR, solvent and resin, and add 0.5 - 1.0% to the mill base. Add balance to letdown prior to any water addition.

Emulsions
Colloids
Dispersions

With or without
co-solvents or amines

No Co-solvent: Post-add under high agitation during letdown prior to adding water.

With Co-solvent: Pre-mix NACORR with coalescing solvent prior to addition. A typical ratio of 1:1 is recommended. Next add mixture under high agitation prior to any water addition.

With Co-solvent & Amines: Pre-mix NACORR with coalescent and amine. Add under high agitation prior to any water. A typical starting ratio for pre-mix: 50% NACORR, 45% coalescent and 5% amine by weight.

NACORR

Product	Metal / Sulfonate	Solvent	% Active	Attributes / Uses
1151	Barium	Mineral Spirits	50	Excellent performance in waterborne and solventborne systems. Best for low pH applications.
1352	Calcium	2-Butoxyethanol	50	Excellent in waterborne applications.
1389	Calcium	2-Butoxyethanol	45	Effective in both solventborne and waterborne coatings. Can be used in air dry and thermoset systems.
1389MS	Calcium	Mineral Spirits	45	Developed for 2K solventborne urethane systems.
1552	Zinc	2-Butoxyethanol	50	Excellent adhesion with outstanding performance in primers. Catalytic in amino crosslinked coatings.
1652	Magnesium	2-Butoxyethanol	50	Excellent adhesion with outstanding performance in waterborne primers.
1754	Amine	2-Butoxyethanol n-Butyl Alcohol	35	Excellent compatibility in water based systems, emulsions and dispersion.
4426	Sodium	Complex Polymer / Water	50	For waterborne emulsions. Effective on steel, galvanized steel and aluminum.

K-STAY 500 Series are pourable, liquid rheology modifiers based on unique sulfonate technology for pigmented and filled systems that need thermal anti-sag. Benefits include:

- Excellent anti-settle & anti-sag performance
- High gloss and gloss retention

- High efficiency - low use levels
- Ease of use - pourable liquids

Solvent Based Systems

K-STAY 555

General Purpose

K-STAY 501

Most Versatile

K-STAY 511

Low Dosage with TiO₂
High Gloss in Urethanes



Pourable liquid

Applications

2K urethane
Moisture cure
Bake finishes
Protective
Monocoat
General industrial



K-STAY 500 SERIES

	Product	Composition	% Active	Treat Rate	Attributes / Uses
SOLVENTBORNE	501	Overbased Calcium Sulfonate Light Aromatic Naphtha	50	0.5-3.0%	For solventborne systems, including polyester/melamine, acrylic/melamine, alkyd/melamine, 2K urethanes and epoxies.
	511	Sulfonate Light Aromatic Naphtha	50	0.5-2.0%	Ultra high efficiency in TiO ₂ containing paints. Excellent gloss in urethane formulations.
	555	Overbased Calcium Sulfonate Light Aromatic Naphtha - MS	57	0.5-2.0%	General purpose anti-sag and anti-settling for solventborne systems. Economical, efficient and easy to use.

Thermal Sag Control**Polyester/Melamine Bake**

Step gap applicator: 6-12mils
Cure schedule: 15 mins. @ 150°C

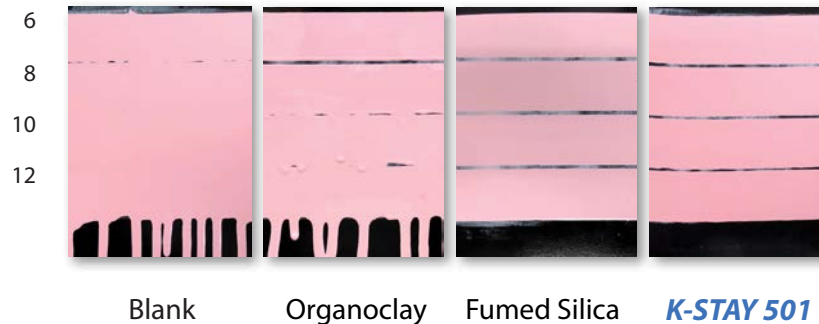
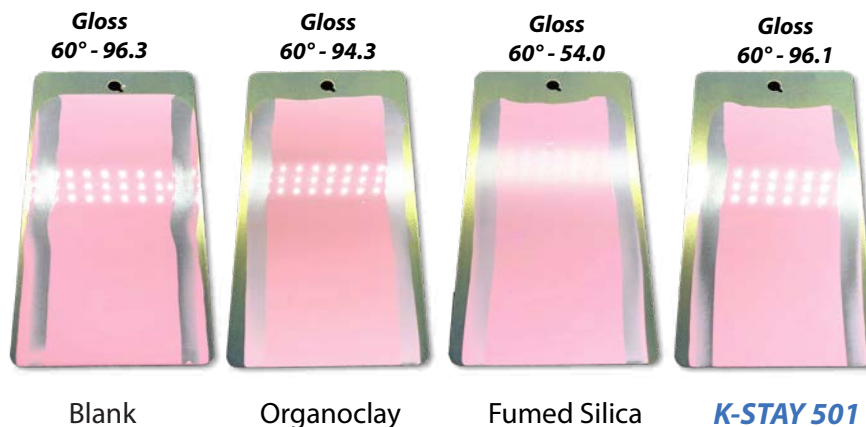
As shown in the photos to the right, K-STAY 501 and K-STAY 555 provide effective sag control at a 6-12mils film thickness of a polyester/melamine bake system.



K-STAY 501 was evaluated against other conventional rheology modifiers in a 2K polyurethane formulation. K-STAY 501 had the best sag control and the best gloss performance as shown below.

Sag Control**2K Polyurethane**

Step gap applicator: 6-12mils
Cure schedule: Force cure 30mins @ 80°C, 1 week ambient

**Gloss Performance**

Monomeric K-SPERSE dispersants are designed for use in non-aqueous systems. These easy to use liquid products are effective at 50% to 75% lower loading than other dispersants. They are particularly efficient at dispersing TiO₂ and iron oxides.

-  Low dosage
-  Cost effective
-  High efficiency

K-SPERSE

Product

Composition

% Active

Attributes / Uses

131

Calcium Sulfonate
Mineral Spirits

50

Use in formulas containing driers/accelerators including alkyds, urethanes and epoxies.

152

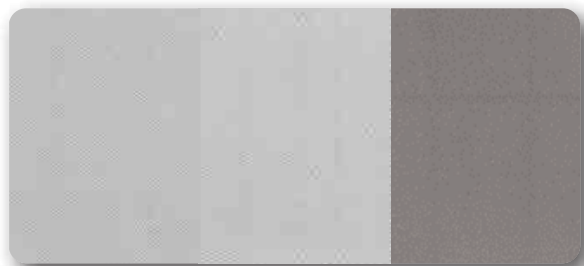
Zinc Sulfonate
2-Butoxyethanol

50

General purpose. Can be used at 1/3 to 1/2 the level of typical commercial dispersants. Synergist for competitive polymeric dispersants.

K-SPERSE 152 - Black Tint of a White Base

Black dispersions were prepared using K-SPERSE 152, a polymeric dispersant and an amphoteric dispersant to tint a white base to determine the color strength developed by each after milling in a steel ball mill.



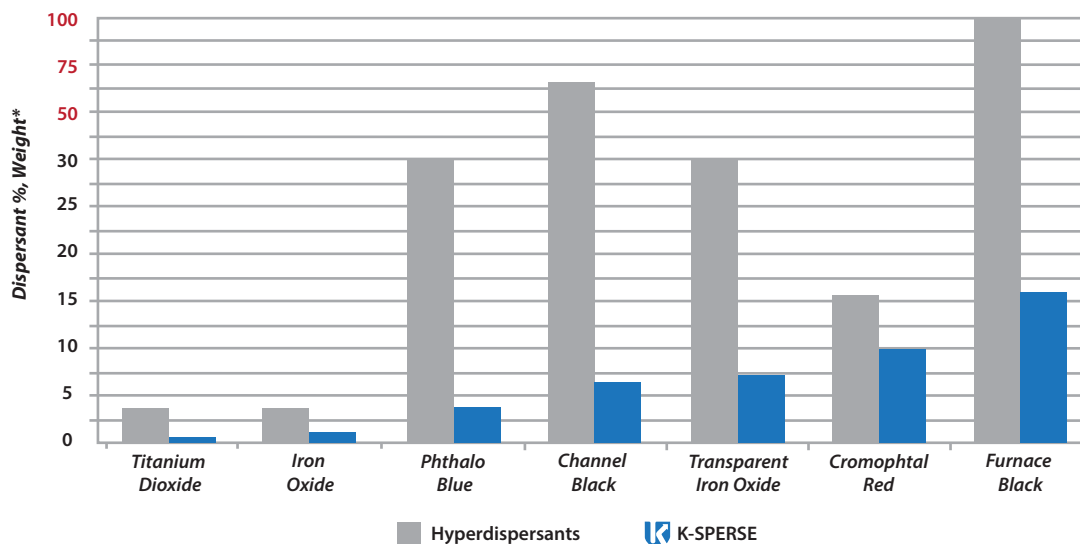
Amphoteric
Dispersant A

Polymeric
Dispersant B



Superior Color Development at Lower Dosages

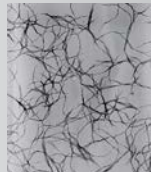
Comparison: Dispersant Weight % on Pigment



*Y-axis scale changes

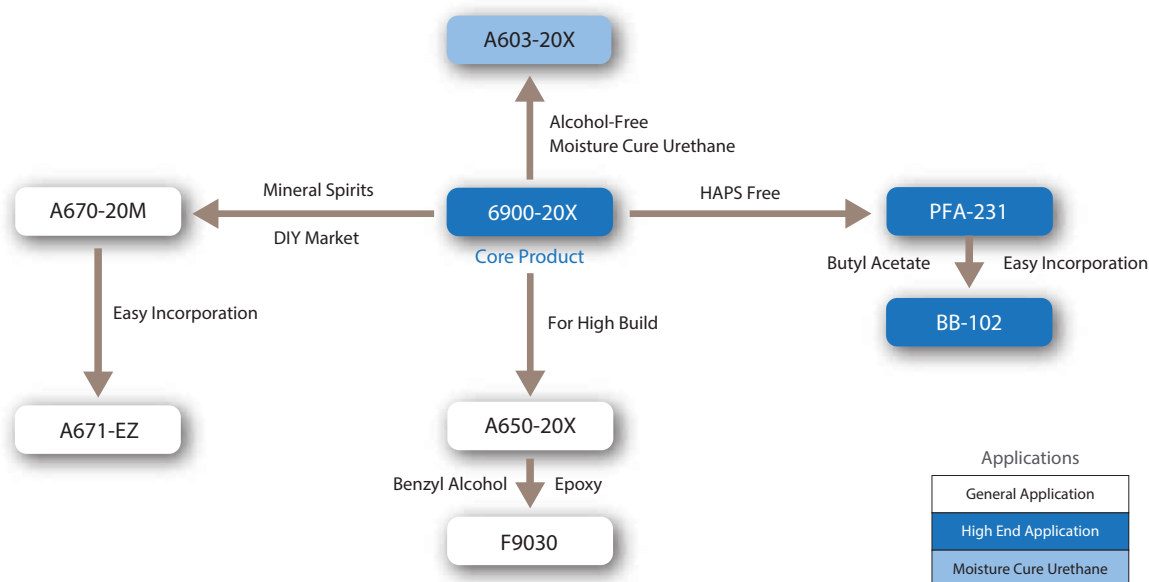
The **DISPARLON®** trade name is applied to a series of functional additives used in paint, ink, adhesive and sealant markets worldwide. Major product lines include thixotropes, dispersants and surface control agents. Proven over years of service, the DISPARLON line continues to expand and revolutionize the market.

DISPARLON Selection

Additive Type	Typical Attributes / Properties
Thixotropes Anti-Sagging Anti-Settling	DISPARLON thixotropes offer formulators a wide choice of unique products with performance benefits including: superior shear thinning, non-seeding, maximum anti-sag/anti-settling, excellent stability on aging and superior performance in high gloss systems.    Pre-activated type 6900-20X Polyolefin type 4200-10 Hybrid type NS-5500
Leveling Anti-Cratering Wetting	Surface control agents are based on a specially prepared acrylic, silicone and acrylic silicone copolymers. These additives are ideal for industrial coatings and offer excellent recoatability.
Defoaming Anti-Popping	Additives designed to eliminate entrapped air and improve gloss and clarity, while preventing pinholes and craters. Available for air dry and baked systems.
Dispersants	A series of additives designed to improve color strength and gloss, prevent flocculation, reduce grinding time and reduce or eliminate flood and float problems.

DISPARLON® Pre Activated Thixotropes

For Solventborne & Solventless Systems



Product	Volatile	Active	Additive Level (Total Formula Weight)	Application
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Pre-activated Polyamide

6900-20X	Xylene, alcohol	20% Paste	0.5-5.0%	General purpose. Best gloss in thin films & clears or with metallic and pearlescent pigments.
A603-20X	Xylene	20% Paste	0.5-5.0%	Moisture cure urethane systems.
A650-20X	Xylene, alcohol	20% Paste	0.5-5.0%	Primers and industrial maintenance coatings. Best efficiency in thick films.
A670-20M	Mineral spirits, alcohol	20% Paste	0.5-5.0%	DIY and industrial stains for good anti-settling of pigments. DIY varnishes for suspension/spacing of flattening silica.
A671-EZ	Mineral spirits, alcohol	10% Soft Paste	0.5-5.0%	Easier to use version of A670-20M.
BB-102	Butyl acetate, alcohol	10% Soft Paste	1.0-6.0%	Pourable paste. Post addable. HAPS free. For best overall appearance and easiest incorporation.
F-9030	Benzyl alcohol	30% Paste	0.4-4.0%	100% solids epoxy systems and epoxy floor paints.
PFA-231	Hydrocarbon, alcohol	20% Paste	0.5-5.0%	HAPS-free version of 6900-20X.

Product	Composition	Volatile	Active	Additive Level (Total Formula Weight)	Application
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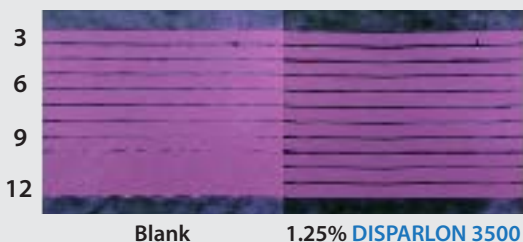
Pigment Dependent

3500	Polyether phosphate	-	100% Liquid	0.5-2.0%	Zero VOC liquid thixotrope. 2K PU. Highly filled systems.	NEW Pourable
4200-10	Oxidized polyolefin	Xylene	10% Flowable Paste	1.0-5.0%	Metallic orientations and anti-settling for industrial systems.	
4200-20	Oxidized polyolefin	Xylene	20% Paste	0.3-1.0%	Anti-settling for all non-aqueous pigmented systems.	
NS-30	Hybrid oxidized polyolefin with polyamide	Xylene	15% Paste	1.0-5.0%	For polyamide side of 2K epoxy maintenance coatings. Anti-sag/anti-settle.	
NS-5500	Hybrid oxidized polyolefin with polyamide	Solvent naphtha, Alcohol	7% Flowable Paste	3.0-8.0%	Post addable. Improved flip/flop with metallics and orientation and anti-settling of flattening silica and inorganic pigments.	NEW Pourable
F-9050	Hybrid oxidized polyolefin with polyamide	Low volatility Diluent	20% Paste	1.0-5.0%	Solvent-free anti-sag and anti-settling agent for 100% solids systems	

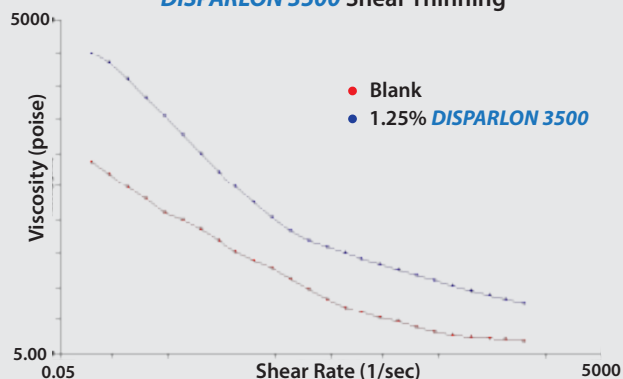
New Thixotropes

DISPARLON® 3500 is a zero VOC liquid thixotrope for pigmented systems. It associates with the pigment and fillers contained in a formulation at dosage levels in the range of 0.5 to 2.0% to improve sag control and rheological properties. DISPARLON 3500's key benefits include ease of use, excellent sag resistance, strong KU response in highly filled formulations, excellent shear thinning and high gloss.

DISPARLON 3500 Sag Resistance



DISPARLON 3500 Shear Thinning



Aluminum Metallic (Alpaste 7620NS [TOYO])

Anti-settling Test: 7 Days
(Viscosity: 17 sec #4 Ford)



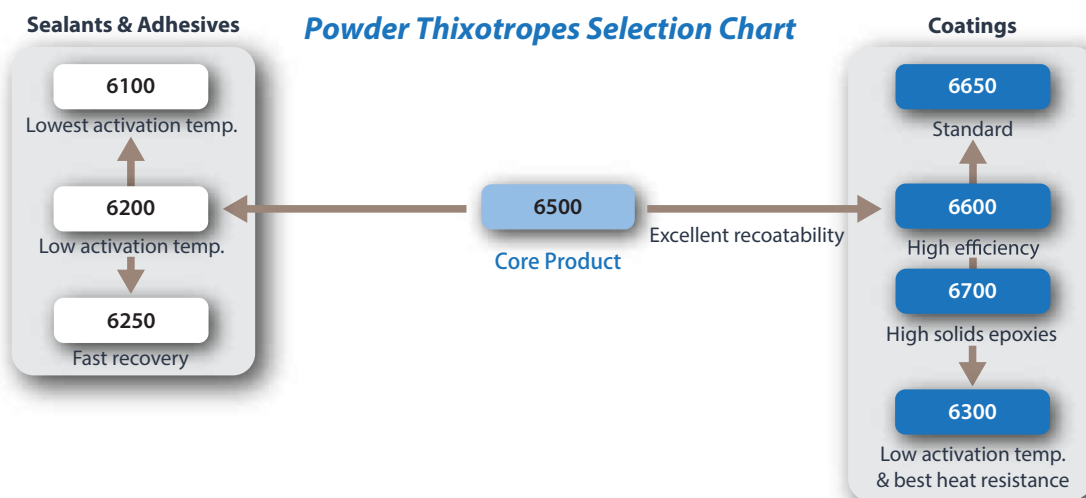
Pigment Orientation



DISPARLON NS-5500 is a hybrid thixotropic agent based on a combination of unique technologies and is supplied as a free flowing paste. Since it is pre-activated, this product can be easily post-added for immediate effects without having to make a master-batch. DISPARLON NS-5500 enables uniform pigment orientation with good gloss, particularly on vertical surfaces because of the uniform extension of its thixotropic structure throughout the coating film. This product is especially effective for anti-settling and orientation of aluminum and mica pigments.

DISPARLON® Powder Thixotropes

For Solventborne & Solventless Systems



Product	Activation Temp.	Active	Additive Level (Total Formula Weight)	Application
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Powder Polyamide

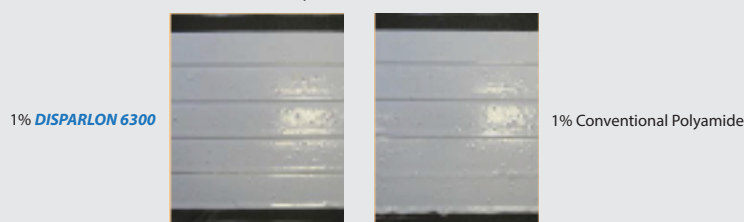
6100	30°C-60°C	100% Powder	0.5-3.0%	Sag/slump control. Lowest activation temperature. Designed specifically for MMA, adhesives and sealants.
6200	40°C-80°C	100% Powder	0.5-3.0%	Sag/slump control. Low activation temperature. Designed specifically for adhesives and sealants.
6250	60°C-80°C	100% Powder	0.5-3.0%	Low activation temperature for silicone, urethane and MS sealants. NEW
6300	50°C-80°C	100% Powder	0.5-2.0%	Low activation temperature. Best sag control when applied to hot surfaces. 100% solids epoxy coatings and adhesives. NEW
6500	60°C-90°C	100% Powder	0.5-2.0%	Sag control. Most versatile. General purpose coatings and sealants.
6600	60°C-70°C	100% Powder	0.5-2.0%	Sag control with improved recoatability for coatings, such as epoxy primers.
6650	60°C-70°C	100% Powder	0.5-2.0%	Cost effective sag control with improved recoatability for coatings, such as epoxy primers.
6700	60°C-70°C	100% Powder	0.5-2.0%	Sag control in heavy-duty paints. Particularly effective in 100% solids epoxies and epoxies containing polar solvents.

New Thixotropes

DISPARLON® 6300 is a powdered thixotropic agent based on amide wax for heavy duty paints. Being 100% active, this product is favorable not only in cost/performance, but because it offers excellent recoatability. This product activates so easily that it finds applications in a wide variety of formulations. DISPARLON 6300 typically activates at 10°C less than conventional polyamide thixotropes.

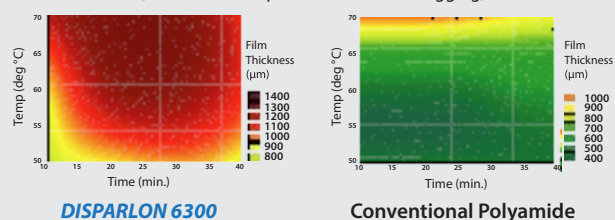
High Solids Epoxy Primer - High Temperature Substrate

Paint Temp: 32°C/Substrate: 50°C



Time vs. Temperature vs. Sagging

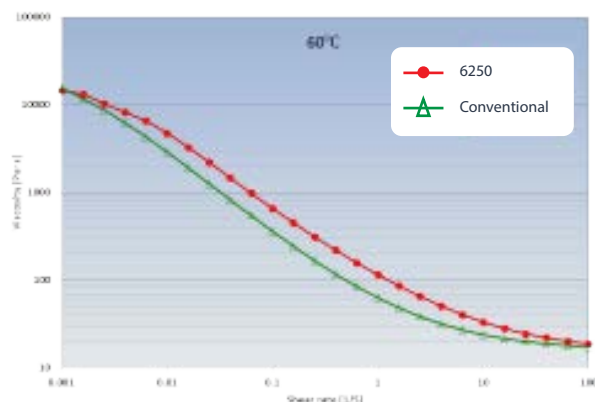
(Thicker Films Equate to Better Anti-sagging)



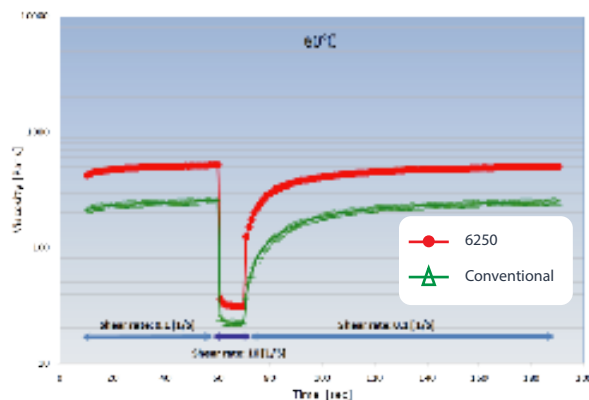
New Thixotropes

DISPARLON® 6250 is a powdered thixotrope based on amide wax for silicone, urethane and polysulfide MS sealants. This product is 100% active and activates at low temperatures of 60°C-80°C for excellent slump resistance, shear thinning and strong structure recovery.

MS-Polymer S-203 / Flow Curve



MS-Polymer S-203H / Viscosity Recovery

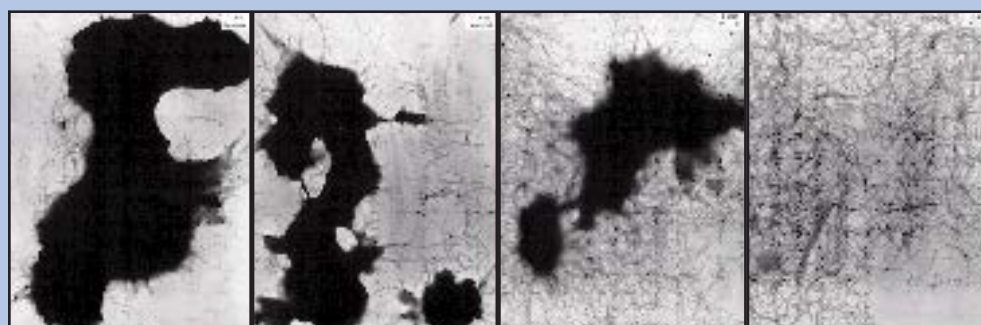


Activation of Powder Thixotropes

The polyamide powder thixotropes need to be activated (swelled and dispersed) in the system. Add the powder to the pigment grind portion of the formulation. While grinding the pigments, allow the temperature of the grind to rise to the temperatures shown in the selection chart below. Once at the “activation temperature” continue to grind for 15 minutes to get full activation of the polyamide. After activating the polyamide, it is generally best to mix slowly during the first 20°C of cool down. The slow mixing during cool down will give the system the most uniform and reproducible rheology.

Please note, these materials will activate at lower temperatures than shown in the chart when in the presence of alcohols or amines, due to increased hydrogen bonding.

Thixotrope Structure vs Dispersing Temperature



Not Activated

Begin Activation

Activation

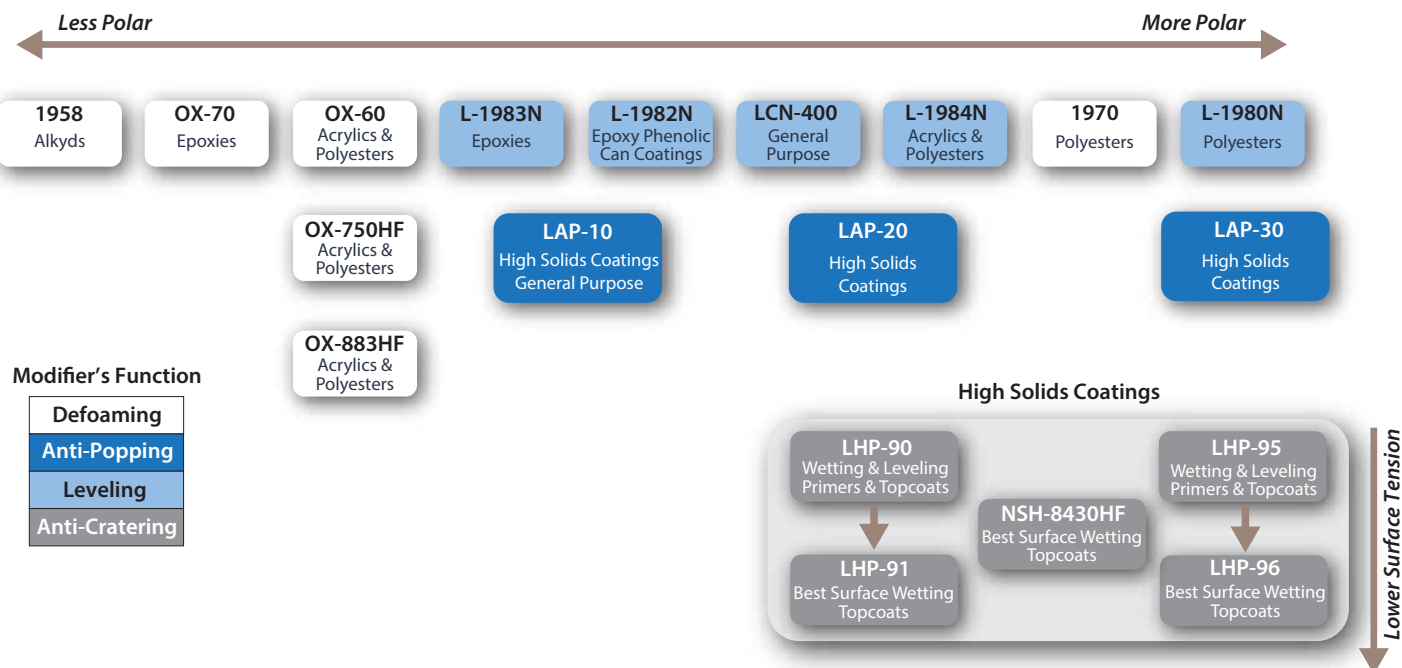
Fully Activated

	Not Activated	Begin Activation	Activation	Fully Activated
Solvent Epoxy	20-35°C	35-50°C	50-60°C	60-80°C
Solvent-Free Epoxy	20-40°C	40-60°C	60-70°C	70-90°C
Curing Agent	<20°C	20-30°C	30-40°C	40-60°C

DISPARLON®

Leveling / Anti-cratering / Wetting
For Solventborne & Solventless Systems

Surface Tension Modifiers Selection Chart



Product	Volatile	Active	Additive Level (Total Formula Weight)	Application
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Leveling

1958	Mineral spirits	20% Liquid	0.2-1.0%	For use with long oil alkyds.
1970	Xylene, mineral spirits	40% Liquid	0.2-1.0%	Baking systems, automotive, coil.
L-1980N	-	100% Liquid	0.2-1.0%	Polyesters, can, coil. Complies with FDA 21 CFR*.
L-1982N	-	100% Liquid	0.2-1.0%	Epoxy phenolic can coatings.
L-1983N	-	100% Liquid	0.2-1.0%	Epoxy coatings. Complies FDA 21 CFR*
L-1984N	-	100% Liquid	0.2-1.0%	Most versatile. Acrylic & polyester based coatings. Automotive coatings. Complies FDA 21 CFR*
LCN-400	Butyl acetate	50% Liquid	0.2-1.5%	General purpose, cost effective, easy to use.

* FDA 21 CFR Section 175.300 (b) (3) xii & xiii (a&b)

Product	Volatile	Active	Additive Level (Total Formula Weight)	Application
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Anti-Cratering and Leveling

LHP-90	Solvent naphtha, Ethyl acetate	50% Liquid	1.0-2.0%	Excellent substrate wetting and leveling. Eliminates surface defects. Silicone free. Auto refinish and industrial coatings.
LHP-91	Solvent naphtha, Ethyl acetate	50% Liquid	1.0-2.0%	Silicone modified version of DISPARLON® LHP-90.
LHP-95	Solvent naphtha	50% Liquid	1.0-2.0%	Excellent substrate wetting and leveling. Eliminates surface defects. Silicone free. Auto refinish and industrial coatings.
LHP-96	Solvent naphtha	50% Liquid	1.0-2.0%	Silicone modified version of DISPARLON LHP-95.
NSH-8430HF	Solvent naphtha, Butyl acetate	10% Liquid	0.5-2.0%	Silicone acrylic copolymer. Excellent wetting and leveling with good recoatability. Primers and top coats. Bake systems.

Defoaming and Anti-Popping

LAP-10	Solvent naphtha, Butyl acetate	20% Liquid	0.5-2.0%	All high solids systems. Select based on coating polarity. Coil coatings.
LAP-20	Butyl acetate	20% Liquid	0.5-2.0%	All high solids systems. Select based on coating polarity. Intermediate polarity coatings.
LAP-30	Butyl acetate	20% Liquid	0.5-2.0%	All high solids systems. Select based on coating polarity. Intermediate polarity coatings.
OX-60	Xylene	50% Liquid	0.2-1.0%	Ambient cure and bake finishes. Acrylic and polyester coatings. Excellent in urethane coatings.
OX-70	Toluene, mineral spirits	30% Liquid	0.2-1.0%	Epoxy coatings. Ambient cure.
OX-750HF	Solvent naphtha	10% Liquid	0.5-1.5%	Acrylic and polyester coatings. Bake coatings. Automotive. HAPS free.
OX-883HF	Solvent naphtha	30% Liquid	0.2-1.5%	Acrylic and polyester coatings. Bake coatings. Automotive. HAPS free.

UV Additives

UVX-188	-	100% Liquid	0.1-2.0%	For use in cationic epoxy based UV systems.
UVX-189	-	100% Liquid	0.1-2.0%	General purpose. For use in cationic epoxy and acrylic based UV systems.
UVX-190	-	100% Liquid	0.1-2.0%	For use in acrylic based UV systems.
UVX-35	-	100% Liquid	0.1-2.0%	For use in highly polar UV systems.
UVX-36	-	100% Liquid	0.1-2.0%	For use in acrylic UV systems.

Product	Volatile	Active	Additive Level (Total Formula Weight)	Application
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Dispersants

DA-325	-	100% Liquid	1.0-20% (In-organic pig)	Solvent-free. Dispersing of organic pigments.
DA-375	-	100% Liquid	30-100% (Organic pig)	Solvent-free. Dispersing of organic pigments.

NEW

Anti-Flood / Anti-Float

KS-273N	Xylene	45% Liquid	0.4-1.2%	Mixed organic and inorganic pigments. Prevents flocculation and flood/float.
KS-873N	Xylene	47% Liquid	0.2-1.0%	Mixed organic and inorganic pigments. Prevents flocculation and flood/float.

New Dispersants & Flood/Float Additives

DISPARLON® DA-325 is a solvent free wetting and dispersing agent based on an amine salt of polyether phosphate, designed for dispersing pigments in solvent free coating systems. It is particularly effective when used with filler and inorganic pigments.

DISPARLON DA-375 is a solvent free wetting and dispersing agent, based on polyether phosphate ester. DISPARLON DA-375 is effective in decreasing viscosity in coating systems that are highly filled with pigments or fillers.

Pearl Pigment Wetting

IRIODIN 121 [MERCK] 10.0
Xylene 11.5 Dissolver: 1,000rpm-5min.
DA-325/DA-375



BLANK

DA-325

DA-375

The **DISPARLON®** trade name is applied to a series of functional additives used in paint, ink, adhesive and sealant markets worldwide. Major product lines include rheology modifiers, dispersants and surface control agents.

DISPARLON Selection

Additive Type	Typical Attributes / Properties
Rheology Modifiers Anti-Sagging Anti-Settling	A range of anti-settling, anti-sagging and pigment orientation agents which are recommended for use in coatings, inks, varnishes and stains. They are extremely shear thinning, which allows for easy application by spray, dip, brush or roller, while maintaining excellent anti-settling in the container.
Dispersants	The AQ series of dispersants are designed for a variety of hard to disperse pigments. DISPARLON AQ-320 and AQ-330 are especially recommended for pearlescent and metallic pigments, while DISPARLON AQ-380 was designed for dispersing carbon black and other organic pigments.
Defoaming Anti-Popping	A variety of additives designed to eliminate entrapped air and improve gloss and clarity, while preventing pinholes. Available for air dry and baked systems.
Leveling Anti-Cratering Wetting	A group of surface control agents based on a specially prepared acrylic, silicone and acrylic silicone copolymers. These products have the unique ability to eliminate cratering caused by various kinds of surface contaminants and spray mists.

The **DISPARLON® AQ Series** of polyamide associative rheology modifiers is designed to suspend dense materials such as metallic, pearlescent and iron oxide pigments, while maintaining low “in can” viscosity and good sag resistance. New products have been developed to improve ease of incorporation and performance properties.

Product	Volatile	Active	Additive Level (Total Formula Weight)	Application
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Acrylic Rheology Modifier

AQ-001	Water, Dimethylethanolamine	15% Liquid	0.5-5.0%	Post addable, highly thixotropic NEW
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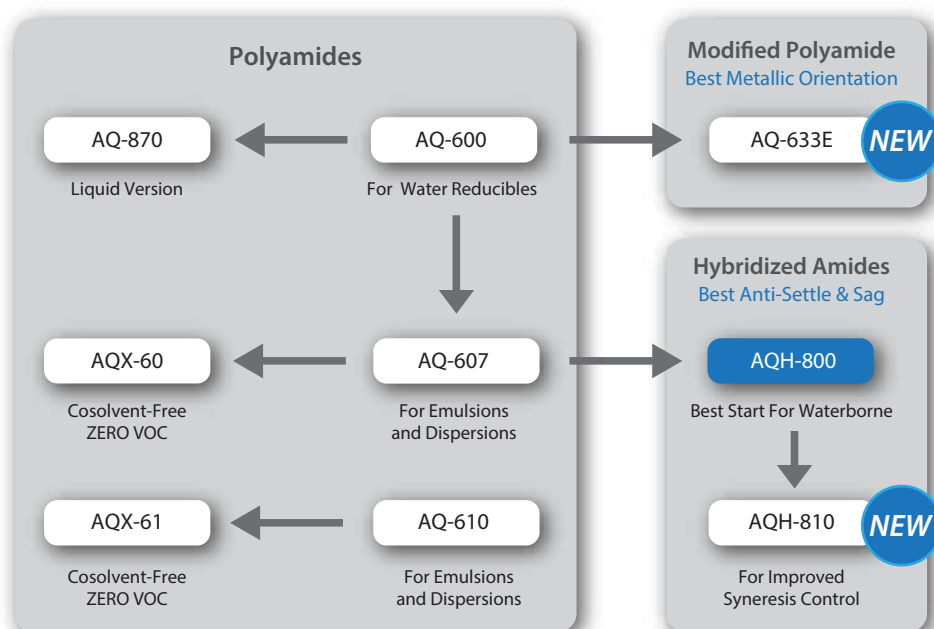
Polyamide Rheology Modifiers

AQ-600	Water, Propylene glycol monomethylether	20% Gel	1.0-5.0%	Water reducible systems Also available as a liquid - AQ-870
AQ-607	Water, Propylene glycol monobutylether	15% Gel	1.0-5.0%	Emulsions and dispersions, best compatibility, excellent efficiency Also available as ZERO VOC - AQX-60
AQ-610	Water, Propylene glycol monomethylether	15% Gel	1.0-5.0%	Emulsions and dispersions Also available as ZERO VOC - AQX-61
AQ-633E	Water, Propylene glycol monomethylether	22.5% Soft Gel	1.0-5.0%	Best metallic and pearlescent pigment orientation, post addable NEW

Hybrid Rheology Modifiers

AQH-800	Water, Propylene glycol monomethylether	10% Soft Gel	1.0-5.0%	First recommendation for all waterborne, anti-settle/anti-sag, post addable, easiest to use
AQH-810	Water, Propylene glycol monomethylether	15% Soft Gel	1.0-5.0%	AQH-800 with enhanced syneresis control, post addable NEW

Amide Selection Tool



DISPARLON AQH-800 is an easy to use rheology control additive based on hybridized amide technology developed for waterborne systems. It forms unique needle-like structures within the formulation, which provides excellent sag control and prevents pigment settling and hard cake development.

DISPARLON AQH-800 is ideal for coatings requiring good pigment suspension, while maintaining a low "in-can" viscosity.

AQH-800 Performance: Shear Thinning, Salt Spray, Anti-Sag, Anti-Settle

Shear Thinning

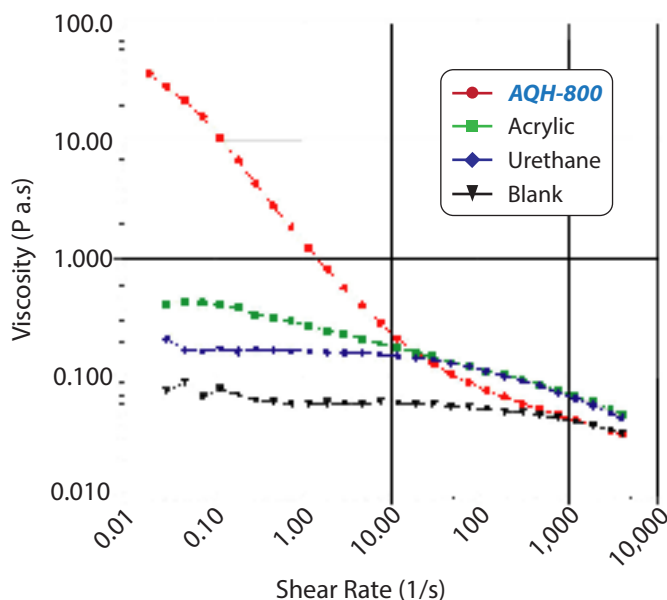
DISPARLON AQH-800 imparts an excellent thixotropic effect without a large increase in viscosity, making it unique when compared to other rheology control agents. AQH-800 is also extremely high shear thinning which allows for easy application by spray, dip, brush or roller, while maintaining excellent pigment suspension within a container.

Anti-Sag & Anti-Settle

The photos below demonstrate the excellent anti-sagging and long-term anti-settle performance of DISPARLON AQH-800 compared to other modifier types. Typical dosage is 2-3% on total formula weight.

Shear Thinning

NeoCryl XK-98 DSM Neo Resins
Viscosity: FC#4 27 sec. (25°C)



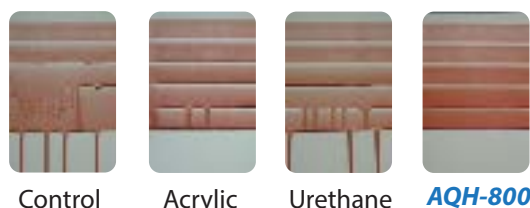
Anti-Settle Comparison - 1 Week at 50°C

1K Self-Crosslinking Wood Coating - NeoCryl XK-98
Application Viscosity: FC#4 27 sec. (25°C)



Anti-Sagging Comparison

1K Self-Crosslinking Wood Coating - NeoCryl XK-98
Application Viscosity: FC#4 27 sec. (25°C)

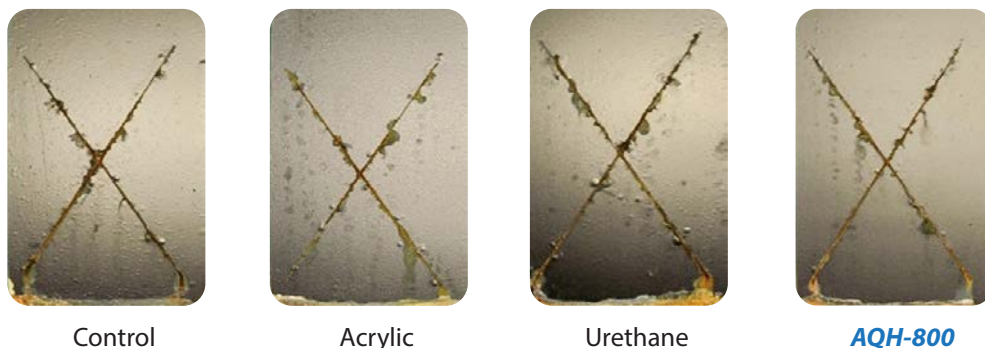


Salt Spray

The photos below demonstrate salt spray performance and hydrophobic nature of DISPARLON AQH-800 compared to other rheology modifiers.

Anti-Corrosion Comparison - 2 Weeks

2K Epoxy-amine Anti-corrosive Primer - Substrate: SPCC-SD
Dry Film Thickness: 50µm



DISPARLON® AQ-300 series of dispersants are specifically designed to aid in the dispersion of metallic and pearlescent and carbon black and other organic pigment types.

SELECTION GUIDE (DISPERSANTS for Waterborne Systems)															
PIGMENTS	Aluminum	Pearl	Carbon Black	Quinacridone Magenta	Phthalocyanine Blue	Phthalocyanine Green	Isoindolinone Yellow	Red Iron Oxide	Titanium Oxide (TiO ₂)	Zinc Oxide (ZnO)	Talc	Barium Sulfate (BaSO ₄)	Calcium Carbonate (CaCO ₃)	Barium Titanate (BaO ₃ Ti)	Alumina (Al ₂ O ₃)
															
PRODUCTS															
AQ-320															
AQ-330															
AQ-380															

 Strongly Recommend  Recommend

Product	Volatile	Active	Additive Level (Total Formula Weight)	Application
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Polyester Phosphate

AQ-320	-	100%	1.0-2.0% (In-organic pigment), 30-100% (Organic pigment)	Pearlescent & metallic pigment dispersions made with cosolvent such as butyl glycol
AQ-330	-	100%		Pearlescent & metallic pigment dispersions made without cosolvent

Acrylic Polymer

AQ-380	Propylene glycol monomethylether	30%	3.0-30% (In-organic pigment), 40-130% (Carbon black / Organic pigment)	Specifically designed to disperse carbon black and organic pigments in waterborne formulations
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Dispersion of Aluminum Paste Waterborne Basecoat



Blank



DISPARLON
AQ-330

Dispersion of Pearlescent Paste Waterborne Basecoat



Blank



DISPARLON
AQ-320

Product	Volatile	Active	Additive Level (Total Formula Weight)	Application
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Vinyl Polymer

AQ-501	2-ethylhexyl alcohol, Mineral Oil	85%	0.3-1.0%	Anti-popping agent for waterborne bake systems
AQ-7533	Hydrocarbon, 2-ethylhexyl alcohol	30%	1.0-3.0%	Universal defoamer and anti-popping agent for all types of waterborne coatings

Defoaming Performance

Blank

With **DISPARLON***Leveling / Anti-Cratering / Wetting*

Product	Volatile	Active	Additive Level (Total Formula Weight)	Application
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Polyether Modified Silicone

LS-430	Propylene glycol monomethylether acetate	50%	0.03-1.0%	Wetting and leveling, wood, plastic, general industrial
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Acrylic

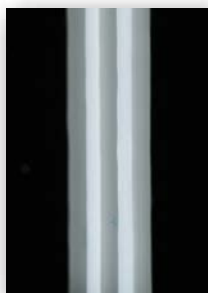
AQ-200	Butyl cellosolve	20%	0.3-1.0%	Leveling with good recoatability, bake and air dry coatings
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Silicone Acrylic Copolymer

AQ-7120	2-Ethylhexyl alcohol	30%	0.5-1.5%	Excellent wetting, leveling with excellent recoatability
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Leveling Performance

Blank

With **DISPARLON**

Blank

With **DISPARLON**



ADDITIVES & TECHNICAL SERVICE

**MELAMINE
CATALYSTS**

**URETHANE
CATALYSTS**

**EPOXY
CATALYSTS**

**PHENOLIC
CATALYSTS**

**SILANE
CATALYSTS**

**RESIN
MODIFIERS**

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