EASTMAN

Solventborne adhesion promoters for difficult-to-adhere-to substrates

Polyethylene, polypropylene and thermoplastic polyolefin (TPO) plastics are used in automotive parts, appliances, toys, containers, other molded items and packaging films. To decorate and/or protect products made of these plastics, manufacturers apply coatings or print aesthetic designs on the plastic part.

Manufacturers can use Eastman adhesion promoters in primers to promote sticking to untreated plastic parts. Other plastics and metal surfaces can also be made more receptive to inks and coatings using Eastman adhesion promoters.

Products meant to stick to automotive and industrial plastic have to stand up to harsh conditions, including exposure to gasoline, acid rain, chemicals and humidity. Eastman adhesion promoters hold up well under these and other environmental conditions.

For graphic arts and ink applications, Eastman adhesion promoters provide additional properties such as fast drying and enhanced elongation.

Table 1. Markets

Adhesion promoter	Market			
	Automotive	General industrial	Graphic arts	Adhesives
Eastman CP 730-1	✓	✓		✓
Eastman AP 550-1	✓	✓	✓	✓
Eastman CP 343-1	✓	✓		
Eastman CP 164-1	✓	✓		
Eastman CP 343-3	✓	✓	✓	✓
Eastman CP 515-2	✓	✓	✓	✓
Eastman CP 153-2		✓	✓	✓

Features and benefits

- Promote adhesion to polypropylene, polyethylene, TPO and other plastics
- Useful for one-step systems or primer formulas
- Useful for inks and coatings
- Promote adhesion to aluminum and galvanized steel
- Available in solution or powder form

Table 2. Eastman solventborne adhesion promoter selector chart

Eastman adhesion promoter	Application		Substrates					Performance properties and attributes		
	Used in primer	Used in coating	TPO[a]	PP[b]	PE[c]	Non-olefin plastics[d]	Metal[e]	Humidity resistance	Fuel resistance	Compatibility
CP 730-1 20% in xylene, Aromatic 100	✓		✓	✓		✓	✓	●	●	◑
AP 550-1 25% in xylene, Aromatic 100	✓		✓	✓			✓	◔	●	◔
CP 343-1 25%, 40%, 50% in xylene 100% solids	✓		✓	✓		✓	✓	●	◔	◑
CP 343-3 25%, 50% in xylene	✓	✓	✓	✓		✓	✓	◑	○	●
CP 515-2 40% in xylene, toluene, Aromatic 100		✓	✓	✓		✓	✓	◔	○	●
CP 153-2 25% in xylene	✓				✓			◑	◔	◑

● Excellent ◔ Good ◑ Average ◔ Fair ○ Poor

[a] *TPO = thermoplastic polyolefin*

[b] *PP = polypropylene*

[c] *PE = polyethylene*

[d] *Non-olefin plastics = nylon, PPE/PA, ABS*

[e] *Metals = polished aluminum, galvanized steel and contaminated steel*

Table 3. Typical properties[a] of Eastman adhesion promoters

	Specific gravity @ 25°C (g/mL)	Weight, per gallon (lb/gal)	Chlorine, wt%	Gardner, color	Softening point range, °C	Flash point, °C (TOC)
Eastman CP 730-1 adhesion promoter						
20% in xylene	0.90	7.51	21–23	4	—	26[b]
20% in Aromatic 100	0.90	7.51	21–23	4	—	26[b]
Eastman AP 550-1 adhesion promoter						
25% in xylene	0.88	7.34	0	4	—	27[b]
25% in Aromatic 100	0.88	7.34	0	4	—	47[b]
Eastman CP 343-1 adhesion promoter						
25% in xylene	0.90	7.51	18–23	7	—	27
40% in xylene	0.93	7.76	18–23	8	—	23
50% in xylene	0.94	7.84	18–23	8	—	28
100%	1.03 (@ 23°C)	8.60 (@ 23°C)	18–23	Light tan powder	80–95	274
Eastman CP 343-3 adhesion promoter						
25% in xylene	0.91	7.59	26–32	6–7	—	23
50% in xylene	0.99	8.26	26–32	11	—	27
Eastman CP 515-2 adhesion promoter						
40% in xylene	0.96	8.01	26–32	3	—	28
40% in toluene	0.96	8.01	26–32	3	—	5
40% in Aromatic 100	0.94	7.84	26–32	7	—	41
Eastman CP 153-2 adhesion promoter						
25% in xylene	0.97	8.10	21–25	12–15	—	30

[a] *Eastman makes no representation that the material in any particular shipment will conform exactly to the values given.*

[b] *Pensky-Martens closed cup*

Eastman adhesion promoters with low chlorine levels are soluble in aromatic hydrocarbons such as xylene, toluene and Aromatic 100. Cyclic hydrocarbon solvents such as methylcyclohexane and ethylcyclohexane can be used to dilute them. Low-chlorine materials are not soluble in aliphatic hydrocarbons, esters, ketones or alcohols but can be diluted as supplied with some long-chain ketones and esters such as methyl amyl ketone and *n*-butyl propionate. When diluting them with long-chain ketones and esters, the solutions may appear hazy. This haze does not appear to affect how the product works.

Eastman CP 343-3 and CP 515-2 adhesion promoters are high-chlorine chlorinated polyolefins (CPO) that have a greater tolerance for esters and ketones as shown in Table 4. Their greater tolerance for esters and ketones makes them easier to incorporate into topcoat systems.

Table 4. Solubility properties of Eastman adhesion promoters[a]

Diluted 5% N.V. Adpro with:	Xylene	Toluene	Aromatic 100	Heptane	Tetrahydrofuran	Ethyl acetate	*n*-Propyl acetate	*n*-Butyl acetate	Methyl ethyl ketone	Methyl *n*-amyl ketone	Ethyl alcohol
Eastman CP 730-1 adhesion promoter											
20% in xylene	✓	✓	✓	x	✓	x	x	x	x	x	x
20% in Aromatic 100	✓	✓	✓	x	✓	x	x	x	x	x	x
Eastman AP 550-1 adhesion promoter											
25% in xylene	✓	✓	✓	x	x	x	x	x	x	x	x
25% in Aromatic 100	✓	✓	✓	x	x	x	x	x	x	x	x
Eastman CP 343-1 adhesion promoter											
25% in xylene	✓	✓	✓	x	✓	x	x	x	x	x	x
40% in xylene	✓	✓	✓	x	✓	x	x	x	x	x	x
50% in xylene	✓	✓	✓	x	✓	x	x	x	x	x	x
100%	✓	✓	✓	x	✓	x	x	x	x	x	x
Eastman CP 343-3 adhesion promoter											
25% in xylene	✓	✓	✓	x	✓	✓	✓	✓	✓	✓	x
50% in xylene	✓	✓	✓	x	✓	✓	✓	✓	✓	✓	x
Eastman CP 515-2 adhesion promoter											
40% in xylene	✓	✓	✓	x	✓	x	✓	x	✓	✓	x
40% in toluene	✓	✓	✓	x	✓	x	✓	x	✓	✓	x
40% in Aromatic 100	✓	✓	✓	x	✓	x	✓	x	✓	✓	x
Eastman CP 153-2 adhesion promoter											
25% in xylene	✓	✓	✓	x	✓	x	x	x	x	x	x

Legend: ✓ = reducible to 5% nonvolatile adhesion promoter x = not reducible to 5% nonvolatile adhesion promoter

[a]*Solubility of adhesion promoter, as supplied, diluted to 5% nonvolatile in a variety of solvents*

Storage and handling of solventborne CPOs

Eastman CP 730-1, AP 550-1, CP 343-1 and CP 153-2, used predominately as primers, have limited solubility and thus provide excellent redissolve resistance. Because of limited solubility, solutions of these adhesion promoters may become hazy, partially precipitate from solution, or gel with time on exposure to low temperature. **Should any of those conditions occur, warming the contents to approximately 38°–49°C (100°–120°F) while keeping away from sparks and open flame, with mild agitation, will generally return the product to its original condition. Static electricity with associated hazards can build up during handling or mixing nonpolar solvents such as xylene or toluene. It is the users' responsibility to determine the suitability of this information for their specific operations and to take all necessary precautions to ensure the safety and health of their employees and protection of the environment.**

Storage of CP 730-1, AP 550-1, CP 343-1 and CP 153-2 solution products near 25°C (77°F) will minimize haze and gel formation. **Storage above 50°C (122°F) may affect product quality.**

Eastman CP 730-1 adhesion promoter

Eastman CP 730-1 is designed to be the active component in automotive adhesion promoter primers used to ensure adhesion of color coats and topcoats to polypropylene (PP) and thermoplastic olefin (TPO) plastics for exterior and interior applications.

Eastman CP 730-1 adhesion promoter provides excellent adhesion properties for all typical base coat chemistries. Adhesion promoters built around CP 730-1 exhibit superior gasoline and humidity resistance, which are required for the newer, high-modulus TPOs used today. Excellent adhesion performance is also achieved on other difficult substrates such as aluminum, galvanized steel, cold rolled steel, and difficult-to-adhere-to non-olefin plastics such as nylon, ABS and other engineering plastic blends.

Eastman CP 730-1 is available at 20 wt% solids in Aromatic 100 or in xylene.

Compatibility

Table 5 shows the compatibility of Eastman CP 730-1 with a variety of coating resins.

Table 5. Compatibility of Eastman CP 730-1

Sample	Duramac™ HS 207-2706[a]	Polymac™ HS 057-5776[a]	Polymac™ HS 220-2010[a]	Polymac™ HS 57-5789[a]	Desmophen™ 670A 80[b]	Paraloid™ AU608X[c]	Acrylamac™ 232-1700[a]	Epon™ 828[d]	Xylene	Eastman CP 730-1 (20% in A-100)[e]	9:1	1:1	Ambient conditions	Heated @ 60°C (1 h)[f]	Rating[g]
1	6.26	—	—	—	—	—	—	—	68.8	25.0		•	•		H
2	11.26	—	—	—	—	—	—	—	83.8	5.0	•		•		I
3	6.26	—	—	—	—	—	—	—	68.8	25.0		•		•	I
4	11.26	—	—	—	—	—	—	—	83.8	5.0	•			•	I
5	—	5.88	—	—	—	—	—	—	69.2	25.0		•	•		C
6	—	10.58	—	—	—	—	—	—	84.4	5.0	•		•		C
7	—	5.88	—	—	—	—	—	—	69.2	25.0		•		•	C
8	—	10.58	—	—	—	—	—	—	84.4	5.0	•			•	C
9	—	—	6.66	—	—	—	—	—	68.4	25.0		•	•		SH
10	—	—	12.00	—	—	—	—	—	83.0	5.0	•		•		SH
11	—	—	6.66	—	—	—	—	—	68.4	25.0		•		•	SH
12	—	—	12.00	—	—	—	—	—	83.0	5.0	•			•	SH
13	—	—	—	5.88	—	—	—	—	69.2	25.0		•	•		C
14	—	—	—	10.58	—	—	—	—	84.4	5.0	•		•		C
15	—	—	—	5.88	—	—	—	—	69.2	25.0		•		•	C
16	—	—	—	10.58	—	—	—	—	84.4	5.0	•			•	C
17	—	—	—	—	—	—	—	—	68.8	25.0		•	•		I
18	—	—	—	—	—	—	—	—	83.8	5.0	•		•		I
19	—	—	—	—	—	—	—	—	68.8	25.0		•		•	I
20	—	—	—	—	—	—	—	—	83.8	5.0	•			•	I
21	—	—	—	—	6.26	—	—	—	68.8	25.0		•	•		I
22	—	—	—	—	11.26	—	—	—	83.8	5.0	•		•		I
23	—	—	—	—	6.26	—	—	—	68.8	25.0		•		•	I
24	—	—	—	—	11.26	—	—	—	83.8	5.0	•			•	I
25	—	—	—	—	—	8.34	—	—	66.6	25.0		•	•		I
26	—	—	—	—	—	15.00	—	—	80.0	5.0	•		•		I
27	—	—	—	—	—	8.34	—	—	66.6	25.0		•		•	I
28	—	—	—	—	—	15.00	—	—	80.0	5.0	•			•	I
29	—	—	—	—	—	—	8.34	—	66.6	25.0		•	•		I
30	—	—	—	—	—	—	15.00	—	80.0	5.0	•		•		H
31	—	—	—	—	—	—	8.34	—	66.6	25.0		•		•	I
32	—	—	—	—	—	—	15.00	—	80.0	5.0	•			•	H
33	—	—	—	—	—	—	—	5	70.0	25.0		•		•	C
34	—	—	—	—	—	—	—	9	86	5.0	•			•	C

[a]Resin supplied by Polynt

[b]Resin supplied by Covestro

[c]Resin supplied by Dow

[d]Ratings for solutions: C = compatible; I = incompatible; H = hazy; SH = slightly hazy

[e]Resin supplied by Miller-Stephenson

[f]CPO used was Eastman CP730-120% solids in Aromatic 100.

[g]Samples were heated at 60°C for 1 hr and evaluated the next day.

How to use

Eastman CP 730-1 is an adhesion-promoting resin that can be used in primers for polypropylene-based substrates. When used in primer applications, it can be used alone or formulated with other resins to make up the adhesion-promoting primer. CP 730-1 may also be used as an additive to improve adhesion to polypropylene-based substrates.

When using CP 730-1 as an additive, its compatibility should be determined before use.

Primer applications

- Clean substrate with isopropyl alcohol.
- Prepare Eastman CP 730-1 adhesion promoter as a primer at 5%–10% solids and apply to the substrate at a thickness of 0.1–0.3 mil (2.5–7.5 µ).
- Primer may be air dried or heated at 80°C for about 10 minutes.
- Topcoats can be applied when the primer dries.

Additive applications

- Clean substrate with isopropyl alcohol.
- Add 5%–25% Eastman CP 730-1, based on resin solids, to the coating, ink or adhesive and mix thoroughly.
- Test for compatibility or effect on dry film properties.
- If that does not work, increase the amount of Eastman CP 730-1 until it sticks. Monitor any effects the additional CP 730-1 has on dry film properties.

Performance as a primer

Table 6. Percent retained adhesion of various automotive OEM topcoats on Sequel[a] 1440 TPO after exposure to Cleveland humidity (ASTM D4585 at 58°C)

Topcoat	Coating bake temperature, °C	Time, hr	% retained adhesion
1K/1K[b] (silver)	120	504	100
1K/2K[c] (white)	120	504	100
2K/2K[d] (white)	80	504	100

[a]Solvay Sequel 1440 TPO has been discontinued.

[b]1K/1K = 1-part melamine-cured base coat/1-part melamine-cured clear coat

[c]1K/2K = 1-part melamine-cured base coat/2-part polyurethane-cured clear coat

[d]2K/2K = 2-part polyurethane-cured base coat/2-part polyurethane-cured clear coat

Table 7. Gasoline resistance (GM 9501P Method B) on Sequel[a] 1440 TPO

Topcoat	Coating bake temperature, °C	Time, h	% retained adhesion
1K/1K[b] (silver)	120	1	100/11
1K/1K[b] (white)	120	1	100/22
1K/1K[b] (white)	120	1	100/23

[a]Solvay Sequel 1440 TPO has been discontinued.

[b]1K/1K = 1-part melamine-cured base coat/1-part melamine-cured clear coat

Table 8. Gasoline resistance (Ford-modified Juntunen) on Sequel 1440 TPO

Topcoat	Coating bake temperature, °C	Time, hr	% retained adhesion
1K/1K[a] (silver)	120	1	100/0; edge
1K/2K[b] (blue)	120	1	98/0; edge
2K/2K[c] (white[b])	80	1	91/0; edge

[a]1K/1K = 1-part melamine-cured base coat/1-part melamine-cured clear coat

[b]1K/2K = 1-part melamine-cured base coat/2-part polyurethane-cured clear coat

[c]2K/2K = 2-part polyurethane-cured base coat/2-part polyurethane-cured clear coat

Eastman adhesion promoters were designed to promote adhesion of coatings, inks and adhesives applied over polypropylene- and polyethylene-based substrates but can also be used on difficult-to-adhere-to, non-olefin plastic substrates. Table 9 shows the adhesion-promoting properties of Eastman CP 730-1 and Eastman AP 550-1 when used as primers for a variety of non-olefin plastic substrates.

Table 9. Percent retained adhesion of automotive OEM topcoat[a] applied over non-olefin plastics

Substrate	Adhesion promoter	Initial adhesion (ASTM D33598)	Adhesion after 72 hours humidity (ASTM D3359 B w/ASTM D4585), 120°F
Nylon[b]	Eastman CP 730-1	100	100
Nylon	None	0	—
Nylon[b]	Eastman AP 550-1	100	100
Nylon	None	0	—
PPE/PA[c]	Eastman CP 730-1	100	100
PPE/PA	None	0	—
PPE/PA[c]	Eastman AP 550-1	40	0
PPE/PA	None	0	—
ABS[d]	Eastman CP 730-1	100	100
ABS	None	20	0
ABS[d]	Eastman AP 550-1	60	0
ABS	None	20	0
PPE[e]	Eastman CP 730-1	100	100
PPE	None	100	100
PPE[e]	Eastman AP 550-1	40	0
PPE	None	100	100

[a]Automotive OEM base coat/clear coat system (baked at 170°F for 40 min)

[b]BASF Capron™ nylon resin (production in North America discontinued in 2007)

[c]Sabic Noryl™ GTX902

[d]Trinseo Magnum™ 3490 ABS

[e]Sabic Noryl™ BN 9300 polyphenylene ether

Eastman adhesion promoters were designed to promote adhesion of coatings, inks and adhesives applied on polypropylene- and polyethylene-based substrates but can also be used on difficult-to-adhere-to metal substrates. Table 10 shows the adhesion-promoting properties of Eastman CP 730-1 and Eastman AP 550-1 when used in primers for untreated steel, oily steel, polished aluminum and galvanized steel.

Table 10. Percent retained adhesion of automotive OEM topcoat[a] applied over metal substrates

Substrate	Adhesion promoter	Initial adhesion (ASTM D33598)	Adhesion after 72 hours humidity (ASTM D3359 B w/ASTM D4585), 120°F
Untreated steel[b]	Eastman CP 730-1	100	100
Untreated steel	None	100	100
Untreated steel[b]	Eastman AP 550-1	100	100
Untreated steel	None	100	100
Oily steel[c]	Eastman CP 730-1	100	100
Oily steel	None	0	—
Oily steel[c]	Eastman AP 550-1	20	0
Oily steel	None	0	—
Polished aluminum[d]	Eastman CP 730-1	100	100
Polished aluminum	None	0	—
Polished aluminum[d]	Eastman AP 550-1	100	100
Polished aluminum	None	0	—
Galvanized steel[e]	Eastman CP 730-1	100	100
Galvanized steel	None	0	—
Galvanized steel[e]	Eastman AP 550-1	100	0
Galvanized steel	None	0	—

[a]Automotive OEM base coat/clear coat system (baked @ 170°F for 40 minutes)
[b]S-36 ground steel panels supplied by Q-Panel Corporation
[c]S-36 steel panel contaminated with WD-40 lubricant
[d]Polished aluminum supplied by Q-Panel Corporation
[e]Hot-dipped, galvanized HB-G70 supplied by ACT

Eastman AP 550-1 adhesion promoter

Eastman AP 550-1 is a second-generation, nonchlorinated polyolefin for adhesion to TPO and PP.

Nonchlorinated systems are known to demonstrate excellent performance under two-part (2K) urethane coatings, but their application is often limited to 2Ks. AP 550-1 expands nonchlorinated performance to applications in melamine-cured and lacquer systems.

Due to its chemical structure and the absence of chlorine, Eastman AP 550-1 shows excellent gasoline resistance. Formulators should see an increase in gasoline resistance by adding AP 550-1.

Eastman AP 550-1 is available at 25 wt% solids in Aromatic 100 or in xylene.

Compatibility

Table 11 shows the compatibility of Eastman AP 550-1 with a variety of coating resins.

Table 11. Eastman AP 550-1 (25% in xylene) resin compatibility

Sample	Duramac™ HS 207-2706[a]	Polymac™ HS 057-5776[a]	Polymac™ HS 220-2010[a]	Polymac™ HS 57-5789[a]	Desmophen™ 670A 80[b]	Paraloid™ AU608X[c]	Acrylamac™ 232-1700[a]	Cymel™ U-80[d]	Cymel™ 303[d]	Epon™ 828[e]	Xylene	Eastman AP 550-1 (25%)[f]	9:1	1:1	Ambient conditions	Heated @ 60°C (1 hr)[g]	Rating[h]
1	6.26	—	—	—	—	—	—	—	—	—	73.7	20.4	—	•	•	—	H
2	11.26	—	—	—	—	—	—	—	—	—	84.7	4.0	•	—	•	—	I
3	6.26	—	—	—	—	—	—	—	—	—	73.7	20.0	—	•	—	•	I
4	11.26	—	—	—	—	—	—	—	—	—	84.7	4.0	•	—	—	•	I
5	—	5.88	—	—	—	—	—	—	—	—	74.1	20.0	—	•	•	—	C
6	—	10.58	—	—	—	—	—	—	—	—	85.4	4.0	•	—	•	—	C
7	—	5.88	—	—	—	—	—	—	—	—	74.1	20.0	—	•	—	•	C
8	—	10.58	—	—	—	—	—	—	—	—	85.4	4.0	•	—	—	•	C
9	—	—	6.66	—	—	—	—	—	—	—	73.3	20.0	—	•	•	—	H
10	—	—	12.00	—	—	—	—	—	—	—	84.0	4.0	•	—	•	—	I
11	—	—	6.66	—	—	—	—	—	—	—	73.3	20.0	—	•	—	•	I
12	—	—	12.00	—	—	—	—	—	—	—	84.0	4.0	•	—	—	•	I
13	—	—	—	5.88	—	—	—	—	—	—	74.1	20.0	—	•	•	—	C
14	—	—	—	10.58	—	—	—	—	—	—	85.4	4.0	•	—	•	—	C
15	—	—	—	5.88	—	—	—	—	—	—	74.1	20.0	—	•	—	•	C
16	—	—	—	10.58	—	—	—	—	—	—	85.4	4.0	•	—	—	•	C
17	—	—	—	—	—	—	—	5.20	—	—	74.8	20.0	—	•	•	—	C
18	—	—	—	—	—	—	—	9.38	—	—	86.6	4.0	•	—	•	—	C
19	—	—	—	—	—	—	—	5.20	—	—	74.8	20.0	—	•	—	•	C
20	—	—	—	—	—	—	—	9.38	—	—	86.6	4.0	•	—	—	•	C
21	—	—	—	—	6.26	—	—	—	—	—	73.7	20.0	—	•	•	—	I
22	—	—	—	—	11.26	—	—	—	—	—	84.7	4.0	•	—	•	—	I
23	—	—	—	—	6.26	—	—	—	—	—	73.7	20.0	—	•	—	•	I
24	—	—	—	—	11.26	—	—	—	—	—	84.7	4.0	•	—	—	•	I
25	—	—	—	—	—	8.34	—	—	—	—	71.7	20.0	—	•	•	—	I
26	—	—	—	—	—	15.00	—	—	—	—	81.0	4.0	•	—	•	—	I
27	—	—	—	—	—	8.34	—	—	—	—	71.7	20.0	—	•	—	•	I
28	—	—	—	—	—	15.00	—	—	—	—	81.0	4.0	•	—	—	•	I
29	—	—	—	—	—	—	8.34	—	—	—	71.7	20.0	—	•	•	—	I
30	—	—	—	—	—	—	15.00	—	—	—	81.0	4.0	•	—	•	—	I
31	—	—	—	—	—	—	8.34	—	—	—	71.7	20.0	—	•	—	•	I
32	—	—	—	—	—	—	15.00	—	—	—	81.0	4.0	•	—	—	•	I
33	—	—	—	—	—	—	—	—	5.00	—	75.0	20.0	—	•	•	—	C
34	—	—	—	—	—	—	—	—	9.00	—	87.0	4.0	•	—	•	—	C
37	—	—	—	—	—	—	—	—	—	5	75.0	20.0	—	•	—	•	H
38	—	—	—	—	—	—	—	—	—	9	87.0	4.0	•	—	—	•	H

[a] *Resin supplied by Polynt*

[b] *Resin supplied by Covestro*

[c] *Resin supplied by Dow*

[d] *Resin supplied by Allnex*

[e] *Resin supplied by Miller-Stephenson*

[f] *Adhesion promoter used was Eastman AP 551-1 25% in xylene.*

[g] *Samples were heated at 60°C for 1 hr and evaluated the next day.*

[h] *Ratings for solutions: C = compatible; I = incompatible; H = hazy*

How to use

Eastman AP 550-1 (25% in Aromatic 100 or xylene) can be used for similar applications as chlorinated polyolefins, which are described in other Eastman publications.

Primer applications

- Clean substrate with isopropyl alcohol.
- Prepare Eastman AP 550-1 at 5%–10% solids and apply to the substrate at a thickness of 0.1–0.3 mil (2.5–7.5 µ).
- Primer may be air dried or heated at 80°C (176°F) for about 10 minutes.
- Topcoats can be applied as soon as the primer has dried.

Additive applications

- Clean substrate with isopropyl alcohol.
- Add 5%–15% Eastman AP 550-1, based on resin solids, to the coating and mix thoroughly.
- Test for compatibility or effect on dry film properties.
- If that doesn't work, increase the amount of Eastman AP 550-1 until it does. Monitor any effects the additional AP 550-1 has on dry film properties.

Performance as a primer

Table 12. Percent retained adhesion of various automotive OEM topcoats on Sequel 1440[a] TPO after exposure to Cleveland humidity (ASTM D4585 at 49°C [120°F])

Topcoat	Coating bake temperature, °C	Time, hr	% retained adhesion
1K/1K[b]	121 (250)	300-500	100
1K/2K[c]	121 (250)	504	100
2K/2K[d]	80 (176)	50	100

[a]Solvay Sequel 1440 TPO has been discontinued.

[b]1K/1K = 1-part melamine-cured base coat/1-part melamine-cured clear coat

[c]1K/2K = 1-part melamine-cured base coat/2-part polyurethane-cured clear coat

[d]2K/2K = 2-part polyurethane-cured base coat/2-part polyurethane-cured clear coat

Table 13. Gasoline resistance (Ford-modified Juntunen) on Sequel 1440[a] TPO

Topcoat	Coating bake temperature, °C	Time, h	% retained adhesion
1K/1K[b] (silver)	121 (250)	1	100/0
1K/2K[c] (blue)	121 (250)	1	100/0
2K/2K[d] (white[c])	80 (176)	1	100/0

[a]Solvay Sequel 1440 TPO has been discontinued.

[b]1K/1K = 1-part melamine-cured base coat/1-part melamine-cured clear coat

[c]1K/2K = 1-part melamine-cured base coat/2-part polyurethane-cured clear coat

[d]2K/2K = 2-part polyurethane-cured base coat/2-part polyurethane-cured clear coat

Eastman CP 343-1 adhesion promoter

Eastman CP 343-1 is an excellent general-purpose adhesion promoter for paint applied to PP and TPO surfaces. CP 343-1 has a chlorine content of 18–23 wt% and a softening point range of 80°–95°C. CP 343-1 can also be used on other difficult-to-adhere-to substrates.

CP 343-1 is available in four different forms: 100% solids and 25, 40 or 50 wt% solids in xylene.

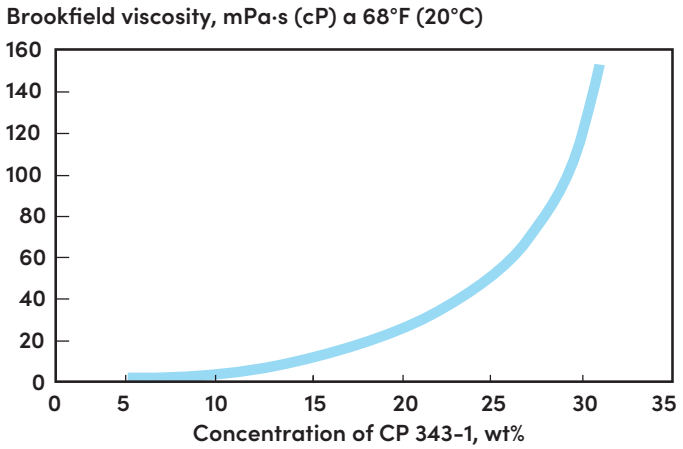
CP 343-1 comes in powder form. CP 343-1 25% solids in xylene is a liquid at room temperature.

Eastman CP 343-1 40 and 50 wt% solids in xylene are viscous liquids and, depending on storage temperature, can be gelled at room temperature. These products can be liquefied again by warming to 38°C with agitation.

Solubility

Figure 1 shows the effect of concentration on solution viscosity of CP 343-1 in toluene. The variation of viscosity with concentration in other solvents would be expected to be similar, although the actual values would be different.

Figure 1. Viscosity of solutions of Eastman CP 343-1 at various concentrations in toluene



Compatibility

The compatibility of Eastman CP 343-1 with a variety of resins is shown in Table 14. Resins that gave clear solutions and deposited clear films when combined with CP 343-1 are called compatible. Although CP 343-1 shows borderline compatibility with many resins, that is not a severe problem in formulating primers. The solvent blend for these primers should provide sufficient solvency to avoid phase separation as the primer dries.

Table 14. Eastman CP 343-1 resin compatibility[a]

Resin	CP 343-1 1:1	CP 343-1 1:3	CP 343-1 1:9	CP 343-3 1:3	CP 343-3 1:19	CP 515-2 1:1	CP 515-2 1:3	CP 515-2 1:9	CP 164-1 1:1	CP 164-1 1:9	CP 164-1 1:19
Acryloid™ A-11	—	—	—	I	I	—	—	—	—	—	—
Acryloid™ AU608S	—	—	—	I	C	—	—	—	I	H	C
Acryloid™ B-66	I	I	I	I	C	I	I	I	I	H	C
Acryloid™ B-67	H	H	H	—	—	H	H	H	I	C	C
Acryloid™ B-72	—	—	—	H	C	—	—	—	I	I	H
Acryloid™ B-99	—	—	—	H	C	—	—	—	I	C	C
Beckosol™ 12-035	I	I	H	—	—	I	I	H	—	—	—
CAB-551-0.2	—	—	—	I	H	—	—	—	—	—	—
CK-2400	—	—	—	I	I	—	—	—	I	I	H
Cymel™ 303	—	—	—	—	—	—	—	—	I	I	C
Desmodur™ N3390	—	—	—	—	—	—	—	—	I	I	C
Desmodur™ N-75	—	—	—	—	—	—	—	—	I	I	C
Desmophen™ 1100	—	—	—	—	—	—	—	—	I	I	I
Desmophen™ 670A	—	—	—	—	—	—	—	—	I	H	C
Elvacite™ 2042	I	I	I	—	—	I	I	I	—	—	—
Elvacite™ 2044	I	I	I	—	—	I	I	I	—	—	—
Elvacite™ 2045	I	I	I	—	—	I	I	I	—	—	—
Elvacite™ 2046	I	I	I	—	—	I	I	I	—	—	—
Elvax™ 150	—	—	—	H	H	—	—	—	I	C	C
Elvax™ 260	I	H	H	H	H	I	H	H	I	I	I
Elvax™ 40W	I	H	H	H	H	I	H	H	I	C	C
Epon™ 1001	—	—	—	I	I	—	—	—	—	—	—
Epon™ 815	—	—	—	—	—	—	—	—	I	I	H
Epon™ 828	I	C	C	C	—	C	C	C	I	C	—
Ester gum 8D	I	H	C	—	—	C	C	C	—	—	—
Hercolyn™ D	I	C	C	—	—	C	C	C	—	—	—
Pentalyn™ A	I	H	C	—	—	I	H	C	—	—	—
Picco™ 5140	I	I	I	—	—	I	H	H	—	—	—
Poly-pale™ ester 10	H	H	C	—	—	H	C	C	—	—	—
RS ¼-sec nitrocellulose	—	—	—	I	C	—	—	—	—	—	—
Staybelite™ ester 3	I	C	C	C	C	C	C	C	—	—	—
Staybelite™ ester 5	I	C	C	—	—	C	C	C	—	—	—
Uni-Rez™ 7003	—	—	—	I	H	—	—	—	I	I	C
Urotuf™ F78-50T	I	I	H	I	H	I	I	H	—	—	—
Urotuf™ F47-M-60	—	—	—	—	—	—	—	—	I	H	C
Versamid™ 140	—	—	—	—	—	—	—	—	H	C	C
VYHH	—	—	—	I	C	—	—	—	—	—	—

[a] *I = incompatible; H = slight haze; C = compatible*

Compatibility

As shown in Table 15, Eastman CP 343-1 has excellent adhesion to polypropylene and good-to-excellent adhesion to a variety of other substrates.

For this evaluation, a 5 wt% solution of CP 343-1 in toluene was applied to the substrates using a 0.25-mm (10-mil) wet-film applicator and allowed to air dry for 24 hours at room temperature. Retained adhesion was evaluated by ASTM D3359, method B, using Intertape 51596. The adhesion ratings were reported as E (excellent), G (good), F (fair) or P (poor) based on the relative proportion of the CP 343-1 film not removed by the tape.

Table 15. Adhesion of Eastman CP 343-1 adhesion promoter to various substrates

Substrate	Adhesion rating[a]	Substrate	Adhesion rating[a]
Aluminum	E	Polyethylene	P
Asphalt	—[b]	Polyethylene terephthalate	G
Eastman Solus™ performance additive	G	Polypropylene	E
Eastman Solus™ performance additive	E	Steel, cold-rolled	E
Hardboard	G[c]	Steel, galvanized	E
Nylon, fiberglass-filled	G	Steel, phosphatized	E
Paper	E	Tin plate	G
Polyallomer	E	Vinyl, flexible	P[d]
Polycarbonate	—[b]	Vinyl, rigid	E
Polyester, unsaturated — SMC	E	Wood	E

[a] *E = excellent; G = good; F = fair; P = poor*

[b] *Substrate softened.*

[c] *Fibers adhered to tape.*

[d] *Film remained tacky.*

Adhesion between topcoat and primer

Adhesion of several topcoats to the primer film was evaluated, and ratings are shown in Table 16. The primer used was a 50/50 blend of CP 343-1/Elvax 260 resin reduced to 5 wt% total solids with toluene. The primer was sprayed on polypropylene panels and allowed to air dry at room temperature. The topcoats were applied and cured as indicated. Retained adhesion was evaluated by ASTM D3359, method B, using Intertape 51596.

Eastman CP 343-1 can be modified with other resins (see Table 14) to formulate primers to satisfy specific needs. For example, in the primer shown in Table 16, modification of CP 343-1 with ethylene vinyl acetate increases the softening point and cohesive strength of the primer film.

High-temperature stability

While a primer based on Eastman CP 343-1 does not require baking, its resistance to hot temperature is good and should not be hurt by normal baking times and temperatures. The section on "Adhesion between topcoat and primer" indicates it will withstand 110°C (230°F) for 20 minutes, and a thermogravimetric analysis (TGA) suggests it will withstand appreciably higher temperatures. Figure 2, a TGA curve of the CP 343-1 polymer, shows its weight loss as it is heated at 20°C/min under nitrogen from 200° to 500°C.

Table 16. Adhesion of topcoats to primed polypropylene panels (primer based on Eastman CP 343-1 adhesion promoter and Elvax 260 resin, formulation 2)

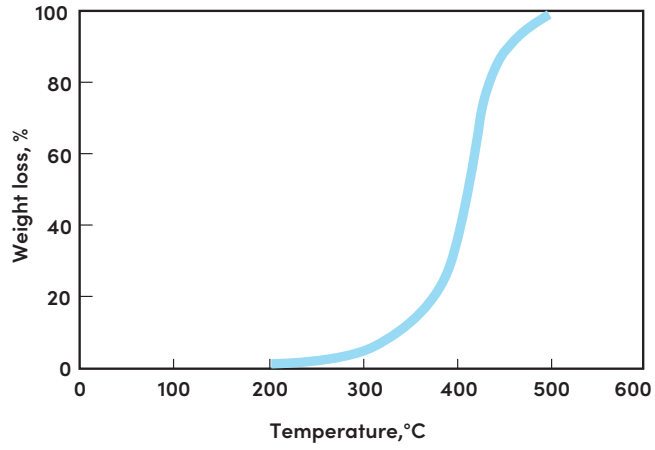
	Adhesion rating[a]				
	Baked 20 min @ 110°C (230°F) and aged @ 25°C (77°F)			Air dried @ 25°C (77°F)	
Type of topcoat	Initial	24 hr	1 wk	24 hr	1 wk
Acrylic automotive lacquer	E	E	E	E	E
Automotive enamel	F	F	F	E	E
Oxidizing alkyd enamel	E	E	E	E	E
Polyurethane enamel	E	F–G	E	E	E
Styrenated alkyd enamel	E	E	E	E	E
Nitrocellulose lacquer	P	P	P	E	E
Thermosetting acrylic enamel	E	E	E	E	E
Urea-formaldehyde/cellulose acetate butyrate/alkyd enamel	E	E	E	E	E

		Wt%	
		1	2
Primer for polypropylene, TPO and other plastics and metals	CP 343-1 (25%)	20.0	10.0
	Elvax 260 or 40W resin[b]	—	2.5
	Toluene	80.0	87.5

[a] *E = excellent; G = good; F = fair; P = poor*

[b] *Ethylene vinyl acetate copolymer resin from DuPont*

Figure 2. TGA of Eastman CP 343-1 (rate 20°C/min, N_2 atmosphere)



Eastman CP 343-3 adhesion promoter

Eastman CP 343-3 is a higher-chlorine-containing adhesion promoter that can be used as an additive for coatings, inks and adhesives for improved adhesion to PP, TPO and other difficult-to-adhere-to surfaces. CP 343-3 has a chlorine content of 26–32 wt%, which allows for improved compatibility with coatings, inks and adhesive systems.

The higher chlorine content of CP 343-3 also allows for improved solubility in a variety of solvents, including esters and ketones. CP 343-3 can also be used in formulated primer systems, but care must be taken when formulating primers with it, since redissolve can occur when a topcoat goes on due to the improved solubility of the CPO.

CP 343-3 is available in two different forms: 25 and 50 wt% solids in xylene.

CP 343-3 50% in xylene can become viscous, especially when stored at lower temperatures. If this occurs, the product can be liquefied by warming to 38°C with agitation.

Table 17. Adhesion[a] results of commercial coatings to untreated polypropylene

			Coatings with CP 343-3 immersed in water @ 38°C (100°F)		
Coating	With no CP 343-3	10 parts CP 343-3 (25%)/100 parts coating[b]	After 24 hr	After 100 hr	After 100 hr and 24 hr recovery
Nitrocellulose lacquer	Poor	Poor	—	—	—
Acrylic lacquer	Poor	Excellent	Good	Good	Good
Acrylic air-dry enamel	Poor	Excellent	Excellent	Excellent	Excellent
Alkyd air-dry enamel	Poor	Excellent	Poor	Poor	Excellent
Two-package urethane enamel	Poor	Poor	—	—	—

[a]*Excellent = less than 10% of coating; good = 10%–40% of coating; poor = 50%–100% of coating*

[b]*Level of chlorinated polyolefin may be adjusted to give optimum properties*

Applications and properties for Eastman CP 343-3

Stir-in additive

Several industrial coatings were evaluated in laboratory tests. The addition of 10 parts (by weight) of Eastman CP 343-3 (25%) to 100 parts of coating improved adhesion of all the coatings to untreated polypropylene, except for a nitrocellulose lacquer and a two-package urethane enamel.

Coatings containing CP 343-3 were sprayed onto untreated polypropylene, allowed to dry at room temperature and evaluated by ASTM D3359, method B, using Intertape™ 51596 for retained adhesion. Similarly prepared samples were immersed for 24 hours in water heated to 38°C (100°F) and tested for adhesion by the same method. Other samples were immersed for 100 hours in water heated to 38°C (100°F) and tested immediately after removal and again after 24 hours at room temperature. Results are shown in Table 17.

Polypropylene primer

Eastman CP 343-3 diluted to 5% nonvolatile with toluene has been evaluated as a plastic primer. Unmodified coating formulations gave excellent adhesion to plastic substrates primed with a thin film of CP 343-3. Results are shown in Table 18.

Table 18. Adhesion of commercial automotive refinish topcoats to primed untreated polypropylene (primer based on Eastman CP 343-3 [25%])[a]

Topcoat	Topcoats air dried	Topcoats air dried and immersed in water
Acrylic lacquer	Excellent[b]	Excellent
Acrylic enamel	Excellent	Excellent

[a]Polypropylene panels were wiped with toluene to remove mold-release agents, and the primer was sprayed on the panels to approximately 0.1-mil dry film thickness.

[b]Less than 5% of topcoat removed

Ink additive

Eastman CP 343-3 is soluble in solvent blends commonly used in gravure and screen ink as well as in some lithographic inks. It is useful as an adhesion promoter for these inks when printing on polypropylene substrates.

Compatibility

Flexibility, paint adhesion and other properties can be enhanced by adding modifying resins to the primer formulation. Table 14 shows compatibility of Eastman CP 343-3 with various resins.

Solvent tolerance

Table 19 shows the solvent tolerance of Eastman CP 343-3 for a variety of solvents that are used in coatings and ink formulations.

Table 19. Typical solvent tolerance of Eastman CP 343-3

Solvent	g solvent per 10 g CP 343-3[a] (25%)
Aromatic 100	> 100
Aromatic 150	> 100
n-Butyl acetate	> 100
Cyclohexanone	> 100
Diisobutyl ketone (DIBK)	> 100
Eastman EEP solvent	> 100
Ethyl acetate (99%)	> 100
Isobutyl acetate	> 100
Isobutyl isobutyrate (IBIB)	> 100
Isopropyl acetate	> 100
Mesityl oxide	> 100
Eastman methyl *n*-amyl ketone (MAK)	> 100
Methyl ethyl ketone (MEK)	> 100
Methylene chloride	> 100
Eastman methyl isoamyl ketone (MIAK)	> 100
Methyl isobutyl ketone (MIBK)	> 100
Eastman methyl *n*-propyl ketone (MPK)	> 100
1-Nitropropane	> 100
2-Nitropropane	> 100
n-Propyl acetate	> 100
Tetrahydrofuran (THF)	> 100
Toluene	> 100
Trichloroethane	> 100
Xylene	> 100
Eastman EB solvent	30
VM&P naphtha	30
Acetone	25
Eastman EP solvent	17
Heptane	17
MAGIESOL 470 OIL[b]	17
Diacetone alcohol	14
n-Butyl alcohol	6
Anhydrous ethyl alcohol	4
Methyl alcohol	2
95% Ethyl alcohol	1

[a]Grams of solvent required to cause turbidity when added to 10 g of CP 343-3 (25%). Addition of solvent ceased after 100 g were added without turbidity.

[b]Calumet Specialty Products Partners, L.P.

Eastman CP 515-2 adhesion promoter

Eastman CP 515-2 is a higher-chlorine-containing adhesion promoter that can be used as an additive for coatings, inks and adhesives for improved adhesion to PP, TPO and other difficult-to-adhere-to surfaces. It is especially useful in graphic art applications. CP 515-2 has a chlorine content of 26 wt% to 32 wt%, which allows for improved compatibility with coatings, inks and adhesive systems. The higher chlorine content of CP 515-2 allows for improved solubility in solvents including esters and ketones.

Eastman CP 515-2 is available at 40 wt% solids in xylene, toluene and Aromatic 100.

Compatibility

CP 515-2's compatibility with a variety of resins is shown in Table 20. Resins that combine with CP 515-2 to give clear solutions and deposit clear films are referred to as compatible. Although CP 515-2 shows borderline compatibility with some resins, it is not a severe problem because of the small amount of CP 515-2 usually added to a coating or ink.

Adhesion

As shown in Table 20, Eastman CP 515-2 has excellent adhesion to polypropylene and good-to-excellent adhesion to many other substrates. In this study, CP 515-2 was reduced to 5 wt% solid with toluene, cast on the substrates using a 10-mil (0.25-mm) wet-film applicator and allowed to air dry for 24 hours at room temperature. Retained adhesion was evaluated by ASTM D3359, method B, using Permacel P-99 tape. Adhesion ratings are based on the relative proportions of the CP 515-2 film not removed by the tape.

Table 20. Adhesion of Eastman CP 515-2 to various substrates

Substrate	Adhesion rating[a]
Aluminum	E
Asphalt	—[b]
Cellulose acetate	E
Cellulose acetate butyrate	E
Hardboard	G[c]
Nylon, fiberglass-filled	G
Paper	E
Polyallomer	E
Polycarbonate	—[b]
Polyester, unsaturated — SMC	E
Polyethylene	P
Polyethylene terephthalate	G
Polypropylene	E
Steel, cold-rolled	G
Steel, galvanized	E
Steel, phosphatized	G
Tin plate	G
Vinyl, flexible	—[b]
Vinyl, rigid	E
Wood	E

[a] *E = excellent; G = good; F = fair; P = poor*

[b] *Substrate softened.*

[c] *Fibers adhered to tape.*

Coatings and inks

Eastman CP 515-2 not only will adhere to a variety of substrates but, when added to coatings and inks, also improves adhesion to those substrates.

To generate the data in Table 21, CP 515-2 (40 wt% in xylene) was added at a ratio of 5 parts CP 515-2 polymer per 100 parts binder solids to an acrylic automotive refinish lacquer and to a maleic paste ink. Portions of the lacquer and ink with and without CP 515-2 were applied to untreated polypropylene panels by conventional techniques and allowed to air-dry at room temperature. Adhesion was determined by ASTM D3359, method B, using Intertape 51596 (see "Adhesion" section), and the percentages of lacquer and ink remaining on the panels were measured. The addition of CP 515-2 improved adhesion appreciably.

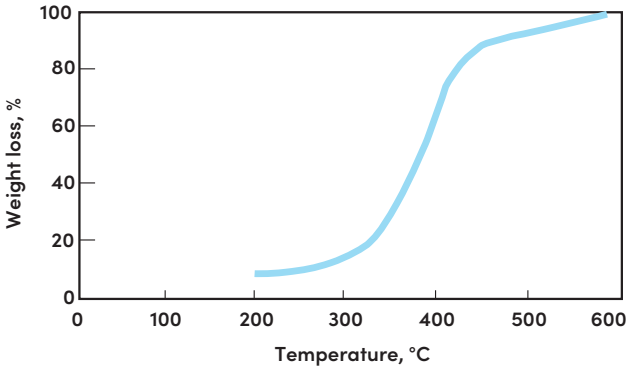
Table 21. Adhesion of an acrylic lacquer and a maleic ink to untreated polypropylene panels

Coating	Adhesion promoter	Coating retained, %
Acrylic lacquer	None	10
Acrylic lacquer	CP 515-2	90–95
Maleic ink	None	< 10
Maleic ink	CP 515-2	90

High-temperature stability

While Eastman CP 515-2 does not require baking to work, its heat resistance is good and should not be hurt by normal baking times and temperatures. Figure 3 is a TGA curve that shows weight loss as the CP 515-2 polymer is heated at 20°C/min under nitrogen from 200° to 600°C.

Figure 3. TGA of Eastman CP 515-2 (rate 20°C/min, N_2 atmosphere)

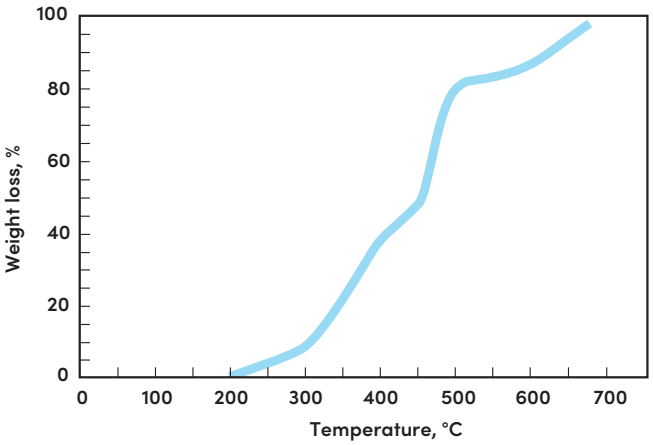


Eastman CP 153-2 adhesion promoter

CP 153-2 is used to promote adhesion of coatings, inks and adhesives to high-density polyethylene, low-density polyethylene and other ethylene-based substrates. CP 153-2 has a chlorine content of 21–25 wt% and is typically used in primer applications. CP 153-2 can also be used with ethylene vinyl acetate (EVA) copolymers in primer systems for improved adhesion between the primer and the topcoat.

CP 153-2 is available at 25 wt% solids in xylene.

Figure 4. TGA of Eastman CP 153-2



The TGA curve of CP 153-2 resin with xylene removed shows weight loss as the heat is increased by 20°C (36°F)/minute under a nitrogen atmosphere. The curve indicates that CP 153-2 has excellent heat stability up to about 200°C.

Laboratory evaluation

In tests at Eastman laboratories, Eastman CP 153-2 adhesion promoter was reduced to 5 wt% resin with toluene and spray applied at a dry film thickness of 0.1 mil on polyethylene plaques that had been cleaned with toluene-soaked cloths. The primed, dried polyethylene plaques were top coated with lacquers and enamels (see Table 22) then dried. Adhesion tests were conducted by ASTM D3359, method B, using Intertape 51596. The results were rated based on how much coating remained on the plaques after the tape was removed.

Table 22. Adhesion of topcoats to polyethylene plaques primed with Eastman CP 153-2

Type of topcoat	High-density polyethylene	Low-density polyethylene
Acrylic lacquer	Good[a]	Good[a]
Acrylic enamel	Good[b]	Excellent[b]
Alkyd enamel	Excellent[b]	Excellent[b]
Nitrocellulose lacquer	Fair[b]	Fair[b]

[a] *Formulation 2 in Table 4*

[b] *Formulation 1 in Table 4*

Table 23. Starting point formulations using Eastman CP 153-2

		Wt%	
		1	2
Primer for polypropylene, TPO, and other plastics and metals	CP 153-2 (25%)	20.0	10.0
	Elvax 40W or 260 resin[a]	—	2.5
	Toluene	80.0	87.5

[a]*Ethylene vinyl acetate copolymer resin from DuPont*

Although unmodified Eastman CP 153-2 offers excellent adhesion to polyethylene, the adhesion between the primer and certain topcoats — like urethane enamels — can be improved by adding EVA copolymers to the primer. Laboratory results show that adding EVA to CP 153-2 (1:1 on a solids basis) increased the strength of the primer film.

High-IV (intrinsic viscosity) EVA resins produced greater heat resistance and toughness than low-IV resins. Typical primer formulations are shown in Table 23.

In addition to being useful as a primer for polyethylene, preliminary studies suggest that CP 153-2 may be useful as a primer for ethylene-propylene diene monomer (EPDM) rubber and that blends of CP 153-2 and EVA may be useful as a laminating adhesive between polyethylene and other films.

Suppliers

Resin	Type	Supplier
Acrylamac™	Acrylic	Polynt
Beckosol™ 12-035	Nondrying alkyd	Reichhold (Polynt)
CK-2400	Phenolic	ASK Chemicals
Cymel™ 303	Melamine	Allnex
Desmodur™ N-75	Polyisocyanate	Covestro
Desmodur™ N3390	Polyisocyanate	Covestro
Desmophen™ 670A	Polyester	Covestro
Desmophen™ 1100	Polyester	Covestro
Duramac™	Short-oil alkyd	Polynt
Eastman Solus™ performance additives	Cellulosic	Eastman
Elvacite™ 2042	Acrylic	Lucite International
Elvacite™ 2044	Acrylic	Lucite International
Elvacite™ 2045	Acrylic	Lucite International
Elvacite™ 2046	Acrylic	Lucite International
Elvax™ 40W	Ethylene vinyl acetate	Dow
Elvax™ 150	Ethylene vinyl acetate	Dow
Elvax™ 260	Ethylene vinyl acetate	Dow
Epon™ 815	Epoxy resolution	Miller-Stephenson
Epon™ 1001	Epoxy resolution	Miller-Stephenson
Hercolyn™ D	Rosin ester	Pinova (DRT)
Paraloid™ A-11	Acrylic	Dow
Paraloid™ B-66	Acrylic	Dow
Paraloid™ B-67	Acrylic	Dow
Paraloid™ B-72	Acrylic	Dow
Paraloid™ B-99	Acrylic	Dow
Paraloid™ AU608S	Acrylic	Dow
Pentalyn™ A	Rosin ester	Pinova (DRT)
Polymac™	Polyester	Polynt
RS™ 1/4-sec nitrocellulose	Cellulosic	TNC Chemicals
SylvaPrint™ 7003	Modified maleic	Kraton
Urotuf™ F78-50T	Urethane	Reichhold
Urotuf™ F47-M-60	Urethane	Reichhold
Versamid™ 140	Polyamide	Huntsman
VYHH	Vinyl	Dow

Conclusion

Eastman's portfolio of solventborne adhesion promoters is useful in automotive and industrial coatings, inks and adhesive applications. Our technical personnel are available to help customers find the right formulation for specific applications.

For help choosing solventborne adhesion promoters, contact your Eastman representative on eastman.com.

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