BASF
The Chemical Company

Innovative Solutions
for Transportation Coatings

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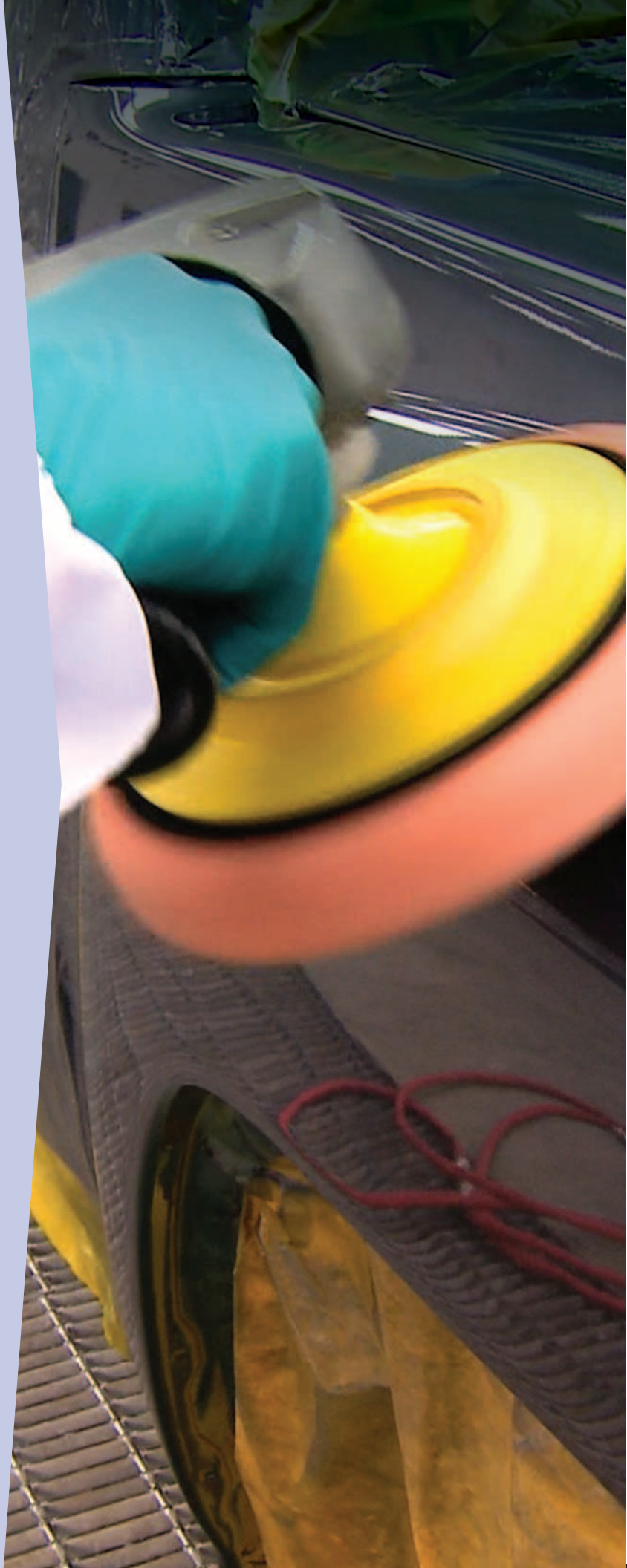


BASF Innovative Solutions for Transportation Coatings

A comprehensive product portfolio

BASF offers single source, end-to-end solutions for the automotive and transportation coatings industry. Thanks to the diversity in product and application expertise, depending on customer needs, we can deliver a wide range of resins, pigments, functional additives, curing agents, rheology modifiers and light stabilizers.

BASF coatings materials help enhance the quality, appearance, heat management and durability of all exterior and interior vehicle coatings, from cars, trucks and trains to aircraft. For example, Joncryl® resins and Basonat® crosslinkers increase the functional performance of the coating. In addition, Heliogen®, Irgazin®, Lumina®, Paliocrom® and others from our broad range of pigment solutions provide not only innovative coloristic properties but also enable dazzling surface effects such as metallic or pearlescent finishes. Tinuvin® light stabilizers are used to improve the durability of primers, basecoats and clearcoats exposed to weathering and other natural degrading factors. Efka® additives such as dispersants, rheology modifiers or flow and leveling agents ensure the protection of the aesthetic quality of coatings on a variety of substrates, as well as help optimize production processes and reduce costs.

Exclusive process for acrylic polyols production

BASF produces a line of Joncryl acrylic polyols through an exclusive process of solid grade oligomer (SGO) polymerization. The SGO process is a high temperature, high pressure, continuous process that yields products with a high degree of reproducibility and narrow molecular weight distribution. This means that BASF-supplied products are more consistent, easier to apply, and have a higher performance capability than those produced by standard batch polymerization.

The SGO process allows the production of polyols at nearly 100% solids, free from reaction solvent variations typically found with conventionally produced polyols. The SGO polyols can subsequently be cut in non-exempt or exempt solvents, without concern for changes in performance properties.

Joncryl polyols can be used in a variety of transportation-related applications that meet stringent performance requirements with good appearance and ease of application, repair and maintenance. Relevant properties are described including dry times, chemical and weathering resistance. When combined with the Basonat line of aliphatic isocyanates, Joncryl polyols become preferred choices for automotive primers, sealers/surfacers, clearcoats and single stage topcoats for refinish and other transportation applications.

BASF Innovation:

Joncryl® Rapid Property Development (RPD) Polyols

Joncryl RPD 950-AC/P and Joncryl RPD 980-B are high-solids acrylic polyols with rapid property development for solvent-borne 2K polyurethane systems in general transportation and automotive refinishes.

Key Features and Benefits

- Balance of early hardness, fast cure and long pot life
- Excellent exterior durability
- Exceptional flow and leveling properties
- Early buffability
- Water-white appearance
- Superior clarity and DOI
- Excellent gloss
- Supplied in VOC exempt solvents, low VOC capability (2.1 lbs/gal)

Table 1. Joncryl RPD Starting Point Formulations

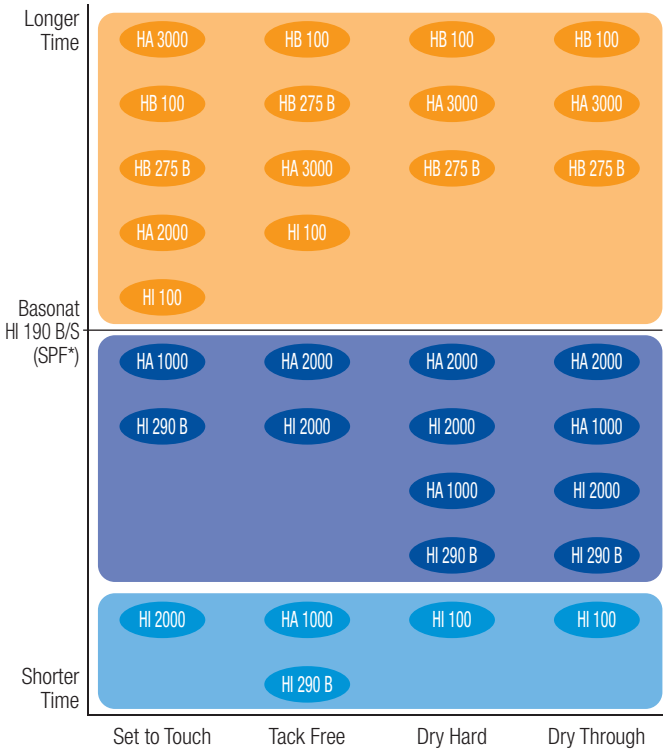
Material	Pounds (Wt %)	(Wt %)
Part A		
Joncryl RPD 950-AC/P	38.37	-
Joncryl RPD 980-B	-	56.75
Acetone	12.53	-
MAK	6.36	20.31
n-Pentyl Propionate	3.23	-
PCBTF	13.85	-
Tinuvin® 5151	0.63	-
Efka® FL 3670	0.08	0.08
1% DBTDL in acetone	1.25	-
Part B		
Basonat® HI-190 B/S	10.89	-
Basonat HI-100		22.86
PCBTF	12.89	-

Joncryl RPD 950-AC/P is recommended for the following applications:

- Interior/exterior automotive
- Interior/exterior refinish primer surfacer
- Interior/exterior fast cure metal coatings
- Interior/exterior plastic coatings

Compared to Joncryl RPD 950-AC/P, Joncryl RPD 980-B provides longer set to touch and tack free times, making it an ideal choice for coating larger surfaces.

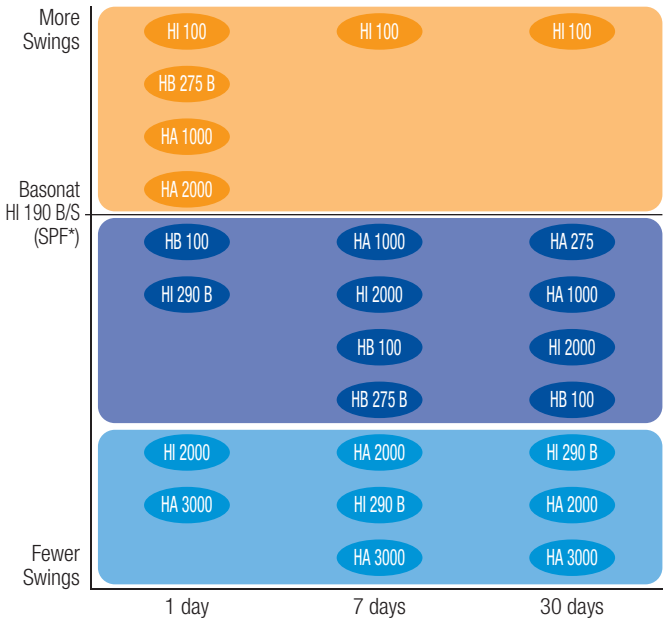
Effect of hardener selection on dry times for RPD-based coatings



* Starting Point Formulation

Figure 1. Dry times of coating formulations containing Joncryl RPD 950-AC/P crosslinked with a variety of Basonat hardener resins.

Effect of hardener selection on hardness development for RPD-based coatings



* Starting Point Formulation

Figure 2. Hardness development (König swings) for coating formulations containing Joncryl RPD 950-AC/P crosslinked with a variety of Basonat hardener resins.

Choice of Hardener

Figures 1 and 2 display performance properties of Joncryl® RPD 950-AC/P crosslinked with selected Basonat® isocyanate hardeners. For example, using Basonat HA 3000 as the hardener resin leads to a coating with longer sand and buff times ("set to touch" time) than the Basonat HI 190-based starting point formulation. However, a shorter "dry through" time indicates that the coating is completely cured in less time than the starting point formulation. In Figure 3, pot lives are plotted for RPD-based coating formulations with various crosslinkers from BASF portfolio. Appropriate selection ensures a pot life in the range between 80 minutes and 140 minutes.

Effect of hardener selection on pot life for RPD-based coatings

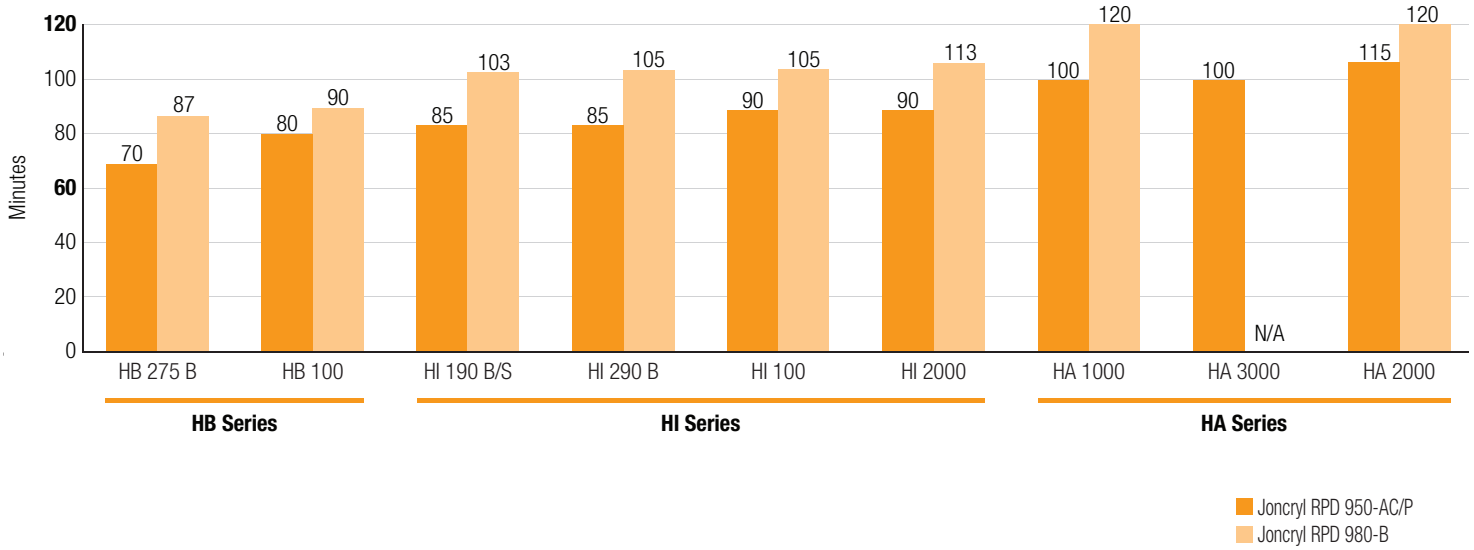


Figure 3. Pot life comparison of coating formulations containing Joncryl RPD 950-AC/P and various Basonat isocyanate crosslinkers.

Basonat Isocyanate Crosslinkers

Old Name	New Name
Basonat LR 9046	Basonat HI 2000
Basonat HA 100	Basonat HA 1000
Basonat HA 200	Basonat HA 2000
Basonat HA 300	Basonat HA 3000

Resins Cure Profiles and Hardness Development

BASF leverages “fast cure” and “fast hardness” technologies into the auto refinish market. Figure 4 demonstrates the advantage that fast cure technology brings to building early hardness development.

Using the SGO process, BASF has developed a new class of polyols with rapid property development (RPD) for solvent-borne 2K polyurethane systems. Crosslinked with BASF aliphatic isocyanates such as Basonat® HI 100 or Basonat HI 190 B/S, these polyols provide fast cure with early hardness development and a long pot life. The ultimate balance between dry times and pot life is achieved as demonstrated for selected products in Figure 5 and Table 2.

Joncryl® RPD 950-AC/P polyol’s exceptionally short dry times make it an ideal choice for spot repairs in auto refinish.

Hardness development for selected Joncryl polyol

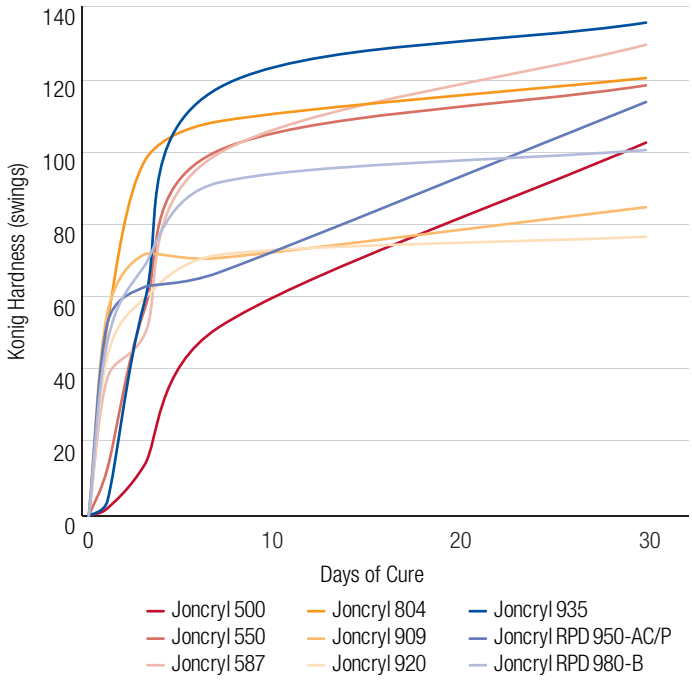


Figure 4. König hardness at 25°C and 50% relative humidity.

Dry times for fast cure and RPD technologies

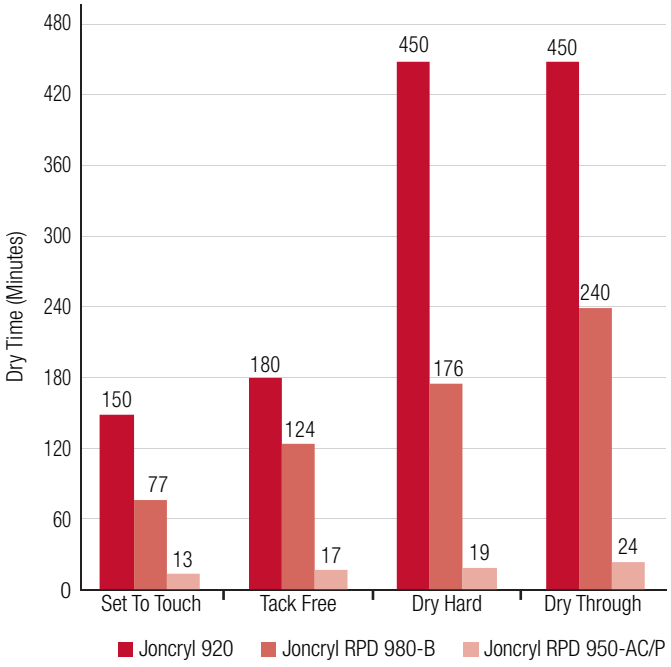


Figure 5. Gardner dry times at 25°C.

Low VOC Capability

Joncryl polyols for solvent-borne coatings are designed to ensure compliance with government VOC regulations and ingredient restrictions. BASF offers conventional (Joncryl 550) and low VOC (Joncryl 500, Joncryl 920) products, as well as exempt solvent versions (acetone, PCBTF, t-butyl acetate).

Table 2. Pot life and dry times for selected Joncryl® polyols. Note advantage of RPD technology in reducing the common tradeoff between these properties.

Product	Pot Life (hours)	Dry Hard (hours)	Dry Through (hours)
Joncryl 500	2.0	21.4	24
Joncryl 550	8.0	11.1	20.2
Joncryl 920	2.0	7.5	7.5
Joncryl RPD 950-AC/P	1.4 (85 minutes)	0.3 (19 minutes)	0.4 (24 minutes)
Joncryl RPD 980-B	1.8 (105 minutes)	2.9 (176 minutes)	4.0 (240 minutes)

Figure 6. Comparison of VOC levels for various Joncryl acrylic polyols. Takes into consideration the effect of exempt solvents.

* Measured for low viscosity clear coat formulations.

Weathering Profiles of Joncryl® Resins

Joncryl 935, Joncryl RPD 950-AC/P and Joncryl RPD 980-B provide superior weathering performance and are ideally suited for high durability, exterior coatings.

Testing as shown in Figures 7 - 10 was conducted without light stabilizers in the formulation. Florida panels were exposed for 3.5 years at 45°. Weathering performance of BASF polyols can be greatly enhanced when used in conjunction with the Tinuvin® line of UV light stabilizers.

Recommended light stabilizer package* for solvent-borne clearcoats:

1-3% UVA - Tinuvin 384-2 or Tinuvin 400
plus
1-2% HALS - Tinuvin 123 or Tinuvin 292

*Product selection dependent on system

Accelerated weathering - gloss retention
Joncryl polyols in clear topcoat formulations

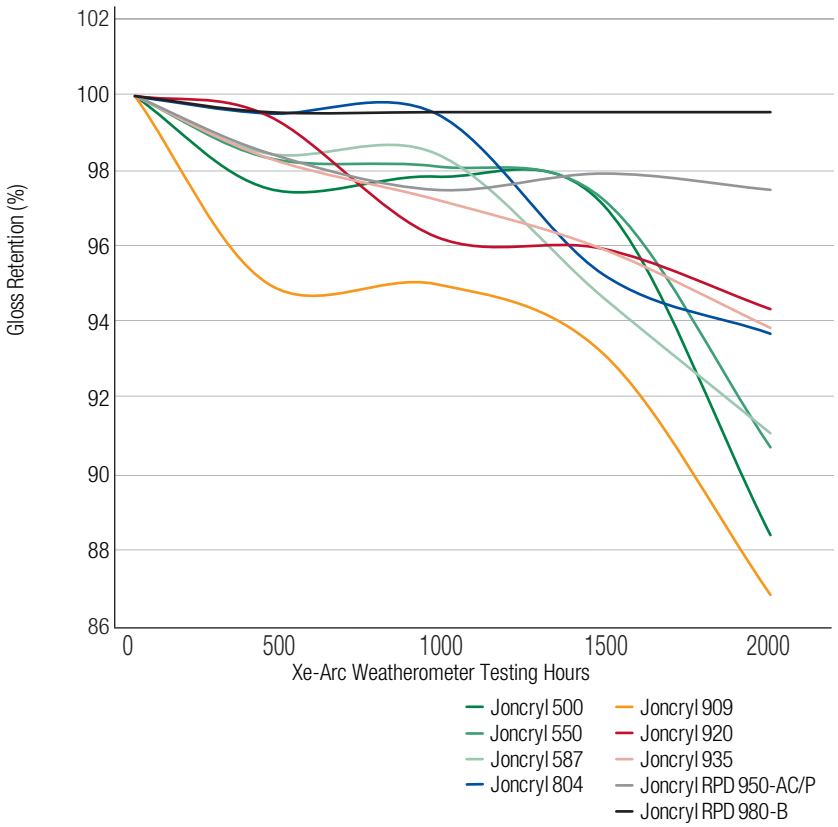


Figure 7. 60° gloss retention, 1 – 1.5 mil DFT over commercial white basecoat.

Florida exposure - gloss retention
Joncryl polyols in clear topcoat formulations

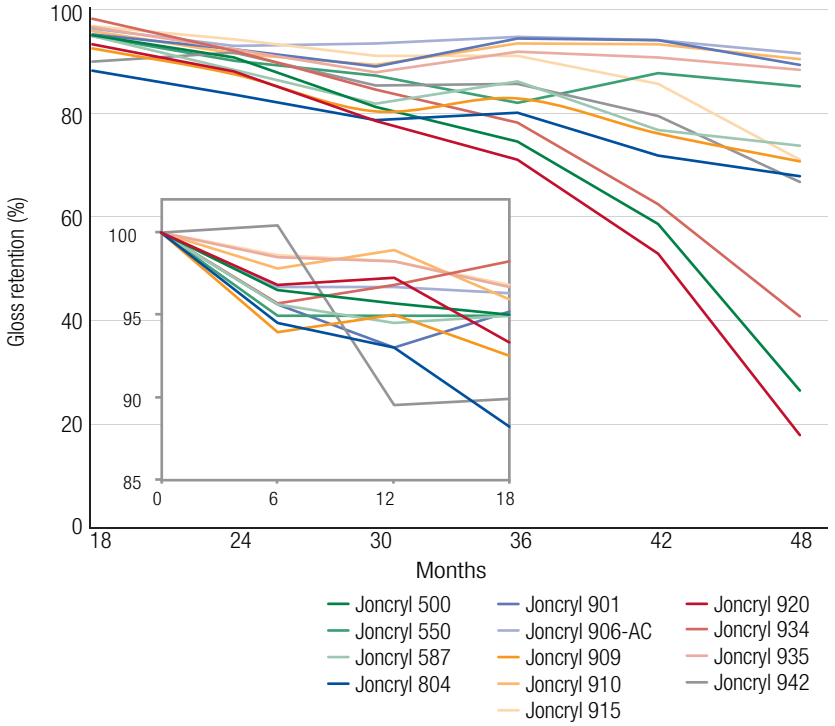


Figure 8. 60° gloss retention, 1 mil DFT over white automotive basecoat/epoxy primer.

Florida exposure - gloss retention
Joncryl® polyols in single stage topcoat formulations

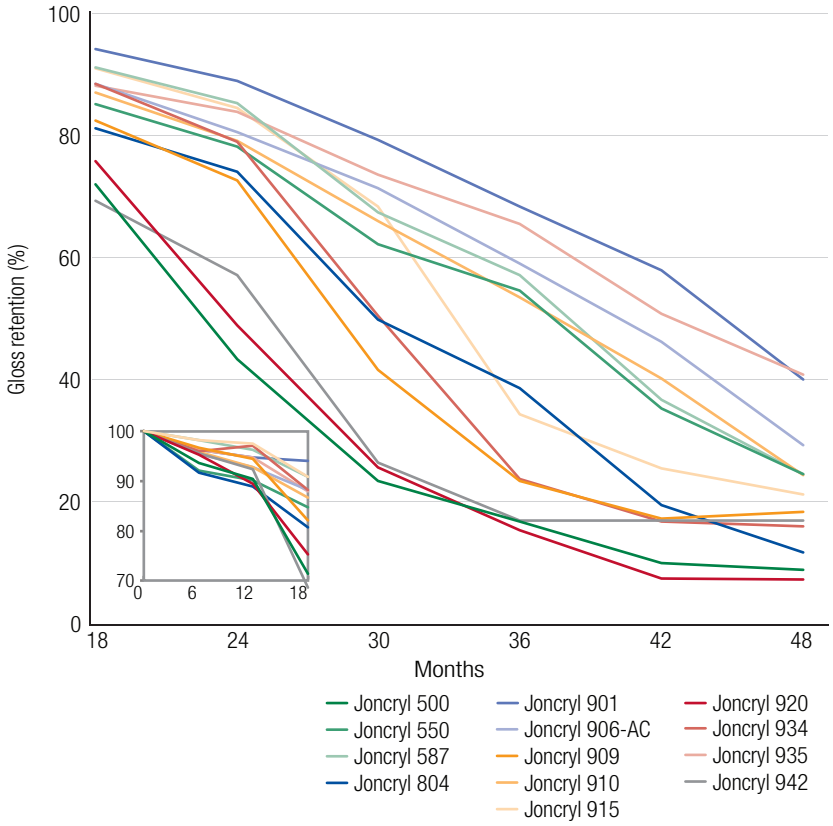


Figure 9. 60° gloss retention, 1.5 mil DFT over epoxy primer.

Florida exposure - color change
Joncryl polyols in single stage topcoat formulations

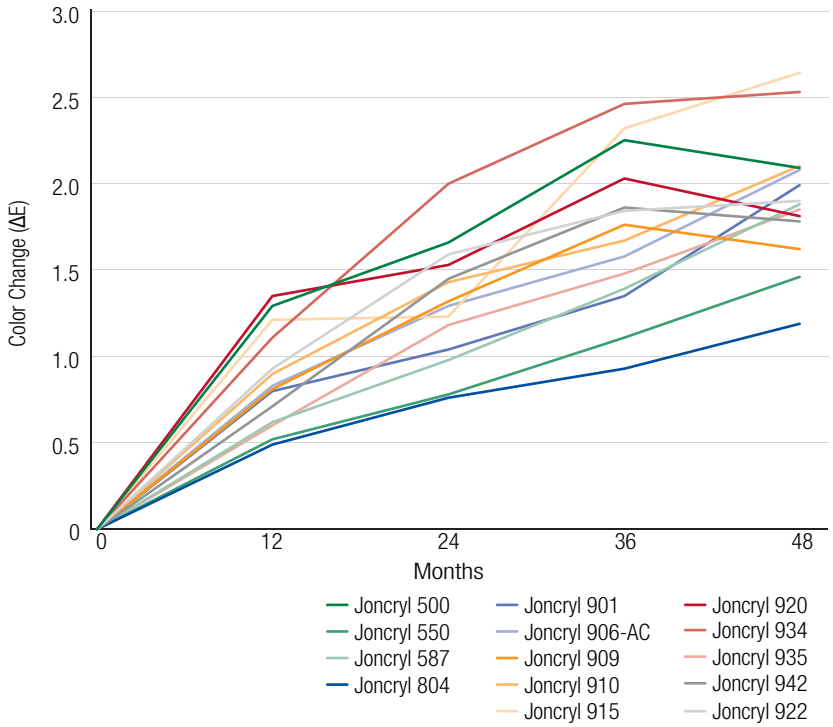


Figure 10. Color change, 1.5 mil DFT over epoxy primer.

Table 3:
Joncryl® Acrylic Polyols

Resin	Formulated VOC Range (lbs/gal)	Solids (wt. %)	Tg (°C)
Standard Cure Polyols			
Joncryl 500	2.3-3.8	80	- 7
Joncryl 504	2.3-3.8	80	- 7
Joncryl 507	2.8-3.8	80	- 7
Joncryl 508	Exempt*	75	- 7
Joncryl 550	4.0+	62	49
Joncryl 551	4.0+	60	49
Joncryl 581	4.0+	100	62
Joncryl 587	4.0+	100	57
Joncryl 587-AC	Exempt*	50	57
Joncryl 804	4.0+	100	70
Joncryl 901	3.2-4.4	77	20
Joncryl 902	3.2-4.4	75	20
Joncryl 906-AC	Exempt*	75	16
Joncryl 935	3.2-4.4	70	17
Reactive Modifiers			
Joncryl 960	-	98+	- 44
Fast Cure Polyols			
Joncryl 909	3.3-4.5	68	25
Joncryl 910	3.4-4.7	71	9
Joncryl 915	3.2-4.4	77	13
Joncryl 920	2.3-3.8	80	- 7
Joncryl 922	2.3-3.8	80	- 7
Joncryl 924	Exempt*	70**	- 7
Joncryl 934	2.9-4.0	77	7
Joncryl 942	3.0-4.2	73.2	26
Rapid Property Development Polyols			
Joncryl RPD 950-AC/P	2.1+	65	27
Joncryl RPD 980-B	2.1-3.8	80	- 7

Equivalent Weight (-OH, on solids)	Hydroxyl Number (on solids)	Viscosity (cps)	Supplied Density (g/cm^3)	Solvent	Features
400	140	3,900	1.03	MAK	High solids, low viscosity, good open times, good flow and leveling
400	140	7,400	1.04	Xylene	Xylene version of Joncryl 500
400	140	3,800	1.04	n-butyl acetate	N-butyl acetate version of Joncryl 500 for non-HAPs applications
400	140	4,000	1.03	t-butyl acetate	Exempt solvent version of Joncryl 500
620	90	6,500	1.05	PM acetate/toluene (65/35)	Conventional solids, fast dry, suitable for primers and clearcoats
620	90	6,000	1.02	Xylene	Xylene version of Joncryl 550
360	155	Solid	1.16	-	High crosslink density, good chemical resistance
610	92	Solid	1.16	-	Fast dry clearcoats and primer surfacers
610	92	200	0.95	Acetone	Acetone version of Joncryl 587
1,250	45	Solid	1.15	-	Low NCO demand, quick dry, good adhesion for primers or clearcoats
500	112	17,500	1.07	MAK	Good overall performance for low VOC clearcoat applications
500	112	9,000	1.09	n-butyl acetate	N-butyl acetate version of Joncryl 901
600	93	6,500	1.07	Acetone	Excellent gloss retention, hardness and chemical resistance; exempt solvent for “0” VOC formulations; high equivalent weight for lower NCO demand
375	150	8,500	1.03	MAK	Excellent exterior durability for topcoats and clearcoats
675	83	14,500	1.05	-	Low viscosity and VOC modifier, increases solids, flexibility, acid etch resistance
480	117	6,500	1.03	n-butyl acetate	Early hardness development and through cure with balanced pot life
600	94	7,000	1.04	MAK	Outstanding weathering performance, good pot life and Skydrol*** resistance
590	95	7,500	1.04	n-butyl acetate	Low VOC, fast dry
400	140	6,000	1.03	MAK	Low VOC, good dry time and pot life
400	140	5,500	1.05	n-butyl acetate	N-butyl acetate version of Joncryl 920
400	140	6,000	1.16	PCBTF	Exempt solvent version of Joncryl 920
800	70	5,000	1.04	n-butyl acetate	Low VOC, low NCO demand
400	140	7,500	1.05	n-butyl acetate	High solids, excellent drying profile and hardness development
510	110	3,000	1.03	Acetone/ PCBTF (3:1)	Clearcoats with 30 min sand and buff time, superior gloss and durability; primers with less than 30 min sand times
400	140	3,000	1.03	n-butyl acetate	High solids, rapid cure and long pot life

*Consult Federal EPA, state and local area regulations regarding status of VOC regulations and exempt solvent listings. Air quality regulations are not consistent throughout the United States. Consult proper regulatory entities if operating in Canada or Mexico regarding any regulations.

**Indicates solids testing for 1 hour at 110°C, all others run for 1 hour at 150°C.

*** Skydrol is a registered trademark of Solutia Inc.

High Performance Pigments:

Highlights and Latest Color Developments

BASF's high performance color and effect pigments have long been established in the transportation industry. This unique portfolio is designed to meet the end user's ever-changing aesthetic and styling needs by offering high performance colors as well as novel metallic, pearlescent and sparkling effects. A reliable materials supplier to the transportation industry, BASF also supports customer's demand for improved process efficiency, film rheology and properties such as stone-chip resistance, transparency and chroma.

BASF offers a robust portfolio of high-performance classical pigments and effect pigments to the transportation and automotive coatings industry. As the world's largest chemical company, we work closely to bring functional solutions that deliver improved durability, aesthetics and performance.

Depicted on the following charts, the superior coloristic characteristics are highlighted from several innovative pigment lines including Lumina® Royal Exterior series, Paliocrom® Brilliant series, Glacier™ Exterior range as well as our new PB 15:6 Heliogen® Blue.

Lumina Royal Exterior Series Blue to Violet Coloristic Properties

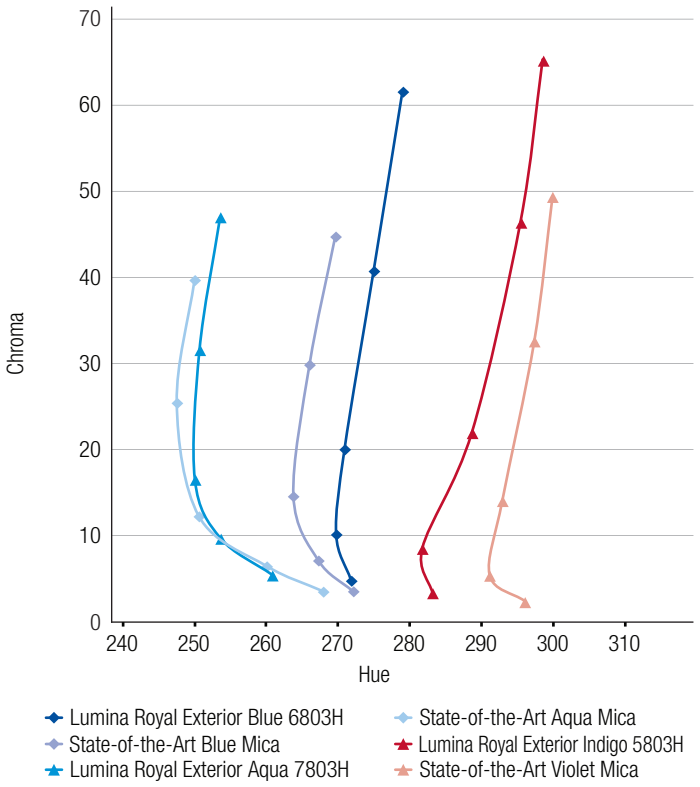


Figure 11. Test system: 90:10 black reduction in a solvent-borne medium solid system (Polyester/CAB).

Paliocrom Brilliant Orange L 2850 and Paliocrom Brilliant Gold L 2050 Coloristic Properties

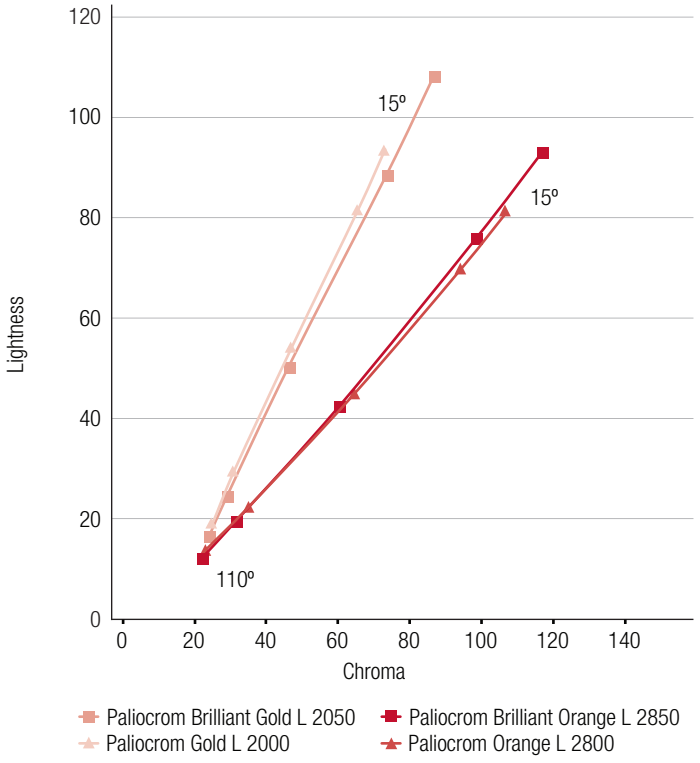


Figure 12. Test system: Full shade in a solvent-borne medium solids system (Polyester/CAB).

Lumina® Royal Exterior Copper 3903H Coloristic Properties

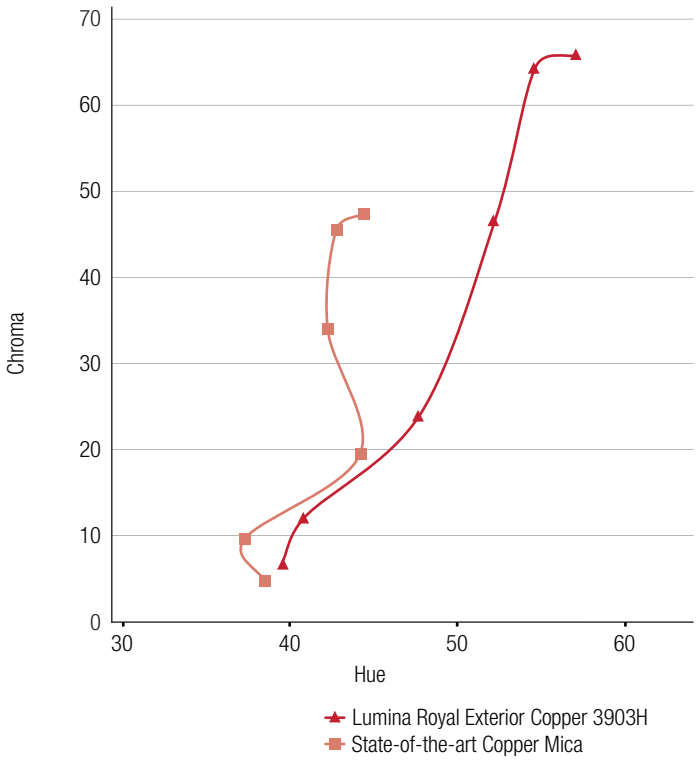


Figure 13. Test system: 90:10 black reduction in a solvent-borne medium solid system (Polyester/CAB).

Glacier™ Exterior Frost White S1303D Coloristic Properties

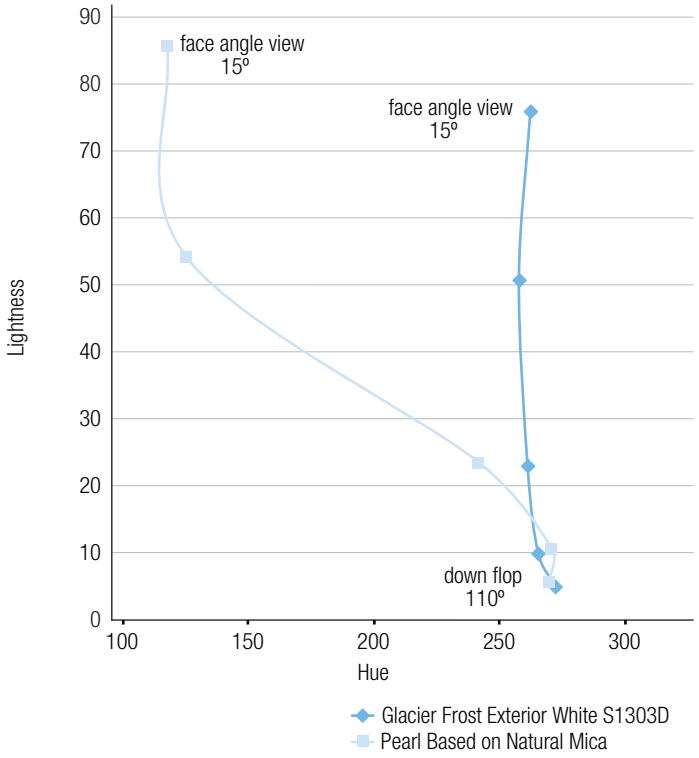


Figure 14. Test system: 90:10 black reduction in a solvent-borne medium solid system (Polyester/CAB).

Heliogen® Blue L 6600 F Coloristic Properties

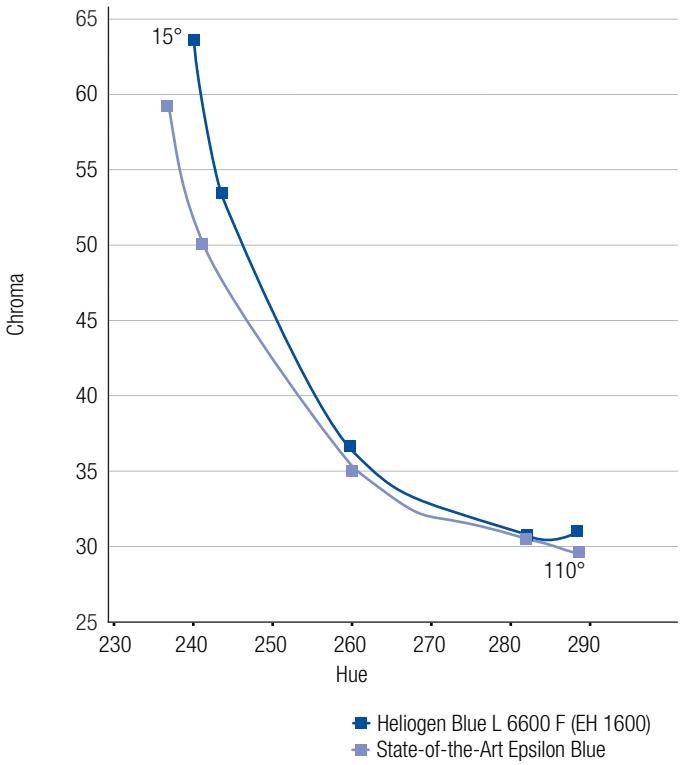


Figure 15. Test system: 50:50 pigment-to-aluminum reduction in water-borne formulation.

Table 4:

High Performance Pigments

Pigment	Color (Pure Shade)	Description	Color Index	Chemical Nature
Cinquasia® Pigments				
The Cinquasia line of high performance quinacridone pigments combine outstanding tinctorial properties with excellent fastness to light, weather, heat and solvents. The range offers beautiful red, violet and magenta shades with high transparency, color strength and excellent dispersibility.				
Cinquasia Red L 4100 (old Cinquasia Red Y RT-759-D)		Opaque medium shade red with highest level of quinacridone durability and heat stability.	Pigment Violet 19	Quinacridone
Cinquasia Magenta L 4510 (old Cinquasia Magenta RT-143-D)		Saturated blue-shade magenta with improved dispersability and well suited for metallic finishes.	Pigment Red 202	Quinacridone
Cinquasia Magenta L 4520 (old Cinquasia Magenta RT-243-D)		Saturated blue-shade magenta for automotive finishes, preferred magenta for metallics.	Pigment Red 202	Quinacridone
Cinquasia Magenta L 4540 (old Cinquasia Magenta RT-355-D)		Very transparent and saturated yellow-shade magenta with outstanding rheology.	Pigment Red 202	Quinacridone
Cinquasia Violet L 5110 (old Cinquasia Violet R NRT-101-D)		Very transparent with high color strength for use in mica and aluminum shades.	Pigment Violet 19	Quinacridone
Cinquasia Violet L 5120 (old Cinquasia Violet R NRT-201-D)		Semi-opaque violet with high color strength for use in mica, aluminum and solid shades.	Pigment Violet 19	Quinacridone
Cromophtal® Pigments				
Cromophtal line of high-grade organic pigments offering excellent opacity and weather fastness.				
Cromophtal Yellow L 1084 HD (old Irgazin Yellow 2084)		Univerisal medium-shade yellow with good opacity, high saturation and excellent durability.	Pigment Yellow 154	Benzimidazalone
Glacier™ Effect Pigments				
Glacier series effect pigments are based on the newest generation of synthetic mica flakes coated with TiO_2. Highly transparent synthetic mica offers better luster and brightness than traditional pigments. The white pearlescent appearance with a bluish color on reflection is ideal for white-to-black effect shades while maximizing luster, brilliance and sparkle effects in all shade areas.				
Glacier Exterior Frost White S1303D		TiO_2 coated synthetic mica with high luster and brightness yielding a "whiter" white appearance.	N/A	TiO_2 coated synthetic mica flakes; additional CFS treatment
Glacier Exterior Silk White S1303V		TiO_2 coated synthetic mica with high luster and brightness yielding a smooth and silky appearance due to its fine particle size.	N/A	TiO_2 coated synthetic mica flakes; additional CFS treatment
Heliogen® Pigments				
Heliogen phthalocyanine blue and green pigments with extremely good fastness and weatherability properties.				
Heliogen Blue L 6600 F		Reddish epsilon phthalocyanine blue with high chroma, high tinting strength and excellent resistance to flocculation.	Pigment Blue 15:6	Phthalocyanine
Heliogen Blue L 6940 F (old Irgazin Blue X-3367)		Chromatic red-shade alpha phthalocyanine blue with good color strength, for water- and solvent-borne automotive paints.	Pigment Blue 15:2	Phthalocyanine
Heliogen Blue L 7101 F		Extremely chromatic beta phthalocyanine blue with excellent resistance to flocculation.	Pigment Blue 15:4	Phthalocyanine
Heliogen Green L 8605		Most bluish copper phthalocyanine green.	Pigment Green 7	Phthalocyanine
Heliogen Green L 9361		Phthalocyanine green with a particularly yellowish and chromatic shade.	Pigment Green 36	Phthalocyanine
Irgazin® Pigments				
Irgazin high performance organic pigments with a broad range of colors, highly indicated for applications where resistance to extreme conditions and/or coloristical, tinctorial properties and high transparency are required.				
Irgazin Cosmoray Orange L 2950 (old Irgazin DPP Cosmoray Orange)		Transparent DPP orange pigment with exceptional saturation enabling a new spectrum of bright, intense metallic and mica shades.	N/A	Diketo-pyrrolo-pyrrole
Irgazin Red L 3660 HD (old Irgazin DPP Red BO)		Medium-red DPP with good hiding power, high saturation and very good fastness to weathering.	Pigment Red 254	Diketo-pyrrolo-pyrrole
Irgazin Rubine L 4020 (old Irgazin DPP Rubine TRI)		Transparent blue-shade DPP red with outstanding color strength, excellent durability, very high saturation and improved flow properties.	N/A	Diketo-pyrrolo-pyrrole
Irgazin Rubine L 4025 (old Irgazin DPP Rubine TR)		Transparent DPP red pigment with very high saturation and color strength, excellent outdoor performance.	Pigment Red 264	Diketo-pyrrolo-pyrrole
Irgazin Rubine L 4030 old: Irgazin DPP Rubine FTX)		Very transparent and saturated blue-shade red with improved rheology.	Pigment Red 264	Diketo-pyrrolo-pyrrole
Irgazin Yellow L 2040 (old: Irgazin Yellow 2RLT)		Transparent reddish yellow, especially suitable for metallic automotive finishes.	Pigment Yellow 110	Isoindolinone
Irgazin Yellow L 2060 (old: Irgazin Yellow 3RLTN)		Good opacity, especially suitable for opaque automotive finishes.	Pigment Yellow 110	Isoindolinone

Physical Data								Dispersant Recommendation	
Bulk Volume	Conductivity	Density	Dry Content	Oil Absorption	Specific Surface	Thermal Resistance	Particle Size Distribution	Solvent-borne	Water-borne
(l/kg)	(µS/cm)	(g/cm³)	(%)	(g/100 g)	(m^2/g)	(°C/°F)	(µm)	(Efka®)	(Dispex®)
4.0	< 200	1.46	≥ 98.5	56	23	200/392	N/A	PX 4310	Ultra PA 4550
2.3	< 200	1.60	≥ 98.5	58	57	200/392	N/A	PX 4310	Ultra PA 4550
2.0	< 200	1.61	≥ 98.5	38	41	200/392	N/A	PX 4310	Ultra PA 4550
2.3	< 200	1.57	≥ 98.5	56	72	200/392	N/A	PX 4310	Ultra PA 4550
2.5	< 200	1.46	≥ 98.5	68	86	200/392	N/A	PX 4310	Ultra PA 4550
2.9	< 200	1.49	≥ 98.5	83	70	200/392	N/A	PX 4310	Ultra PA 4550
3.6	< 200	1.60	≥ 98.5	43	19	160/320	N/A	PA 4401	Ultra PX 4585
~0.4	24 (10% suspension)	2.95 g/ml	100	N/A	N/A	700/1292	D_{10} ~ 9, D_{50} ~ 19, D_{90} ~ 35	N/A	N/A
6.3	21 (10% suspension)	3.30 g/ml	100	N/A	N/A	700/1292	D_{10} ~ 5.5, D_{50} ~ 11.5, D_{90} ~ 21.4	N/A	N/A
2.3	< 200	1.60	≥ 98.5	50	73	350/662	N/A	PX 4350	Ultra PX 4585
4.1	< 200	1.53	≥ 98.5	51	55	200/392	N/A	PX 4350	Ultra PX 4585
4.0	< 200	1.61	≥ 98.5	45	64	300/572	N/A	PX 4350	Ultra PX 4585
2.6	< 200	2.08	≥ 98.5	30	61	400/752	N/A	PX 4350	Ultra PX 4585
2.5	< 200	2.94 g/ml	≥ 98.5	20	62	300/572	N/A	PX 4350	Ultra PX 4585
2.9	< 200	1.60	≥ 98.5	90	93	200/392	N/A	PX 4340	Ultra PX 4585
2.9	< 200	1.63	≥ 98.5	44	15	200/392	N/A	PX 4340	Ultra PX 4585
2.5	< 200	1.40	≥ 98.5	62	76	200/392	N/A	PX 4340	Ultra PX 4585
3.8	< 200	1.39	≥ 98.5	62	100	200/392	N/A	PX 4340	Ultra PX 4585
2.5	< 200	1.37	≥ 98.5	60	83	200/392	N/A	PX 4340	Ultra PX 4585
3.3	< 200	1.78	≥ 98.5	50	48	200/392	N/A	PX 4330	Ultra PX 4585
2.8	< 200	1.78	≥ 98.5	38	27	200/392	N/A	PX 4330	Ultra PX 4585

Pigment	Color (Pure Shade)	Description	Color Index	Chemical Nature
Lumina® Effect Pigments				
Lumina Royal represents the new generation of technologically highly advanced, mica effect pigments which offer the highest chroma, brightness, luster and color purity of any mica effect pigment currently available.				
Lumina Royal Exterior Blue 6803H		Intense red shade blue interference effect pigment with exceptional chroma and brilliancy that allow formulators to style with maximum interference color.	N/A	Rutile TiO_2 coated mica flakes; additional CFS treatment
Lumina Royal Exterior Aqua 7803H		Intense greenish blue interference effect pigment with exceptional chroma and lightness allowing formulators to style with maximum interference color.	N/A	Rutile TiO_2 coated mica flakes; additional CFS treatment
Lumina Royal Exterior Indigo 5803H		Intense bluish red shade interference effect pigment with exceptional chroma and brilliance allowing formulators to style with maximum interference color.	N/A	Rutile TiO_2 coated mica flakes; additional CFS treatment
Lumin® Royal Exterior Copper 3903H		Intense semi-transparent copper shade effect pigment with exceptional chroma and sparkle that allow formulators to style colors with tremendous impact in the copper, orange and red color area.	N/A	Iron oxide coated mica flakes; additional CFS treatment
Paliocrom® Brillilant Effect Pigments				
Paliocrom Brilliant effect pigments are a further development of the well-established Paliocrom technology based on aluminum flakes of the thin silver dollar type with a very narrow particle size distribution. Combining excellent hiding power with pronounced flop characteristics and subtle sparkle, designers will be able to create new eye-catching effects and differentiate their products better in an increasingly competitive market.				
Paliocrom Brilliant Gold L 2050		Vibrant chroma and lightness allow for completely new golden to red metallic shades with excellent hiding and demonstrates much higher brilliancy than well-established standard grades.	N/A	Aluminum flakes (silver-dollar type), coated with iron oxide
Paliocrom Brilliant Orange L 2850		Vibrant chroma and lightness allow for completely new orange to red metallic shades with excellent hiding and demonstrates much higher brilliancy than well-established standard grades.	N/A	Aluminum flakes (silver-dollar type), coated with iron oxide
Paliogen® Pigments				
Paliogen pigment portfolio includes opaque and transparent red perylenes as well as indanthrone blue pigments. The range demonstrates high chroma with the highest transparency. Paliogen pigments are ideal for high end applications based on their excellent fastness properties to weathering and flocculation stability.				
Paliogen Blue L 6480		Strong red-shade transparent indanthrone blue with improved color strength and high chroma.	Pigment Blue 60	Indanthrone
Paliogen Blue L 6482		Transparent indanthrone blue with high chroma and color strength.	Pigment Blue 60	Indanthrone
Paliogen Red L 3875		Transparent perylene red pigment for brilliant shades, particularly suitable for high-solids solvent-borne formulations.	Pigment Red 179	Perylene
Paliogen Red L 3885		Transparent perylene red pigment with high chroma in effect coatings. Mainly used in water-borne systems.	Pigment Red 179	Perylene
Paliotol® Pigments				
Paliotol high performance range, consisting of various pigment chemistries, span the yellow and orange color spaces delivering high chroma, hiding power and weather fastness.				
Paliotol Yellow L 2146 HD		Highly opaque red-shade yellow offering high chroma, excellent hiding power and good weatherfastness.	Pigment Yellow 139	Isoindoline
Sicopal® Pigments				
Sicopal inorganic yellow or orange bismuth vanadate pigments for brilliant yellow, orange, red and green shades with high opacity and superior resistance to weathering.				
Sicopal Yellow L 1100		Highly opaque inorganic bismuth vanadate pigment with excellent resistance to weathering.	Pigment Yellow 184	Bismuth Vanadate

Physical Data								Dispersant Recommendation	
Bulk Volume	**Conductivity**	**Density**	**Dry Content**	**Oil Absorption**	**Specific Surface**	**Thermal Resistance**	**Particle Size Distribution**	**Solvent-borne**	**Water-borne**
(l/kg)	(µS/cm)	(g/cm³)	(%)	(g/100 g)	(m^2/g)	(°C/°F)	(µm)	(Efka®)	(Dispex®)
3.5	32 (10% suspension)	2.84 g/ml	100	N/A	N/A	700/1292	D_{10} ~ 10, D_{50} ~ 19, D_{90} ~ 34	N/A	N/A
3.2	37 (10% suspension)	2.96 g/ml	100	N/A	N/A	700/1292	D_{10} ~ 9, D_{50} ~ 18, D_{90} ~ 33	N/A	N/A
3.4	33 (10% suspension)	2.85 g/ml	100	N/A	N/A	700/1292	D_{10} ~ 9, D_{50} ~ 18, D_{90} ~ 33	N/A	N/A
2.2	n/a	3.20 g/ml	100	N/A	N/A	700/1292	D_{10} ~ 9, D_{50} ~ 19, D_{90} ~ 34	N/A	N/A
~ 1.5	< 200 (10% suspension)	1.54	100	N/A	N/A	N/A	D_{10} ~ 13, D_{50} ~ 22, D_{90} ~ 35	N/A	N/A
1.4	< 200 (10% suspension)	1.50	100	N/A	N/A	N/A	D_{10} ~ 13, D_{50} ~ 22, D_{90} ~ 35	N/A	N/A
2.0	< 200	1.55	≥ 98.5	–	4	250/482	N/A	PX 4340	Ultra PX 4585
2.0	< 200	1.55	≥ 98.5	–	4	250/482	N/A	PX 4340	Ultra PX 4585
2.5	< 400	1.50	≥ 98.5	–	31	300/572	N/A	PX 4310	Ultra PX 4585
2.1	< 200	1.50	≥ 98.5	35	39	300/572	N/A	PX 4310	Ultra PX 4585
3.8	< 200	1.72	> 99.5	50	25	250/482	N/A	PA 4401	Ultra PX 4585
1.1	< 200	5.80	> 99.5	27	10	200/392	N/A	PX 4330	Ultra PA 4550

New Additives for Robust Formulation and Processing

An extensive range of dispersing agents, defoamers, rheology modifiers, wetting agents and surface modifiers, and film-forming agents are available under the Efka® brand for solvent based coating formulations.

The latest in innovation, Efka PX 4350 is a dispersing agent based on patented Controlled Free Radical Polymerization (CFRP) technology, which allows for highest control over polymer structures.

Efka PX4350 was specifically designed for Cu-Phthalocyamime pigments, to achieve better rheology control of typically difficult-to-disperse pigments.

Pigment Concentrate	Pounds (Wt %)
Laropal® A81, 50% in nBA / Aromatic 100	20.0
nBA / Aromatic 100 (1:1 blend)	56.2
Efka PX 4350	8.8
Heliogen® Blue L 6600 F	15.0

Let-down Clear	Pounds (Wt %)
Joncryl® 587-AC	88.4
PCBTF	5.7
t-BuAc	5.7
Efka SL 3035	0.2

Rheology after four days at 60 °C

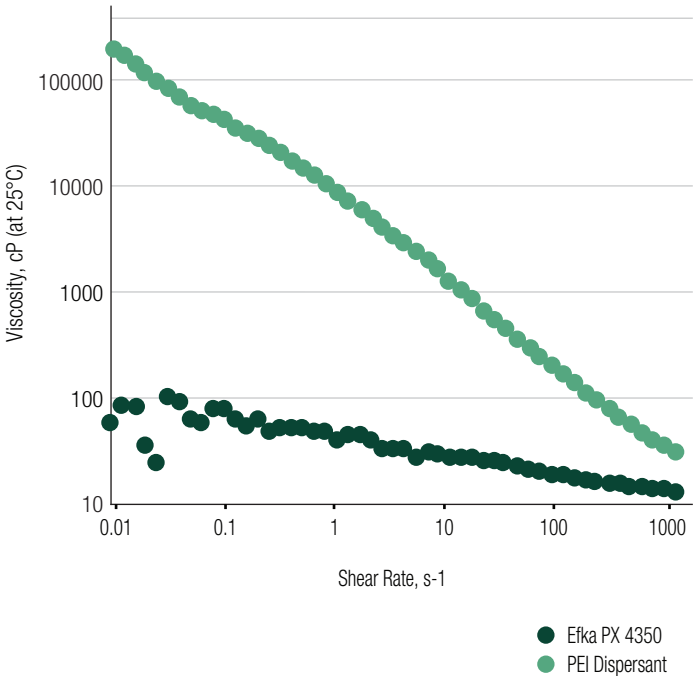


Figure 16. 30% Dispersant on Pigment, Pigment Heliogen Blue L 6600F, 15% Pigment loading.

Transparency after four days at 60 °C

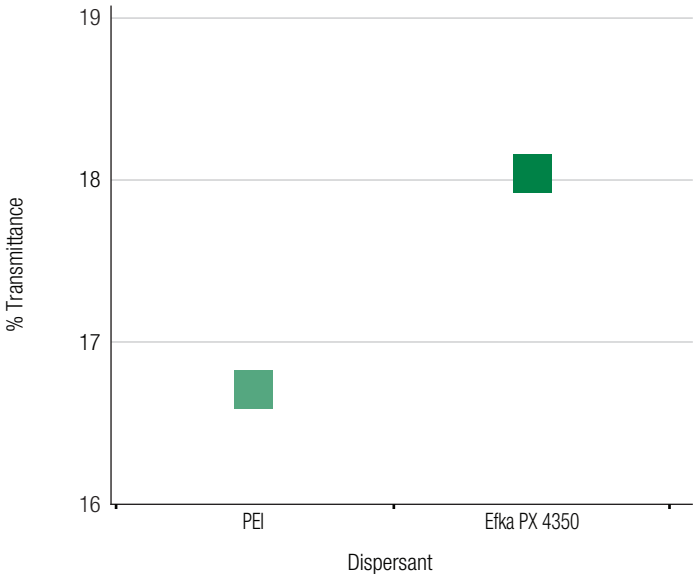


Figure 17. 30% Dispersant on Pigment, Pigment Heliogen Blue L 6600 F, Scandex Time: 6 h.

Table 5. Selected Efka® Formulation Additives: Dispersing Agents.

Product Name	Old Product Name	Solids (%)	Amine Number (mg KOH/g)	Acid Value (mg KOH/g)	Features and Benefits
Efka PX 4310	Efka 4310	50	19	N/A	Well suited for organic pigments as well as carbon blacks for highest jetness in medium polar to polar systems
Efka PX 4320	Efka 4320	50	28	N/A	Well suited for organic pigments as well as carbon blacks for highest jetness in less polar to medium polar systems
Efka PX 4330	Efka 4330	70	28	N/A	Broad compatibility for pigment pastes, especially in combination with grinding resins such as Laropal® A 81
Efka PX 4340	Efka 4340	55	4	N/A	Good performance in CAB-modified systems as well as 2K PU and 2K Epoxy systems
Efka PX 4350	N/A	51	12	N/A	Peak performance with phthalocyanine pigments in medium polar to polar systems

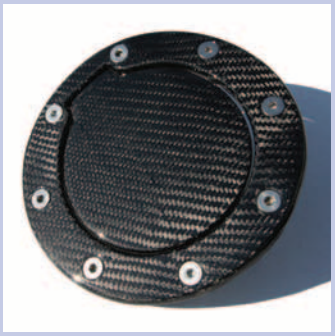
Performance Additives

for UV Protection and Durability

Appearance and styling are equally important factors in making each car unique. Tinuvin® performance additives are designed to protect cars inside and out. The portfolio contains two types of light stabilizers: Ultraviolet Light Absorbers (UVA) and Hindered-Amine Light Stabilizers (HALS). UVA filter harmful UV light and prevent discoloration and delamination of coatings. Based on the nature of the light absorbing unit, several types of UVA are commercially available. Benzotriazoles offer the broadest spectral coverage, as observed in Figure 18.

HALS trap free radicals to maintain surface properties such as gloss and prevent cracking and chalking of paints. When combined, UVA and HALS provide synergistic effects and offer simplicity of formulation.

Tinuvin CarboProtect® is an advanced additive uniquely designed to provide top durability and high tech styling options for exposed lightweight carbon fiber reinforced composite materials in automotive parts.



Additive Type	Key Features and Benefits
Benzotriazole	Long photo-permanence
	Long wavelength absorbance
Triazine	Long photo-permanence
	High extinction coefficient
DW (water-dispersible) additive series	Low/zero VOC compositions
	Stir-in, non-settling material

Absorbance spectra of UVA types

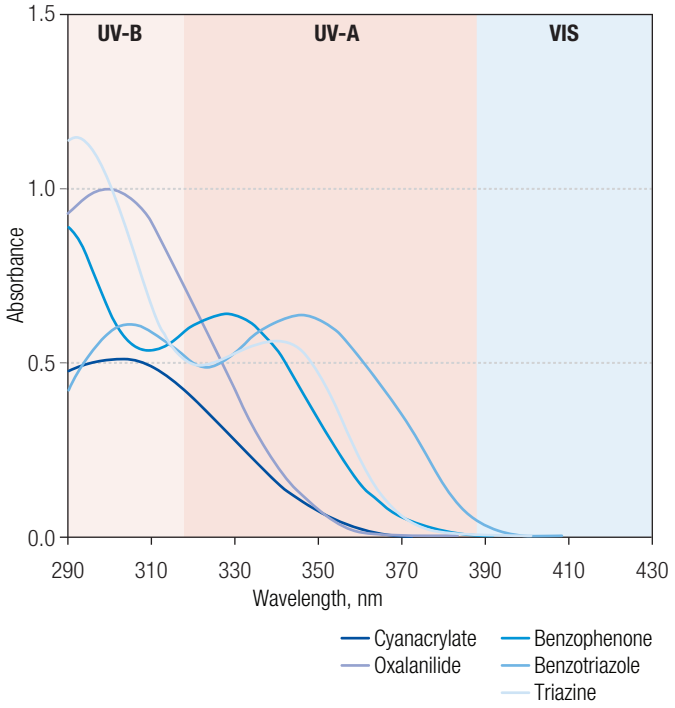


Figure 18. Test samples were prepared at a concentration of 20 mg/l in toluene, path = 1 cm.

Synergistic effects of UVA and HALS

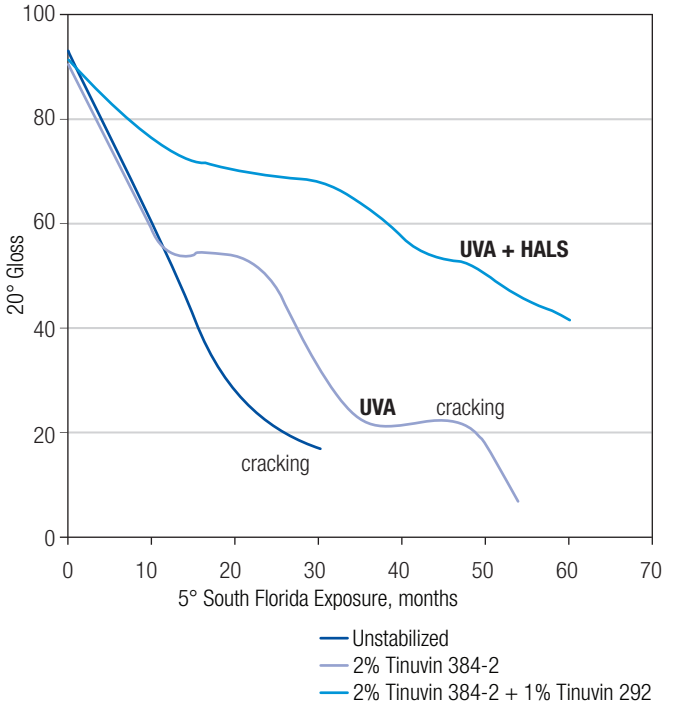


Figure 19. 20° gloss values for panels coated with acrylate/melamine clear topcoat over water-borne silver metallic basecoat (bake at 130° C for 30 minutes) and subjected to South Florida exposure at 5°.

Photo-permanence of UVA

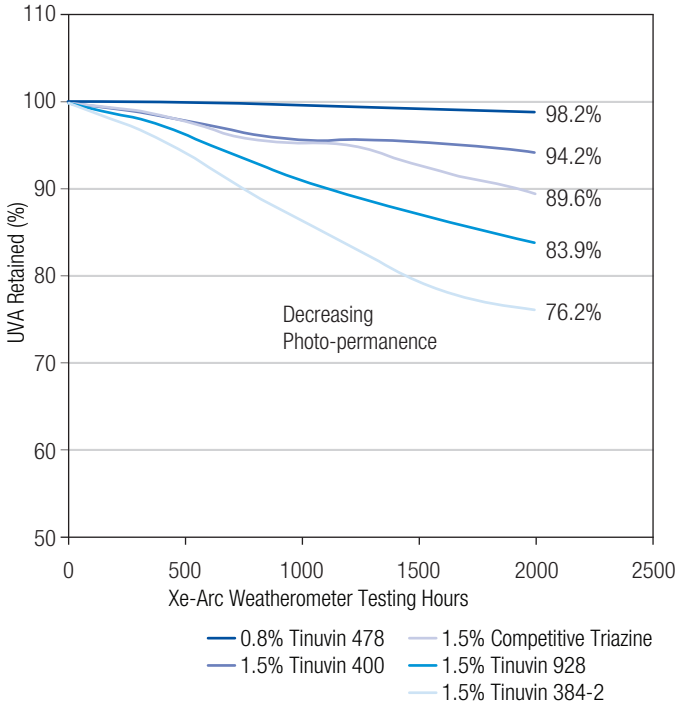


Figure 20. Depletion of UVA upon accelerated weathering, 30 µm clear topcoat with UVA + 1% Tinuvin® 292 on glass plates (% UVA determined at 345 nm). This data demonstrates that triazines are the best choice for UV protection of coatings subject to extreme environments and conditions.

Illustration of Tinuvin CarboProtect very red shifted spectral coverage and substrate protection

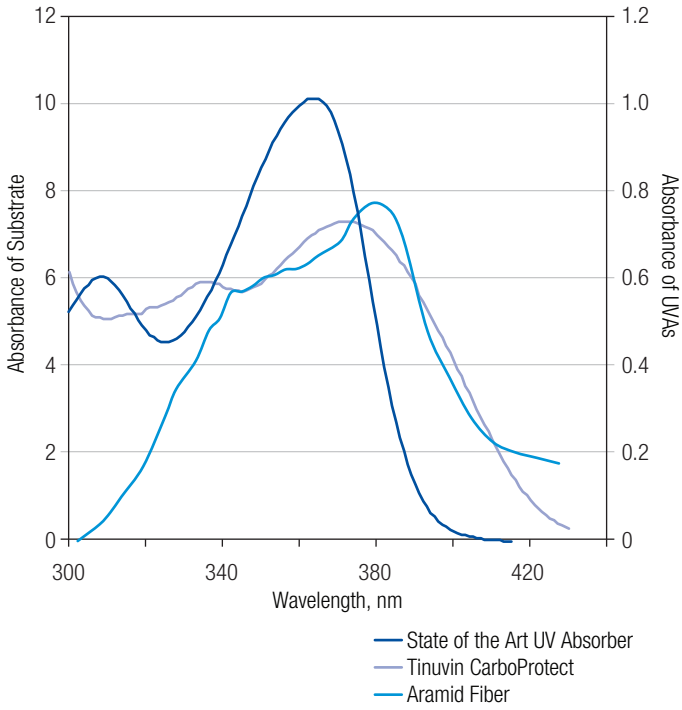


Figure 21. Comparative absorbance of Aramid substrate and standard UV absorbers vs. Tinuvin CarboProtect.

Table 6:

Tinuvin® Light Stabilizer Additives

Product	Physical Form	Melting Range (°C)	Solubility/Miscibility at 20°C (g/100g)					
			Mineral spirit/ *Toluene*	Xylene/ *Methyl Isobutyl Ketone*	Methyl amyl ketone/ *Methyl ethyl ketone*	Butyl acetate/ *Ethyl acetate*	Ethyl Cellosolve* acetate/ *Butyl Cellosolve* acetate*	Butyl Carbitol*/ *Texanol***
(2-hydroxyphenyl)-Benzotriazole								
Tinuvin 384-2	Liquid	-	> > 50/ *> 50*	> 50/ *> 50*	> 50/ *> 50*	> 30/ *> 50*	NA/ *> 50*	> 50/ *> 30*
Tinuvin 900	Solid	137 - 141	< 0.1/ *24*	10/ *3*	4/ *5.5*	4.5/ *4*	< 0.1/ *2*	NA/ *< 0.1*
Tinuvin 928	Solid	109 - 113	-	> 50/ *NA*	30/ *NA*	> 30/ *30*	10/ *9.5*	-
Tinuvin 1130	Liquid	-	NA/ *> 50*	> 50/ *> 50*	> 50/ *> 50*	> 50/ *> 50*	> 50/ *> 50*	> 50/ *> 50*
Tinuvin CarboProtect®	Solid	132 - 136	NA/ *> 50*	-	NA/ *30*	28/ *NA*	-	-
(2-hydroxyphenyl)-s-Triazine								
Tinuvin 400	Liquid	-	NA/ *> 50*	> 50/ *> 50*	> 50/ *> 50*	-	> 50/ *> 50*	> 50/ *> 50*
Tinuvin 405	Solid	74 - 77	-	20/ *NA*	-	25/ *NA*	-	-
Tinuvin 477	Liquid	93 - 102	NA/ *> 50*	> 50/ *> 50*	> 50/ *> 50*	-	> 50/ *> 50*	> 50/ *> 50*
Tinuvin 479	Solid	68 - 101	-	-	-	17/ *NA*	-	-
Hindered Amine Light Stabilizers (HALS)								
Tinuvin 123	Liquid	-	> 50/ *> 50*	> 50/ *> 50*	> 50/ *> 50*	> 50/ *> 50*	-	-
Tinuvin 144	Solid	146 - 150	-	10 *NA*	NA/ *9*	10/ *NA*	-	1.5/ *NA*
Tinuvin 152	Solid	83 - 90	-	> 70/ *NA*	> 75/ *NA*	> 70/ *NA*	-	-
Tinuvin 292	Liquid	-	> 50/ *> 50*	> 50/ *> 50*	> 50/ *> 50*	> 50/ *> 50*	-	> 50/ *> 50*
UVA/HALS Blends								
Tinuvin 5050	Liquid	-	> 50/ *> 50*	> 50/ *> 50*	> 50/ *> 50*	> 50/ *> 50*	> 50/ *> 50*	> 50/ *> 50*
Tinuvin 5151	Liquid	-	> 50/ *> 50*	> 50/ *> 50*	> 50/ *> 50*	> 50/ *> 50*	> 50/ *> 50*	> 50/ *> 50*
Tinuvin 5248	Liquid	-	> 50/ *> 50*	> 50/ *> 50*	> 50/ *> 50*	> 50/ *> 50*	> 50/ *> 50*	> 50/ *> 50*
Tinuvin 5350	Liquid	-	-	-	-	-	-	-

*Cellosolve and Carbitol are trademarks of The Dow Chemical Company.
**Texanol is a trademark of the Eastman Chemical Company.

Table 7. Tinuvin DW light stabilizers for ease of incorporation into water-borne systems.

Product Name	Physical Form	Protect Product from Freezing	Features and Benefits
Tinuvin 99-DW	Liquid	Yes	Solvent-free UV absorber that allows formulation of low/zero VOC coatings
Tinuvin 400-DW	Liquid	Yes	Encapsulated UV absorber with high extinction in the UVB range for high performance coatings and low/zero VOC water-based formulations
Tinuvin 479-DW	Liquid	Yes	Low/zero VOC coatings with high photo-permanence
Tinuvin 5333-DW	Liquid	Yes	Aqueous UVA/HALS blend with high active content for water-borne and water-borne UV coatings

Water	Features and Benefits
< 0.01	UV absorber with high thermal stability and environmental permanence for coatings exposed to high bake cycles or extreme environmental conditions
< 0.01	UV absorber for coatings exposed to high temperatures or extreme environmental stresses
< 0.01	UV absorber for high performance coating applications and light sensitive substrates
< 0.01	Versatile UV absorber with excellent spectral coverage in the UVA and UVB range
< 0.01	UV absorber specifically designed for long term performance of carbon fiber coatings
< 0.01	UV absorber for high performance and durability of solvent-borne, water-borne and 100% solids coatings
< 0.01	UV absorber for coatings subject to extreme processing conditions and light exposure
< 0.01	UV absorber for solvent-borne and liquid UV curable coatings
< 0.01	UV absorber with high photo-stability; ideal for thin film coating applications
< 0.01	Minimize cracking and gloss reduction for clear coats and chalking for pigmented paints; recommended for acid catalyzed coatings
< 0.01	Provide protection against thermal and light induced degradation
< 0.01	Reactable, high performance HALS that significantly improves coating durability; compatible with polar systems
< 0.01	Extended durability and protection from cracking and gloss reduction; can be incorporated into water-borne systems
< 0.01	High thermal stability, suitable for coatings exposed to high bake or extreme environmental temperatures
< 0.01	Minimize interaction with acidic materials; improve coating resistance to cracking and gloss reduction
< 0.01	High performance blend
< 0.01	Solvent-free blend for high performance, non-acid catalyzed systems

About BASF

BASF Corporation, headquartered in Florham Park, New Jersey, is the North American affiliate of BASF SE, Ludwigshafen, Germany. BASF has more than 16,600 employees in North America, and had sales of $18.5 billion in 2012. For more information about BASF's North American operations, visit www.basf.us.

BASF is the world's leading chemical company: The Chemical Company. Its portfolio ranges from chemicals, plastics, performance products and crop protection products to oil and gas. We combine economic success with environmental protection and social responsibility. Through science and innovation, we enable our customers in nearly every industry to meet the current and future needs of society. Our products and solutions contribute to conserving resources, ensuring nutrition and improving quality of life. We have summed up this contribution in our corporate purpose: We create chemistry for a sustainable future. BASF had sales of €72.1 billion in 2012 and more than 110,000 employees as of the end of the year. Further information on BASF is available on the Internet at www.basf.com.

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