Eastman Liquid Additive 450

Introduction

Eastman Liquid Additive 450 was developed for high-solids coating systems used in industrial maintenance applications. This performance additive is a solution product provided in *tert*-butyl acetate. Liquid Additive 450 offers the following benefits in high-solids epoxy coatings:

- Improved sag resistance
- Minimal impact on formulation viscosity
- Improved tack-free time
- Excellent gloss and appearance
- No increase in volatile organic compound (VOC) content[1]

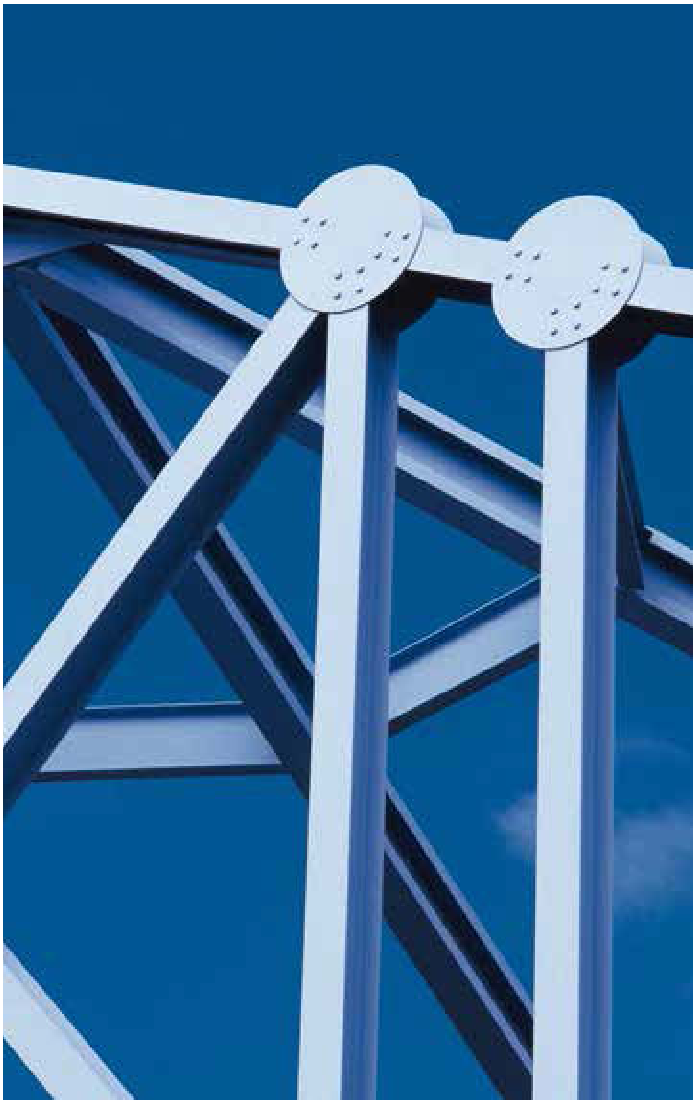
Limited studies have also shown that Eastman Liquid Additive 450 improves sag resistance with minimal impact on formulation viscosity in high-solids alkyd and urethane formulations.

High-solids epoxy coatings with Eastman Liquid Additive 450

To demonstrate the advantages of Eastman Liquid Additive 450, high-solids epoxy coating formulations were prepared with 1% and 3% (on epoxy resin solids) of Liquid Additive 450 (see Appendix A for formulation details). Liquid Additive 450 was added to the formulation at the end of the grind stage to ensure good mixing. These paints were compared to two control paints that differed only in the solvents used. The first control (Control 1) contained only xylene, and the other (Control 2) contained a mixture of xylene and *t*-butyl acetate to more closely match the solvent composition of a formulation containing Liquid Additive 450. This allowed the impact of the solvent change to be separated from the benefits of the Liquid Additive 450. All paints were made at 85 weight percent solids.

Paints were tested for a variety of performance properties. No significant differences were observed between the controls and the paints with Eastman Liquid Additive 450 in key properties such as salt fog resistance, pencil hardness, impact resistance, water resistance, and mandrel bend tests. Unless otherwise stated in the test method, properties were tested on drawdowns (5-mil dry film thickness) on cold rolled steel test panels (Q panel RI-36). Test methods are summarized in Appendix B.

This formulation did not have anticorrosive pigments and, therefore, had extensive scribe creep by 500 hours. The least scribe creep was seen with 1% of the Eastman Liquid Additive 450. The corrosion resistance of the unscribed area was not significantly affected by the addition of Liquid Additive 450.



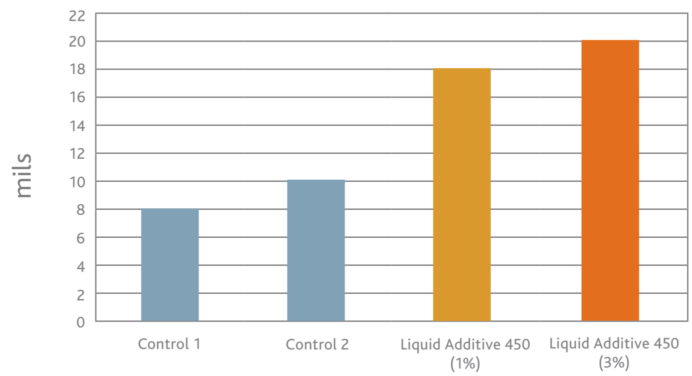
[1] *The U.S. EPA has added* t-*butyl acetate to the list of compounds which are exempt from the definition of VOC. Users should carefully review state and local regulatory requirements in their target regions to determine the status of* t-*butyl acetate in their application.*

Table 1. Salt fog results with and without Eastman Liquid Additive 450

	Unscribed area				Scribed area	
Rating scale	0–10		0–10	0–10	mm	0–10
	Blister size D714	Blister density D714	% area rust D610	% area rust D1654	Rust creepage D1654	Scribe blister size D714
300 hours						
1% Eastman Liquid Additive 450	None	None	10.0	10.0	1.0–2.0	8
3% Eastman Liquid Additive 450	8	Few	9.5	9.5	1.0–2.0	8
Control, xylene	None	None	10.0	10.0	1.0–2.0	8
Control, *t*-butyl acetate	8	Few	10.0	10.0	1.0–2.0	8
500 hours						
1% Eastman Liquid Additive 450	None	None	10.0	10.0	3.0–5.0	8
3% Eastman Liquid Additive 450	8	Few	9.5	9.5	5.0–7.0	6
Control, xylene	None	None	10.0	10.0	7.0–10.0	8
Control, *t*-butyl acetate	8	Few	10.0	10.0	7.0–10.0	8

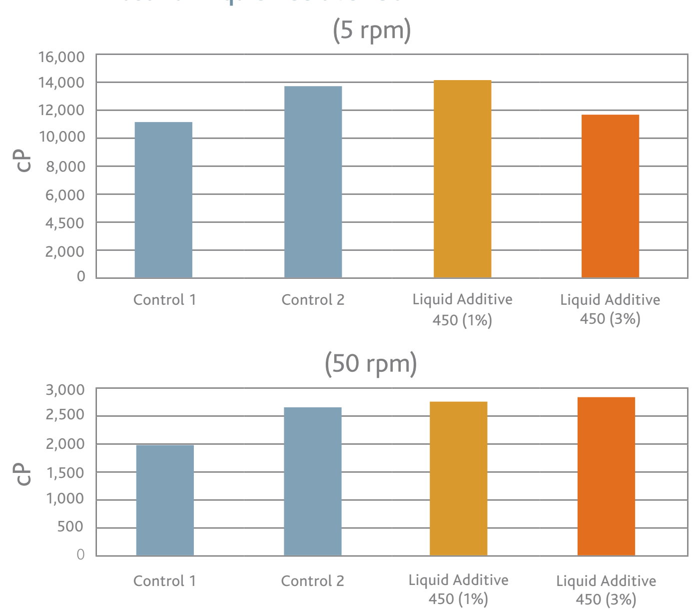
The benefits of Eastman Liquid Additive 450 sag results for paints with and without Liquid Additive 450 are seen in the significantly improved sag resistance at both 1% and 3% incorporation levels. The sag results are illustrated in Figure 1.

Figure 1. Sag results for paints with and without Eastman Liquid Additive 450



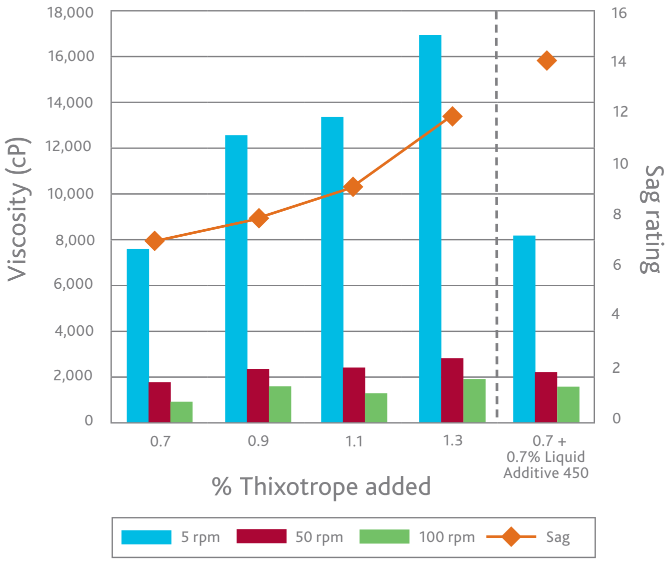
This increase in sag resistance is unique because Eastman Liquid Additive 450 gives only a minimal increase in the application viscosity of the paints. Viscosities for both the 1% and 3% Liquid Additive 450 paints are similar to the viscosities of the control paints. The Brookfield viscosity data for these paints is summarized in Figure 2.

Figure 2. Brookfield viscosities for paints with and without Eastman Liquid Additive 450



In comparison, if additional thixotrope is added to increase sag resistance, the application viscosity increases significantly. This difference is demonstrated in Figure 3.

Figure 3. Thixotrope addition compared to Eastman Liquid Additive 450



Tack-free time of the high-solids epoxy paints was evaluated with a Gardner linear dry time recorder and also by the zero-gram Zapon tack tester method (no weight added to the tack tester). Tack-free time is significantly shorter with the 3% level of Eastman Liquid Additive 450 in the paint. These results are shown in Figures 4 and 5.

Figure 4. Gardner tack-free times for paints with and without Eastman Liquid Additive 450

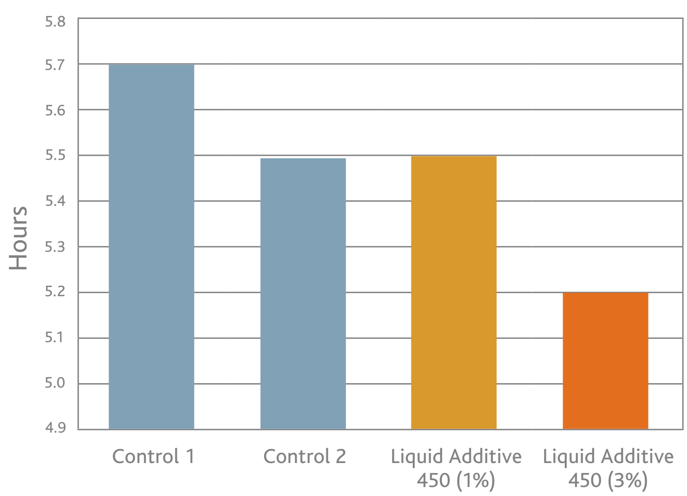
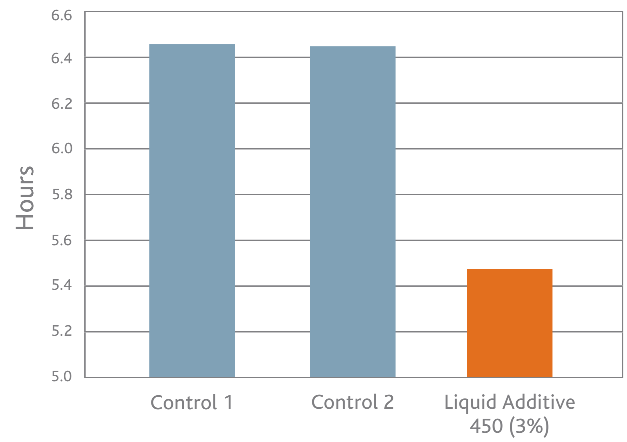
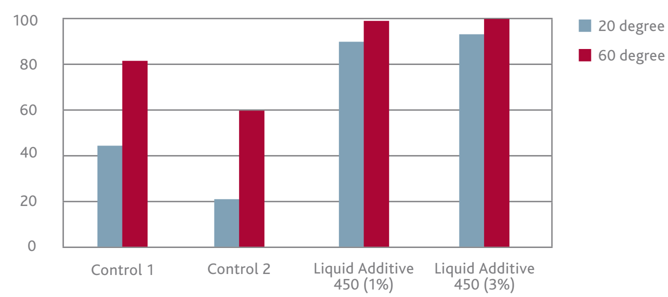


Figure 5. Zapon (zero gram) tack-free times for the paints with and without Eastman Liquid Additive 450



Gloss was also measured on the 1% and 3% Liquid Additive 450 paint to compare to the controls (Figure 6).

Figure 6. Gloss of paints with and without Eastman Liquid Additive 450



There is a significant improvement in both the 20° and 60° gloss when 1% or 3% Eastman Liquid Additive 450 is added to the paint.

High-solids urethane coatings with Eastman liquid Additive 450

Sag results (Figure 7) and formulation viscosities (Figure 8) are shown for paints with and without Eastman Liquid Additive 450 in a high-solids urethane formulation for industrial maintenance applications (see Appendix A for formulation details). As in epoxy formulations, Eastman Liquid Additive 450 significantly improved sag resistance when incorporated into the formulation at 1% additive solids on resin solids without a drastic increase in formulation viscosity.

Figure 7. Sag results for paints with and without Eastman Liquid Additive 450

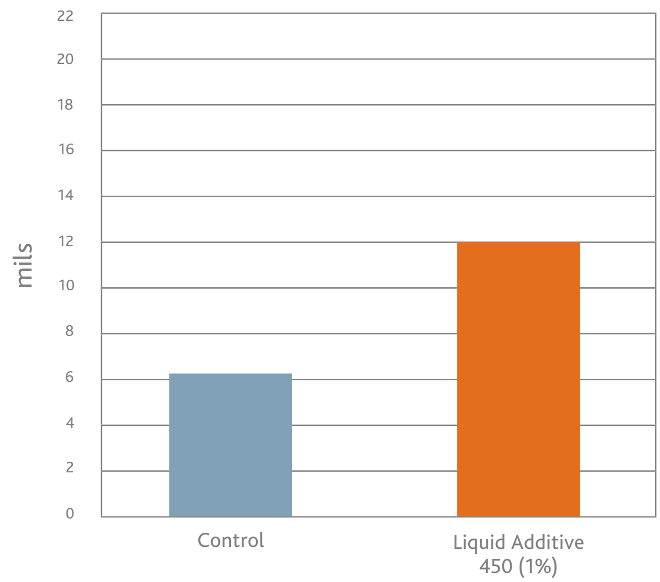
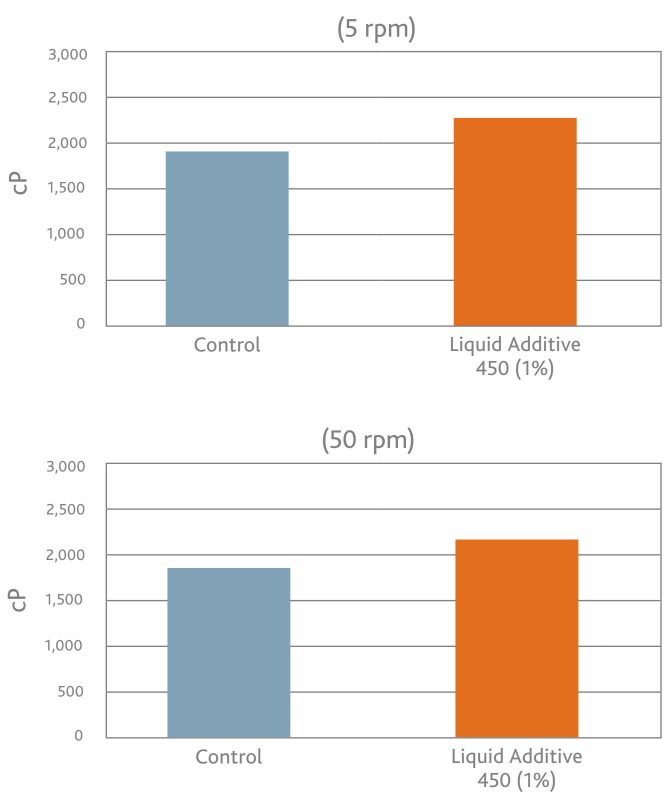


Figure 8. Brookfield viscosities for paints with and without Eastman Liquid Additive 450



High-solids alkyd coatings with Eastman Liquid Additive 450

Eastman Liquid Additive 450 was also incorporated into an alkyd formulation for industrial maintenance and marine (see Appendix A for formulation details). Again, Liquid Additive 450 significantly improved sag resistance when incorporated into the formulation at 3% additive solids on resin solids without a drastic increase in formulation viscosity.

Figure 9. Sag results for paints with and without Eastman Liquid Additive 450

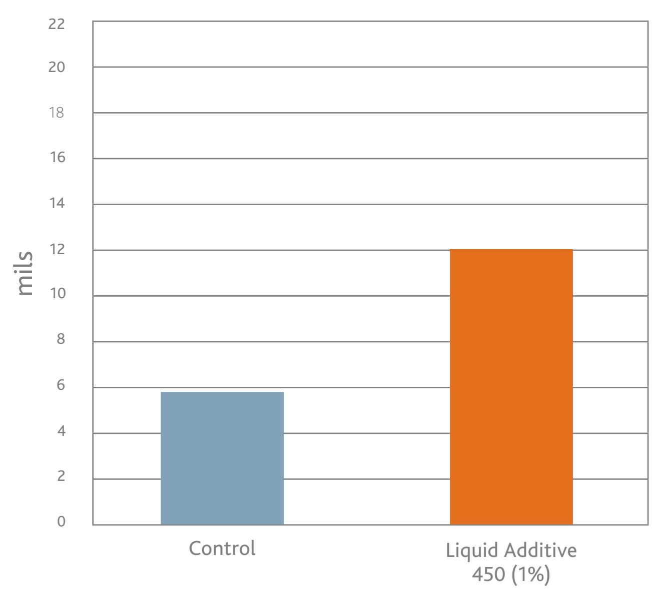
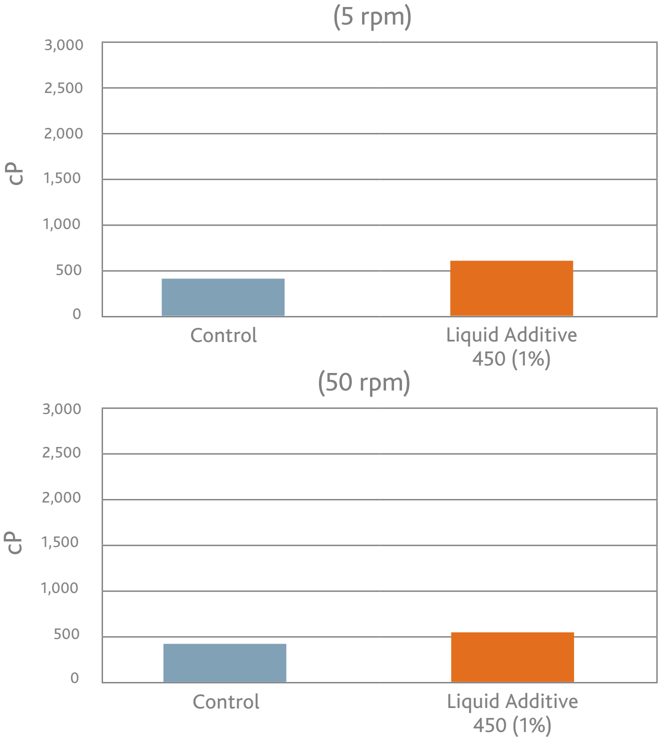
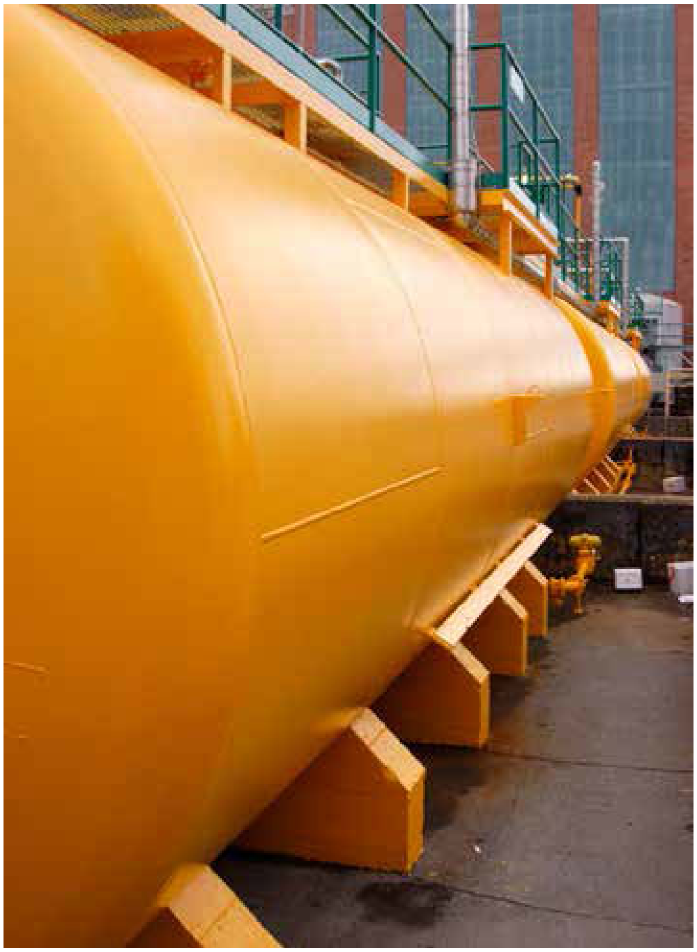


Figure 10. Brookfield viscosities for paints with and without Eastman Liquid Additive 450





Conclusion

Eastman Liquid Additive 450 significantly improved sag resistance, tack-free time, and gloss of the high-solids epoxy coating without negatively impacting formulation viscosity or VOC content. Significant improvement in sag resistance was also seen in high-solids alkyd and urethane formulations for industrial maintenance and marine coatings.

Appendix A

Epoxy formulations				
Ingredient	**Eastman Liquid Additive 450 (1%)**	**Eastman Liquid Additive 450 (3%)**	**Control (xylene)**	**Control (*t*-butyl acetate)**
Part A **Grind**				
EPON™ 828[a]	100.0	100.0	103.1	103.1
Disparlon™ 6650[b]	3.4	3.4	3.4	3.4
Ti-Pure™ R-706[c]	90.7	90.7	90.7	90.7
Huberbrite™ 3[d]	213.8	213.8	213.8	213.8
Xylene	5.0	5.0	5.0	5.0
High Sp disperse 20 min @ 3,000 rpm, 160°F **Letdown**				
Disparlon OX-70[b]	2.8	2.8	2.8	2.8
Eastman Liquid Additive 450[e]	4.0	12.4	—	—
Silquest™ A-187[a]	15.8	15.8	15.8	15.8
Xylene	—	—	37.5	—
t-butyl acetate[f]	34.5	28.0	—	37.5
Part B				
Ancamine™ 1618[g]	60.5	61.8	61.8	61.8
Xylene	10.7	10.9	10.9	10.9
Total	**541.2**	**544.6**	**544.8**	**544.8**
Total solids	**85.0**	**85.0**	**85.0**	**85.0**

[a]*Momentive Specialty Chemicals Performance Products* [b]*King Industries* [c]*DuPont* [d]*Huber* [e]*Eastman Chemical Company* [f]*LyondellBasell* [g]*Air Products*

Urethane formulations		
Ingredient	**Control**	**Eastman Liquid Additive 450 (3%)**
Part A Grind		
Acrylamac™ HS 232-2365[a]	51.3	51.3
Disperbyk™ 110[b]	3.7	3.7
Ti-Pure™ R-902[c]	188.4	188.4
n-butyl acetate[d]	7.4	7.4
Grind to a 7 Hegman		
Eastman Liquid Additive 450[d]	—	7.5
Letdown		
Acrylamac HS 232-2365[a]	183.4	183.4
Dabco™ T-12[e]	0.1	0.1
Disparlon™ OX-70[f]	4.0	4.0
Byk™ 306[b]	0.6	0.6
n-butyl acetate[d]	30.3	30.8
t-butyl acetate[g]	5.6	—
Part B		
Desmodur™ N 3300[h]	46.6	46.6
Total	**521.4**	**523.8**
Total solids	**81.7**	**81.7**

[a]*PCCR USA* [b]*BYK Chemie* [c]*DuPont* [d]*Eastman Chemical Company* [e]*Air Products*
[f]*King Industries* [g]*LyondellBasell* [h]*Bayer MaterialScience*

Alkyd formulations		
Ingredient	**Control**	**Eastman Liquid Additive 450 (3%)**
Grind		
Ti-Pure™ R-902[a]	49.3	49.3
BECKOSOL™ 5422-K3-75[b]	19.7	19.7
Xylene	9.9	9.9
Nuosperse™[c]	1.2	1.2
Disperse to 7 Hegman		
Eastman Liquid Additive 450[d]	—	7.5
Letdown		
BECKOSOL 5422-K3-75[b]	62.4	62.4
6% Cobalt Hex-Cem™[e]	0.5	0.5
6% Calcium Hex-Cem™[e]	1.2	1.2
6% Zirconium Hex-Cem™[e]	1.0	1.0
MEKO™ 2[f]	0.1	0.1
Xylene	17.2	17.6
t-butyl acetate	5.2	—
Total	**167.7**	**170.4**
Total solids	**67.3**	**67.3**

[a]DuPont [b]Reichhold [c]Elementis Specialties, Inc. [d]Eastman Chemical Company [e]OM Group
[f]DURA Chemicals Inc.

Appendix B: Test and measurement methods

Unless otherwise stated in the test method, paints were evaluated in 5-mil dry film thickness drawdowns on cold rolled steel test panels (Q panel RI-36).

ASTM B117 Operating Salt Fog Apparatus

ASTM D522 Mandrel Bend Test of Attached Organic Coatings (Method A)

ASTM D523 Specular Gloss

ASTM D610 Evaluation Degree of Rusting on Painted Steel Surfaces

ASTM D714 Evaluating Degree of Blistering of Paints

ASTM D870 Testing Water Resistance of Coatings Using Water Immersion
Panels were partially submerged and scribed to evaluate submerged area and area above submerged portion of panel.

ASTM D1474 Indentation Hardness of Coatings (Method A Tukon or Knoop Hardness)

ASTM D1640 Drying, Curing, or Film Formation of Organic Coatings at Room Temperature

ASTM D1654 Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

ASTM D2196 Rheological Properties of Non-Newtonian Materials by Rotational (Brookfield type) Viscometer

ASTM D2794 Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)

ASTM D3363 Film Hardness by Pencil Test

ASTM D4062 Leveling of Paints by drawdown method
Level Luminator was not used. Draw downs were compared to standards using lighting in laboratory and feel to evaluate the height of the ridges.

ASTM D4366 Hardness of Organic Coatings by Pendulum Damping Tests

ASTM D4400 Sag Resistance of Paints Using a Multi-notch Applicator

ASTM D4587 Fluorescent UV-Condensation Exposures of Paint and Related Coatings (Cycle 2)

ASTM D5402 Assessing the Solvent Resistance of Organic Coatings Using Solvent Rubs

ASTM D5895 Evaluating Drying or Curing During Film Formation of Organic Coatings Using Mechanical Recorders (Method A)

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