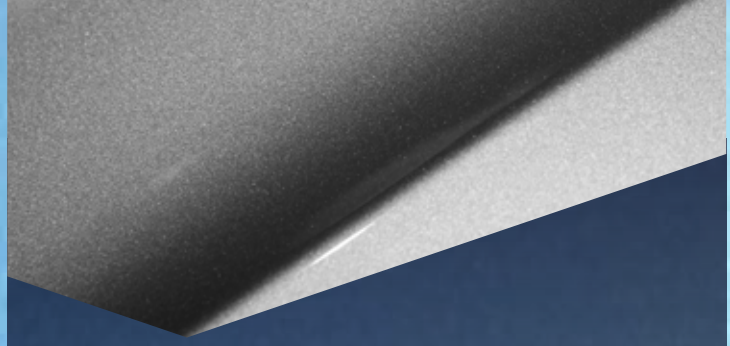

Eastman **TETRASHIELD**™
protective resin systems

Tetrashield AC1001 protective resin system for automotive monocoats

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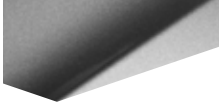


Eastman Tetrashield™ AC1001 protective resin system is a highly durable polyester resin system that improves the performance of pigmented monocoats.

Key attributes

- Enhanced long-term weathering performance
- Improved mar/scratch resistance and toughness due to higher T_g
- Higher solids formulation flexibility
- Extended durability due to increased hydrolytic stability
- Improved chemical and stain resistance

Typical resin physical properties

Solvent	*n*-Butyl acetate
% Nonvolatiles	74–76
Viscosity, poise (Brookfield DV-II, spindle #5, 50 rpm, 25°C)	12–32
Color, APHA	< 60
Acid number, mg KOH/g	< 8
Hydroxyl number, mg KOH/g	120–150
Density, lb/U.S. gal (kg/L)	8.8 (1.05)

Cross-linker selection

Partially butylated melamine resin is the preferred cross-linker for Tetrashield AC1001. The typical incorporation level is 30% on total resin solids; however, levels can be adjusted to balance desired performance. Formulations that incorporate highly methylated melamine systems should be carefully designed to achieve optimum gloss and appearance. For high-solids monocoat formulations, low-viscosity, highly reactive butylated melamine resins are optimal. In geographical regions of concern, it is suggested to carefully balance melamine selection to achieve high solids and desired reaction speed while minimizing formaldehyde content.

Catalyst selection

Full film properties are achieved by using blocked *p*-toluenesulfonic acid (PTSA) chemistry (for example, Nacure™ 2500 or Cycat® VXK 6395). Recommended dosage level of PTSA is 1.5–1.7 per hundred resin (PHR) on catalyst-supplied form. An alternate catalyst choice is a blocked dodecylbenzene sulfonic acid (DDBSA) type (for example, Nacure™ 5414 or Nacure™ 5225) with a dosage at 4.8–5.0 PHR on catalyst-supplied form. If electrostatic spray resistivity is too low, blocked DDBSA-type catalysts may be utilized to increase resistivity.

Additives and formulation techniques

Tetrashield AC1001 has excellent dispersing and grinding properties. It is compatible with most common additives used in pigmented monocoats.

Sag control agent/rheology modifiers

Sag control agent (SCA)-modified thermosetting acrylics are recommended and provide good sag limit control and application properties when combined with Tetrashield AC1001. Fumed silica is effective alone or in combination with standard SCA polymers to adjust rheological behavior. Addition of the SCA resin during the letdown stage should be incremental and done under continuous agitation to keep the dispersion intact.

Light stabilizer package

A UV stabilizer package containing 0.5% hindered amine light stabilizers (HALS) and 1.0% UV absorbers (UVA) of total formulation by weight provides extended durability to the applied coating. Light stabilizer package levels can be tailored based on quality requirements from the OEM. Tinuvin™ 123 type (HALS) and Tinuvin™ 1130, Tinuvin™ 900, Tinuvin™ 928, or Tinuvin 384™ type (UVA) are all suitable for Tetrashield AC1001 monocoat applications.

Surface additives

Various silicone, silicone-containing, and polyacrylate surface additives for enhancing final product performance are available. Formulators should select the correct surface additive and recommended dosage for their specific system needs.

Reducing solvent(s)

To achieve high application solids, ketones such as Eastman methyl amyl ketone (MAK) are recommended. However, aromatic solvents such as xylene, Aromatic 100, and Aromatic 150 are efficient reduction solvents to reach desired application viscosity.

Application recommendations

Fine atomization (high rpm on bell) application conditions deliver the highest quality films. For longer flash times between coats, it is critical to increase open time through use of slow evaporating solvents such as Eastman EB acetate.

Medium-solids white monocoat formulation

Raw material	Weight (%)	lb/100 gal	gal/100 gal	Supplier
Mill base				
Tetrashield AC1001	7.42	73.42	8.46	Eastman
Aromatic 100	3.84	38.00	5.24	—
DISPERBYK-110	0.89	8.81	1.03	BYK
AEROSIL™ 972	0.15	1.48	0.08	Evonik
Ti-Pure™ R-706	22.25	220.16	6.61	DuPont
Subtotal	*34.55*	*341.87*	*21.42*	—
Mill wash				
Tetrashield AC1001	7.42	73.42	8.46	Eastman
Aromatic 100	2.55	25.23	3.48	—
Subtotal	*44.52*	*440.53*	*33.36*	—
Letdown				
Tetrashield AC1001	15.97	158.02	18.21	Eastman
Setalux™ 91795 VX-60	9.57	94.70	11.58	Allnex
Eastman DB solvent	1.09	10.79	1.36	Eastman
Aromatic 100	4.21	41.66	5.75	—
Setamine™ US138	16.60	164.26	19.12	Allnex
Tinuvin™ 123	0.29	2.87	0.35	BASF
Tinuvin™ 1130	0.42	4.16	0.44	BASF
BYK-331 solution, 10 wt% in xylene	0.34	3.36	0.46	BYK
Nacure™ 2500	0.61	6.04	0.75	King Industries
AC1001 automotive thinner*	6.38	63.13	8.64	Eastman
Total	***100.00***	***989.50***	***100.00***	—

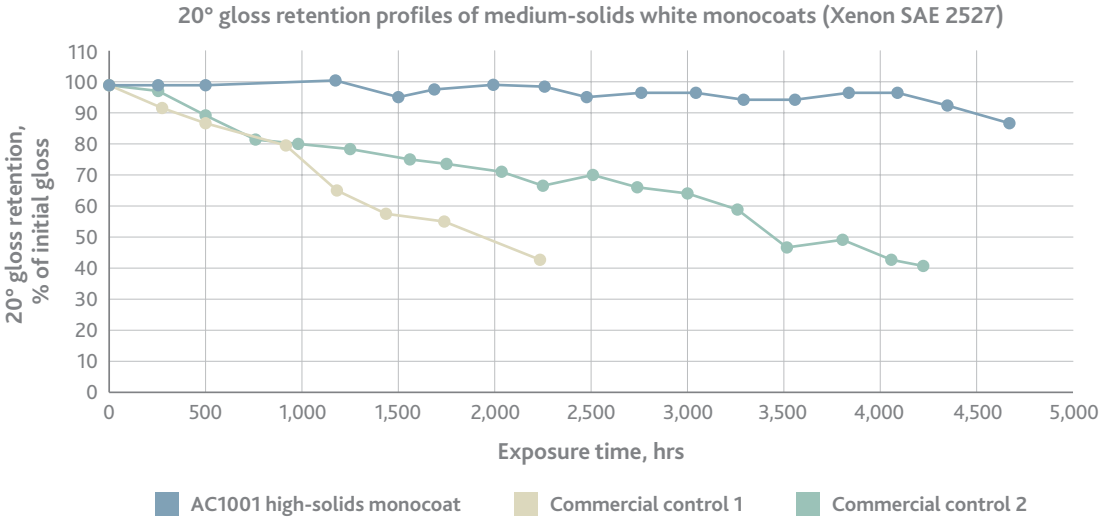
**Thinner is 40 parts xylene, 50 parts Aromatic 100, and 10 parts Eastman EB acetate by weight; thin to DIN #4 28 sec.*
Recommended curing conditions: 140°C for 30 minutes

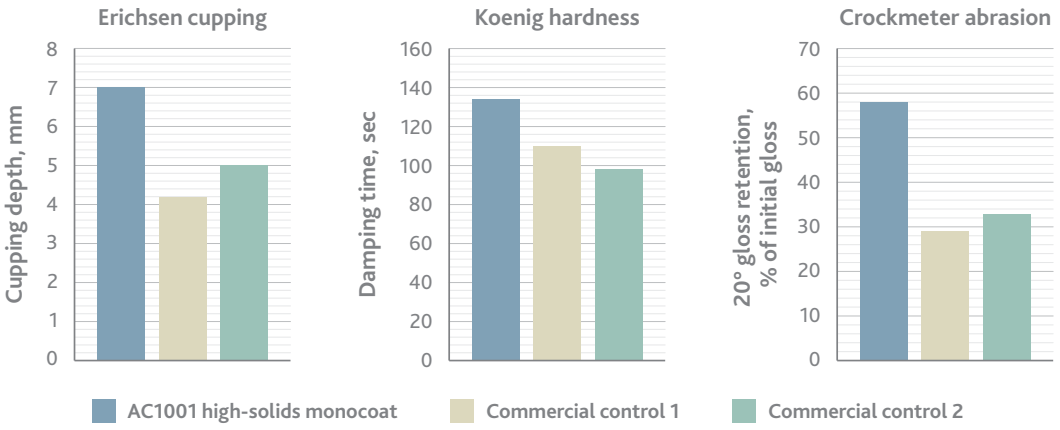
AC1001 medium-solids white formulation physicals	
% Nonvolatiles, weight	64.2
% Nonvolatiles, volume	51.0
Pigment-to-binder weight ratio	0.55:1
Melamine % of total resins	30.2
VOC, g/L	420
VOC, lb/gal	3.5
Pounds per gallon	9.9

AC1001 medium-solids white typical performance properties		
Property	**Test**	**Typical value**
Application viscosity	Din 4, sec	28–30
Application solids, %	110°C, 60 min	60–61
Gloss	20°	87–88
Hardness	Koenig pendulum, sec	130
Gloss retention, %	Crockmeter, 10 dbl rubs	58–60
Cupping	Erichsen	No cracking at 7 mm

Medium-solids white monocoat formulation benchmarking performance

Tetrashield AC1001 medium-solids white monocoat was compared with two commercially adopted solutions. The AC1001-based monocoat outperformed both commercial systems for durability, mar resistance, and flexibility/hardness characteristics.





High-solids white monocoat

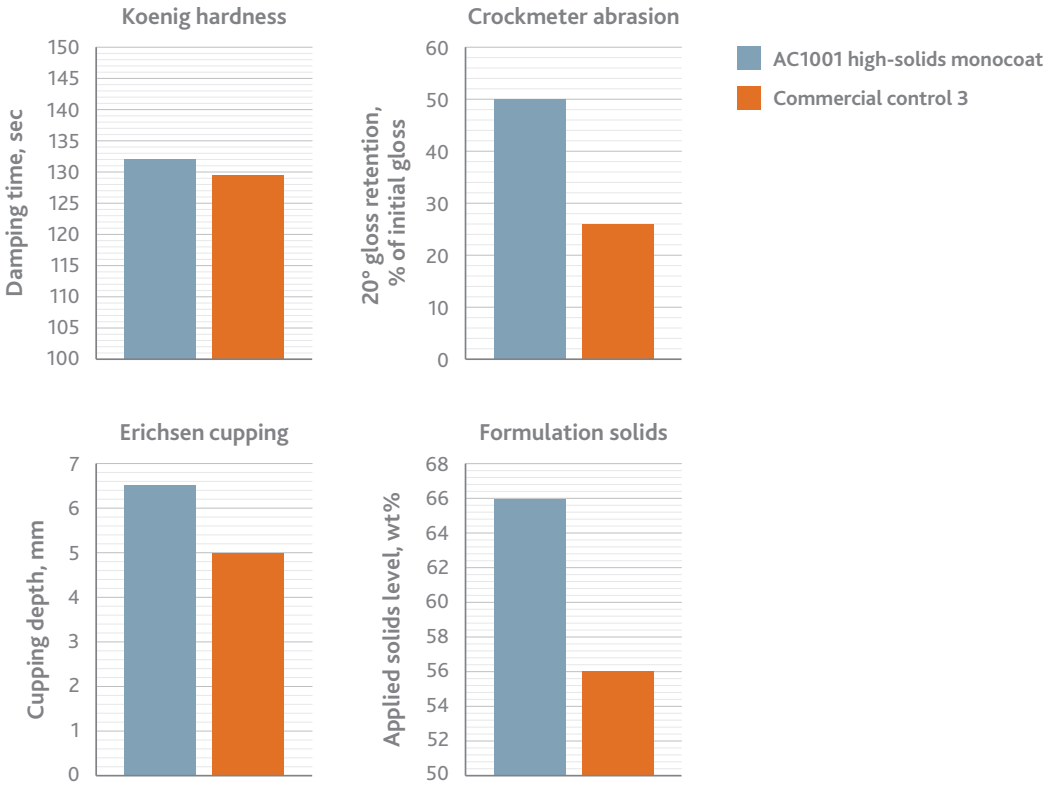
Raw material	Weight (%)	lb/100 gal	gal/100 gal	Supplier
Mill base				
Tetrashield AC1001	5.93	59.56	6.86	Eastman
Eastman butyl acetate	0.80	8.04	1.09	Eastman
Eastman DB solvent	0.40	4.02	0.51	Eastman
DISPERBYK-110	0.71	7.13	0.83	BYK
AEROSIL™ 972	0.15	1.51	0.08	Evonik
Ti-Pure™ R-706	23.30	234.04	7.02	DuPont
Subtotal	*31.29*	*314.29*	*16.40*	—
Mill wash				
Tetrashield AC1001	5.93	59.56	6.86	Eastman
Subtotal	*37.22*	*373.86*	*23.27*	—
Letdown				
Tetrashield AC1001	17.04	171.16	19.72	Eastman
Setalux™ 91795 VX-60	14.31	143.74	17.57	Allnex
Eastman DB solvent	0.69	6.93	0.88	Eastman
Luwipal™ 018	4.52	45.40	5.23	BASF
Luwipal™ 072	12.64	126.96	13.23	BASF
Tinuvin™ 123	0.21	2.11	0.26	BASF
Tinuvin™ 1130	0.42	4.22	0.44	BASF
BYK-331 solution, 10 wt% in xylene	0.34	3.42	0.46	BYK
Nacure™ 2500	0.60	6.03	0.74	King Industries
BYK™ 180	0.30	3.01	0.34	BYK
Eastman MAK	9.00	90.40	13.29	Eastman
Eastman EB acetate	2.50	25.11	3.20	Eastman
Eastman butyl acetate	1.00	10.04	1.37	Eastman
Total	***100.79***	***1012.39***	***100.00***	—

Recommended curing conditions: 140°C for 30 minutes

AC1001 high-solids white formulation physicals		AC1001 high-solids white typical performance properties		
% Nonvolatiles, weight	67.4	**Property**	**Test**	**Typical value**
% Nonvolatiles, volume	53.7	Application viscosity	Din 4, sec	28–32
Pigment-to-binder weight ratio	0.55:1	Application solids, %	110°C, 60 min	65–68
Melamine % of total resins	29.7	Gloss	20°	88–89
VOC, g/L	395	Hardness	Koenig pendulum, sec	125
VOC, lb/gal	3.3	Gloss retention, %	Crockmeter, 10 dbl rubs	50–52
Pounds per gallon	10.1	Cupping	Erichsen	No cracking at 6.5 mm

High-solids white monocoat formulation benchmarking performance

Tetrashield AC1001 high-solids white monocoat was tested alongside a high-solids white commercial system. The AC1001-based monocoat surpassed the commercial system for mar resistance and flexibility/hardness characteristics while simultaneously showing an increase of 10 wt% applied solids at equal viscosities.



With Eastman Tetrashield™ protective resin systems, you can formulate coatings that provide superior protection with a unique balance of durability and flexibility.

Tetrashield AC1001 has been shown in laboratory tests to extend UV stability, improve mar and scratch resistance, allow reduced VOC formulations, and enable optimization of the coating process for both OEMs and formulators. This high performance polyester resin can be formulated into both pigmented topcoats and clear coats while allowing formulators to increase volume solids.

In a world where the environment is tough on automotive coatings—and consumers are tough critics—protect what's important to you with Eastman Tetrashield™ protective resin systems.

For more information on Tetrashield, visit **www.eastman.com/Tetrashield**.

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