

Eastoflex™ amorphous polyolefins

Base polymers in hot-melt adhesives,
paper laminating, sealants,
pressure-sensitive adhesives, and
waterproofing compounds

Eastoflex™ amorphous polyolefins

Eastoflex™ amorphous polyolefins (APOs) are characterized by consistent quality, low odor, good heat stability, low color, and broad compatibility with numerous elastomers, polymers, and tackifying resins.

These APOs are used as base polymers in hot-melt adhesives, paper laminating, sealants, and pressure-sensitive adhesives. They are especially useful as elastomer extenders in sealants. They can also be used as waterproofing compounds for wire and cable-flooding applications and as asphalt modifiers for modified bitumen roofing membranes. Eastoflex APOs can be processed with standard extrusion or roll-coating equipment, drum-melting units, and virtually all hot-melt adhesive application equipment.

In sealants, Eastoflex APOs can be used as elastomer extenders and as viscosity and flow modifiers. This allows the formulator to reduce raw material costs, shorten mixing time, and save energy, while improving water resistance and peel adhesion.

In hot-melt adhesives, Eastoflex APOs offer excellent adhesion to polyolefin and metallic substrates. The wide viscosity range and low application temperatures of Eastoflex APOs make them ideally suited for disposable goods assembly involving thin thermoplastic films and nonwovens.

In addition to current commercial products, Eastman can make custom APO blends for specific property requirements. The minimum production run for a new product is 40,000 lb (approximately 18 metric tons) for a molten tank truck and 20,000 lb (approximately 9,000 kg) for packaged material. An order commitment of at least this size is necessary to support a production run of a new Eastoflex product.

Modified
bitumen
roofing

Laminated
tape

Cable filling
and flooding

Insulating glass
sealant



APO product forms & packaging

Molten bulk

All grades of Eastoflex™ APOs can be delivered in North America in molten bulk form in railcars or tank trucks. For related information, refer to Eastman publication WA-35, "Bulk Handling and Storage of Molten Eastoflex™ Amorphous Polyolefins," http://www.eastman.com/Literature_Center/W/WA35.pdf.

Pellets

Most Eastoflex products are available in pellet form. Formulas ending in PL are pellets coated with a polypropylene powder, while formulas ending in PL-1 are pellets coated with a low-density polyethylene powder. Eastoflex APO pellet formulas are packaged in bags (50-lb net weight), 2,250-lb net weight per pallet and boxes (50-lb net weight), 900-lb net weight per pallet. The bags used to package Eastoflex APO pellets are made of polypropylene. Pellet boxes are lined with a low-density polyethylene liner.

Eastoflex E1003 packaging and blend options

Because of its softness, Eastoflex E1003 cannot be packaged in pellet form. The only available solid-form package for Eastoflex E1003 is a 270–330 lb (approximately 120–150 kg) fiber drum. This package option is available on a made-to-order basis only and requires a minimum order quantity of 40,000 lb (approximately 18,000 kg). Handling Eastoflex E1003 is likely to require drum-melting and unloading equipment.

Eastoflex E1016PL and Eastoflex E1016PL-1 are pelletized formulas containing a significant portion of Eastoflex E1003.

Eastoflex pellets are available in bags or boxes.

Molten bulk can be delivered by tank truck or railcar.



APO blends

Eastman can make custom-blended APO mixtures from nearly any combination of Eastoflex P1010, P1023, E1003, E1060, and E1200. The mixtures listed in Table 1 are examples of standard commercial blends. Other blended products can be made if the composite properties of the mixture fall within the blending range (Figure 1).

There are minimum order requirements for the development of a custom APO blend. Note that only Eastoflex P1010, P1023, E1003, E1060, and E1200 are available for blending. If you have any questions about Eastman's capabilities for APO blending, contact your Eastman sales representative.

Parameters for the five Eastoflex APOs available for blending are illustrated in Figures 1 and 2, showing ranges for Thermosel™ viscosity at 190°C, ring and ball softening point, glass transition temperature, and needle penetration hardness.

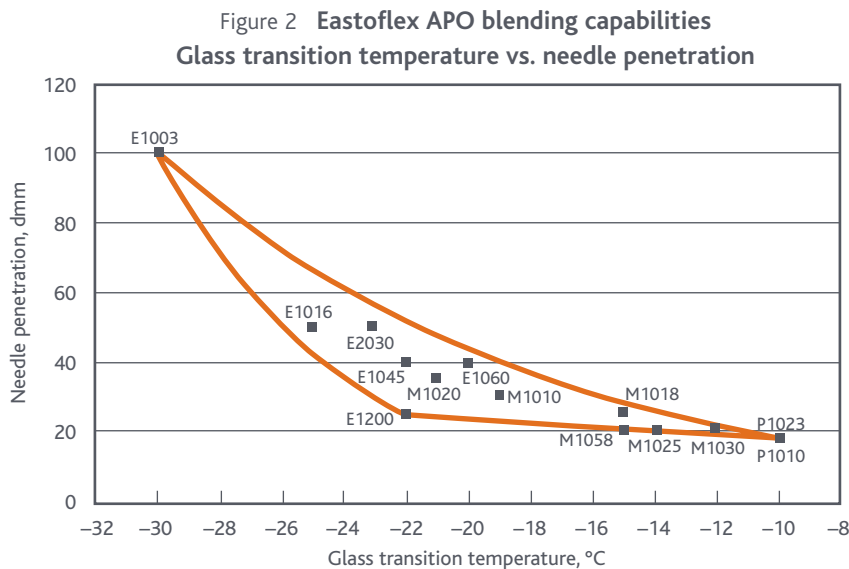
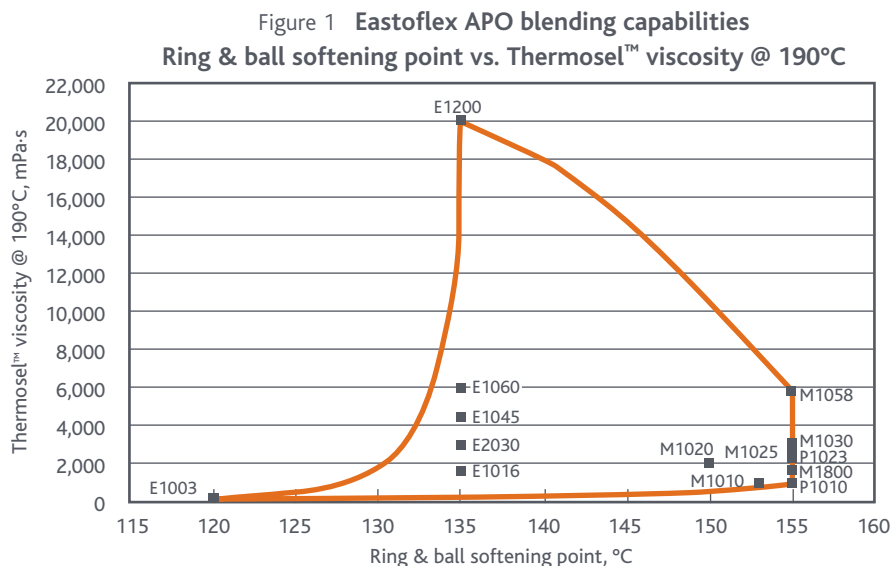


Table 1 Eastoflex™ APOs—Typical properties

Product name	Form	Viscosity, @ 190°C, mPa·s	R&B Softening pt, °C (°F)	Glass transition temperature, °C (°F)	Penetration hardness, dmm
		ASTM method			
		D3236	E28	D3418	D5
Propylene homopolymers					
P1010	Molten/solid ^a	1,000	155 (311)	–10 (14)	18
P1010PL	Pellets	1,000	155 (311) ^b	–10 (14)	18
P1023	Molten/solid ^a	2,300	155 (311)	–10 (14)	18
P1023PL	Pellets	2,300	155 (311) ^b	–10 (14)	18
Propylene-ethylene copolymers					
E1003	Molten/solid ^a	300	120 (248)	–30 (–22)	100
E1016	Molten/solid ^a	1,600	135 (275)	–25 (–13)	50
E1016PL	Pellets	1,600	140 (284) ^b	–25 (–13)	50
E1016PL-1	Pellets	1,600	135 (275)	–25 (–13)	50
E2030	Molten/solid ^a	3,000	135 (275)	–23 (–9)	50
E1045	Molten/solid ^a	4,500	135 (275)	–22 (–8)	40
E1045PL	Pellets	4,500	140 (284) ^b	–22 (–8)	40
E1060	Molten/solid ^a	6,000	135 (275)	–20 (–4)	40
E1060PL	Pellets	5,700	140 (284) ^b	–20 (–4)	35
E1060PL-1	Pellets	6,000	135 (275)	–20 (–4)	35
E1200	Molten/solid ^a	20,000	135 (275)	–22 (–8)	25
E1200PL	Pellets	17,000	143 (289) ^b	–22 (–8)	25
Polypropylene/propylene-ethylene copolymer mixtures					
M1010	Molten/solid ^a	1,000	153 (307)	–15 (5)	30
M1018	Molten/solid ^a	1,800	155 (311)	–15 (5)	25
M1018PL	Pellets	1,800	155 (311) ^b	–15 (5)	25
M1018PL-1	Pellets	1,800	150 (302)	–15 (5)	25
M1020	Molten/solid ^a	2,000	150 (302)	–21 (–6)	35
M1020PL	Pellets	2,000	153 (307) ^b	–21 (–6)	35
M1020PL-1	Pellets	2,000	150 (302)	–21 (–6)	35
M1025	Molten/solid ^a	2,500	155 (311)	–14 (7)	20
M1030	Molten/solid ^a	3,000	155 (311)	–12 (10)	20
M1030PL	Pellets	3,000	155 (311) ^b	–12 (10)	20
M1030PL-1	Pellets	3,000	155 (311)	–12 (10)	20
M1058	Molten/solid ^a	5,800	155 (311)	–15 (5)	20
M1058PL	Pellets	5,800	155 (311) ^b	–15 (5)	20

^aMolten available in tank trucks or railcars. Solid may be available in drums.^bRBSP of pellet coating is 163°C. Pellet coating typically 1.5% to 2% by weight.

Properties reported in this publication are typical of average lots. Eastman makes no representation that the material in any particular shipment will conform exactly to the listed values.

Hydrocarbon resin compatibility

Figure 3 displays a cloud point compatibility chart of selected Eastoflex™ APOs and Eastman hydrocarbon resins. The resins are plotted by Mz molecular weight vs. diacetone alcohol cloud point (DACP). The level of compatibility with the highly polar solvent blend used for the determination of DACP indicates the polarity of the resin. For more information on tackifying resin cloud points, refer to "Eastman's Spectrum of Hydrocarbon Resins," http://www.eastman.com/Literature_Center/W/WA86.pdf.

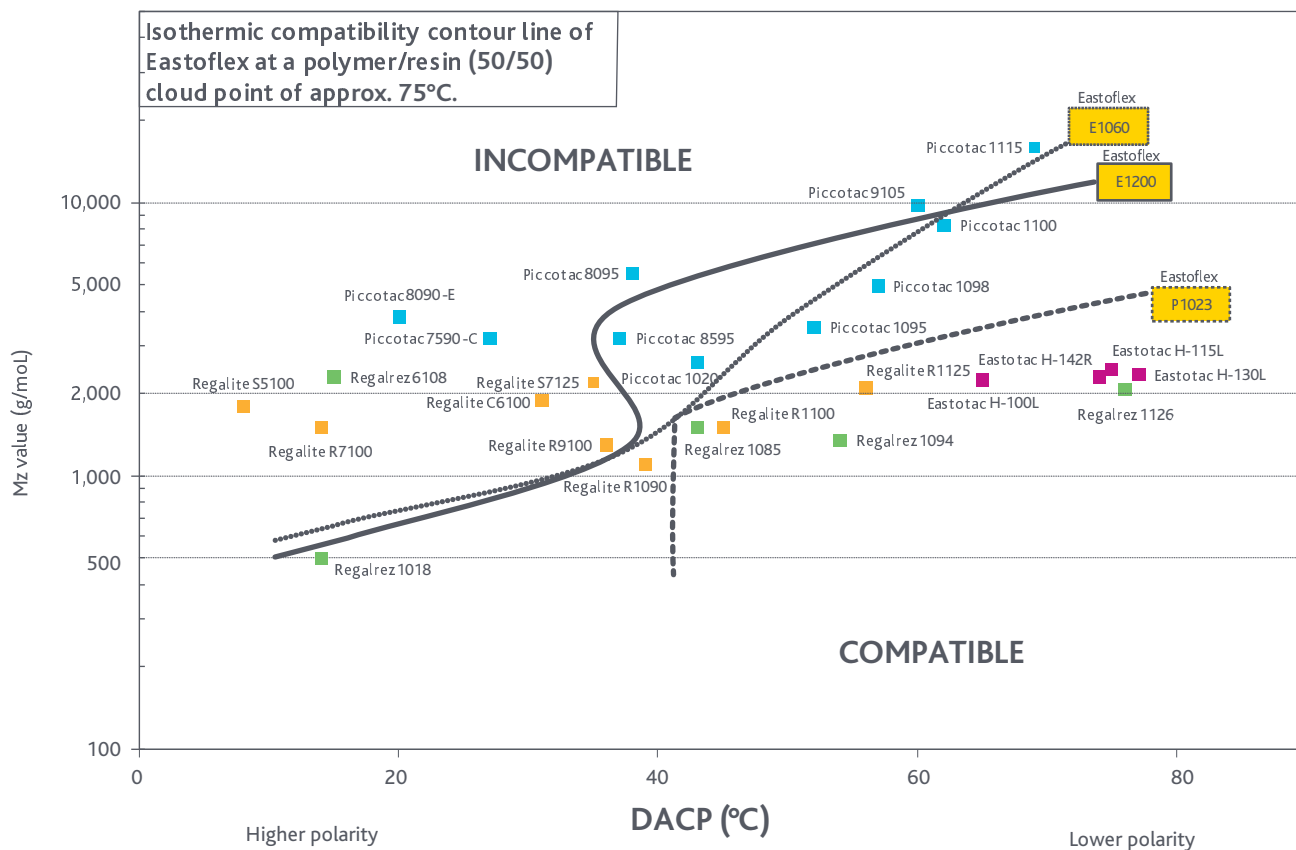
Cloud point temperatures of 1:1 mixtures of Eastoflex APOs and hydrocarbon resins were measured. Mixtures that did not have any visual haze at or above 75°C

were determined to be compatible, although partial compatibilities may exist. Compatible resins are found below the 75°C isotherm line given for each Eastoflex polymer. Figure 3 is provided as a guide to formulators for choosing an appropriate hydrocarbon resin for tackification of Eastoflex APOs.

FDA regulatory status

Detailed information on the current status of Eastoflex APOs for use in food contact applications is available on <http://www.eastman.com/Brands/Eastoflex/Pages/Overview.aspx>. Refer to the regulatory information sheet for each individual product.

Figure 3 Mz value vs. DACP of Eastman hydrocarbon resins



Three different Eastoflex™ amorphous polyolefins have been evaluated in various solvents.¹ They include:

- Eastoflex E1003 low viscosity propylene ethylene copolymer
- Eastoflex E1060 propylene ethylene copolymer
- Eastoflex P1023 propylene homopolymer

The APOs were added at a level of 10% by weight and mildly agitated for 24 hours at room temperature. Solubility of each APO in various solvents is shown in Table 2.

¹Other amorphous polyolefins were evaluated with similar results.

Results indicate that all three APOs are soluble at a 10% level in aromatic and chlorinated solvents. Low molecular weight E1003 displays increased solubility in aliphatic solvents and several ketones.

This information aids in the selection of appropriate solvents for amorphous polyolefins used in solution coatings and adhesives, as well as choosing solvents for cleaning equipment used to process amorphous polyolefins.

Table 2 Solubility values and ratings of APOs^a

Solvent	Eastoflex		
	E1003 APE	E1060 APE	P1023 APP
Mineral spirits	S	INS	INS
Kerosene	S	INS	INS
Hexane	S	C	C
Heptane	S	C	C
VM&P naphtha	S	C	C
Cyclohexane	S	C	C
Methyl isobutyl ketone	S	INS	INS
Methyl <i>n</i> -amyl ketone	S	INS	INS
Carbon tetrachloride	S	C	C
Butyl bromide	INS	INS	INS
Ethylene glycol butyl ether acetate	INS	INS	INS
Xylene	S	S	S
Toluene	S	S	S
Butyl Cellosolve™	INS	INS	INS
Mesityl oxide	INS	INS	INS
Ethyl acetate	INS	INS	INS
Benzene	—	—	—
Diacetone alcohol	INS	INS	INS
Methyl ethyl ketone	INS	INS	INS
Dibutyl phthalate	INS	INS	INS
Trichloroethylene	S	S	S
2-Ethylhexanol	INS	INS	INS
Methyl acetate	INS	INS	INS
Diethylene glycol ethyl ether	INS	INS	INS
Nitropropane	INS	INS	INS

Solvent	Eastoflex (continued)		
	E1003 APE	E1060 APE	P1023 APP
1,4-Dioxane	INS	INS	INS
Ethylene glycol butyl ether	INS	INS	INS
Acetone	INS	INS	INS
<i>n</i> -Amyl alcohol	INS	INS	INS
Acetic anhydride	INS	INS	INS
Dimethyl phthalate	INS	INS	INS
Nitroethane	INS	INS	INS
Cyclohexanol	C	C	C
Isopropyl alcohol	INS	INS	INS
Aniline	INS	INS	INS
Allyl alcohol	INS	INS	INS
Acetonitrile	INS	INS	INS
Dimethyl sulfoxide	INS	INS	INS
Diethylene glycol	INS	INS	INS
Butyrolactone	INS	INS	INS
Propylene glycol	INS	INS	INS
Nitromethane	INS	INS	INS
Ethyl alcohol	INS	INS	INS
Diethyl amine	INS	INS	INS
Lauryl alcohol	INS	INS	INS
Methyl isoamyl ketone	INS	INS	INS
Isopropyl acetate	INS	INS	INS
<i>n</i> -Decane	S	C	C
Isophorone	INS	INS	INS
<i>n</i> -Butyl acetate	PS	INS	INS
Diethyl ketone	PS	INS	INS

^a10% by weight solutions

Legend: S = clear solution, C = cloudy solution, NS = insoluble, PS = phase separation



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