Epolene

POLYMERS

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EASTMAN

Contents

Introduction

Eastman Chemical Company offers a series of medium to low molecular weight polyethylene or polypropylene polymers under the *Epolene* trade name.

They are useful in the plastics industry as lubricants for PVC, processing aids, mold release agents, dispersion aids, and coupling agents. They are also widely used as base polymers for hot-melt adhesives and pavement-striping compounds as well as petroleum wax modifiers for use in candles, investment casting, cable filling, and various paperboard coatings. Numerous types of *Epolene* polymers are available, and properties can be selected to fit various processing operations. Many of these polymers meet U.S. FDA food additive regulations for various applications.

Applications

Candles

Using 1%–5% *Epolene* N-11, N-34, C-10, and C-15 polymers is common to improve shrinkage, mold-release properties, gloss, sheen, opacity, and color dispersion in petroleum wax based candles. These additives are virtually odorless and smokeless when the correct wick size, candle shape, and additive concentration are used, plus with excellent melt and color stability, they can produce brighter, more reproducible colors when compared to stearic acid. *Epolene* N-11 and N-34 are suggested when very low melt viscosities are preferred.

Coatings

Epolene polymers are useful as:

- Hot-melt or emulsion coatings on paper, providing high gloss and excellent barrier properties.
- High-gloss emulsion coatings for citrus fruits to maintain freshness and flavor of the fruit by reducing moisture loss and shrinkage.
- Coatings/laminations of paper for packaging materials used in manufacturing spiral-wound fiber drums.
- Components in hot melts for improved durability as compared with paint for marking highway surfaces.
- Temporary protective coatings for metal surfaces.
- Scuff-resistant emulsion coatings for glass bottles.
- Flatting agents for lacquers and enamel paints.
- Ingredients in sprayable herbicide and insecticide formulations for improved wetting and spreading characteristics.

Coupling Agents

Epolene maleated polyolefins are useful as coupling agents and adhesion promoters for filled/reinforced polyolefins. *Epolene* polymers attract various materials such as inorganic fillers, metal surfaces, cellulosic surfaces, and nylon polymers to nonpolar polyolefins.

Hot-Melt Adhesives

Epolene C polymers are useful as base polymers for hot-melt adhesives, producing bonds with low color, low density for excellent mileage, high char resistance, relatively high elevated temperature resistance, and excellent compatibility with various tackifying resins. Because of its relatively low viscosity and high softening point, *Epolene* N-21 polymer can be useful as an additive for improving set speed.

Inks

Dispersions and emulsions of *Epolene* polymers are added to solvent and waterborne inks to improve resistance to rub-off, increase slip to the printed surface, and reduce offset. The emulsions are compatible with many acrylic polymers used in formulating inks for the water-based market.

Natural/Wood Fiber Composites

Epolene maleated polyolefins strengthen wood plastic composites and natural fiber reinforced polyolefins. The maleic functionality wets out and bonds natural fibers into the base polymer to substantially increase tensile strength, and other physical properties. *Epolene* polymers are especially useful for strengthening highly filled composites with 50–60% wood fiber loadings.

Paper

As a lubricant for clay coatings applied to paper, *Epolene* E polymers tend to outperform many calcium stearate dispersions by providing increased lubricity during calendering. *Epolene* polymer dispersions in clay coatings allow for higher processing speeds, less dusting, and higher gloss.

Personal Care Products

By improving elevated-temperature resistance, chemical resistance, and inertness, *Epolene* polymers find use in a number of cosmetics and personal care products.

Petroleum Wax Blends

As a paraffin wax modifier in candles and crayons, *Epolene* polymers provide desirable gloss, sheen, opacity, and good mold release properties.

Petroleum wax coating formulations can be modified with *Epolene* polymers to provide gloss retention, scuff resistance, improved hold-out and, in certain formulations, heat seal-ability. Specific applications include coatings for corrugated kraftboard, folding cartons, carbon paper, and a variety of other paper products.

Plastic Additives

As dispersion aids, *Epolene* polymers have unique wetting and dispersion characteristics for highly filled compositions and color concentrates. The maleic-anhydride modified *Epolene* polymers function as coupling agents for many filled or reinforced plastics to improve processability and surface characteristics. These functionalized polymers are also useful as compatibilizers for various polymer alloy systems.

Epolene polymers can be used as external lubricants for rigid and flexible PVC (polyvinyl chloride), including the extrusion of rigid PVC pipe for potable water.

As a processing aid for linear-low-density polyethylene (LLDPE), *Epolene* N-34 polymer has been found to increase the throughput of LLDPE with conventional extrusion equipment.

Polishes

Epolene E polymers are used in a number of polish applications:

- Emulsions based on *Epolene* E polymers may be used in industrial or household liquid floor polishes to improve slip resistance, hardness, scuff resistance, durability, gloss, water resistance, leveling, buffability, and color.
- Small additions of *Epolene* E polymers have been found to impart excellent gloss and film hardness in creamy automobile polishes that are used in a single application to clean and wax weathered automobile finishes.
- *Epolene* E polymers are used in spray-and-wipe furniture polishes as typically applied using manual, pump-type dispensers to impart excellent luster and serve as a good dusting aid.

Processing Aids

The addition of small amounts of *Epolene* polymers can substantially improve the processability of many plastics.

Rubber

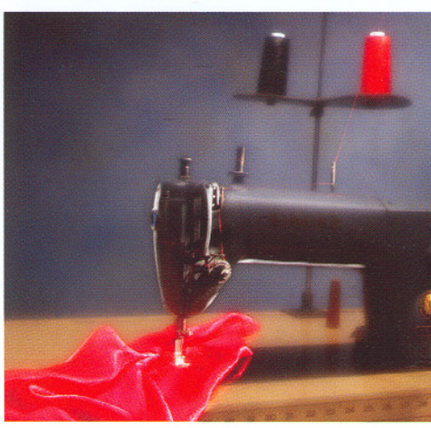
As a processing aid for nitrile, butyl, SBR, EPDM, and neoprene rubber, *Epolene* polymers improve mixing of recipe ingredients, help reduce shrinkage, and reduce tackiness during processing.

Textiles

Emulsions based on *Epolene* E polymers are effective as softeners and lubricants for natural and synthetic fibers, improving abrasion resistance, tear resistance, and hand and sewing lubricity.

Wire and Cable

Epolene N-21 and N-22 wax can be used in gelled mineral oil formulations to improve high-temperature properties such as slump and sag resistance. It is also useful in the modification of amorphous polyolefin and polybutene polymer-type cable flooding compounds. *Epolene* C waxes can be used to upgrade the properties of petrolatum in both filling and flooding compounds.



Properties

Abrasion Resistance

Epolene polymers' outstanding toughness and low coefficient of friction enable them to be excellent additives for improvement of abrasion resistance in a wide variety of formulated coating materials.

Additive Dispersion

Low melt viscosity and good compatibility with a variety of materials enable *Epolene* polymers to improve the dispersion properties of pigments, fillers, and other additives in a variety of plastics and rubber formulations.

Antiblocking Action

Epolene polymers are added to a variety of coating formulations to prevent parts that are coated with the formula from sticking together.

Barrier Properties

Based on polyolefins, *Epolene* polymers are resistant to water, grease, and many chemicals. They can be used in hot melts and aqueous emulsions and/or as solution/solvent dispersions.

Color

Most *Epolene* polymers have very low color (Gardner color scale values in the 1 to 2 range).

Compatibility

Epolene polymers are compatible with many polymers, resins, and natural and synthetic waxes.

Hardness

Penetration hardness values for *Epolene* polymers range from 0.1 to 7.0 tenths of a mm at 25°C. *Epolene* polymers tend to retain more hardness at elevated temperatures than most natural and paraffin waxes.

Lubricity

Because of their low coefficient of friction and range of compatibility, *Epolene* polymers are often added to formulated or compounded materials to improve surface lubricity, slip, and release properties. *Epolene* E polymers are frequently used as external lubricants in the extrusion of rigid PVC for such applications as pipe, siding, and profiles. *Epolene* C and N polymers can be used as external lubricants for flexible PVC.

Melt Viscosity

Epolene polymers are available in a broad selection of low, medium, and high viscosities. Each product is manufactured under a narrow viscosity range.

Moisture and Grease Resistance

Epolene waxes are insoluble in water, which results in high moisture resistance. They are also quite resistant to grease and many other chemicals.

Softening Point

Epolene polymers are available with a wide range of softening points ranging from 100° to 163°C.

Solubility

Epolene polymers tend to have limited solubility in solvents and oils at room temperature, but at elevated temperatures, they are soluble to varying degrees. Using cloud point, it has been found that *Epolene* E emulsifiable polymers tend to be more soluble in aliphatic solvents than nonemulsifiable *Epolene* C and N polymers, and *Epolene* C polymers tend to be more soluble than *Epolene* N polymers.

Furthermore, the lower-density products tend to be more soluble than the higher-density products, and the lower molecular weight products tend to be more soluble than the higher molecular weight products. Solubility tends to be best in nonpolar solvents such as toluene, xylene, mineral spirits, and naphtha. They tend to be insoluble in such solvents as n-butyl alcohol, n-propyl acetate, and ethyl alcohol.

Surface Appearance

The addition of *Epolene* polymers to formulated or compounded plastics can improve gloss and surface appearance of finished products.

Toughness

Epolene polymers are tougher than most natural and many synthetic waxes.

Viscosity Modification

A broad range of *Epolene* polymers exist with low, medium, and high viscosities, making them excellent viscosity modifiers for plastics, adhesives, elastomers, and natural and synthetic waxes.

Emulsifiable Polymers

Epolene E-10

An oxidized polyethylene developed for water-emulsion floor polishes, *Epolene* E-10 polymer imparts excellent slip resistance, outstanding toughness, and good durability to polish films. These properties are often apparent at low polymer concentrations, but they are best observed where E-10 comprises 20% or more of the total solids in the polish. It can be used in both atmospheric polymeric wax-to-water and pressure emulsification methods.

Emulsions of E-10 are also used as finishing agents for cotton and synthetic fabrics and as textile softeners in conjunction with wash-and-wear finishing waxes. They are also used as lubricants in clay coatings on paper to reduce dusting during calendering.

Epolene E-14 and E-15

Epolene E-14 and E-15 are oxidized polyethylenes that have lower densities and softening points than E-10. Such properties contribute to their versatility and ease of emulsification in both wax-to-water and pressure emulsification methods.

E-14 has a lower molecular weight than E-10, which allows for more forgiveness in atmospheric emulsification. E-14 is commonly used to impart excellent slip resistance to floor polish films. The best results tend to occur when used in concentrations of 20% or less solids or in polishes containing both natural and synthetic waxes. E-14 in powdered form (*Epolene* E-14P) is useful as a lubricant in processing rigid and flexible polyvinyl chloride and as a pigment dispersing aid in color concentrates.

E-15 has the lowest density and is the softest of the emulsifiable *Epolene* polymers and is generally used at low concentrations in mixed-wax emulsions and high-polymer floor polishes to improve slip resistance.

Along with E-10 and E-20 polymers, E-14 and E-15 are lawful for use (21 CFR 175.125) in formulating pressure-sensitive adhesives for use in food-contact surfaces of tapes and labels used in dry food and processed, frozen, dried, or partially dehydrated fruits and vegetables.

They can also be lawful for use in manufacturing food-contact articles as defined under regulation 21 CFR 177.1620 and as adjuvant substances on textiles and textile fibers intended for use in contact with food in amounts not exceeding those required to achieve their intended effect (21 CFR 177.2800). Other applications for these four polymers include use as coatings or as a component of coatings for various fruits and vegetables as noted under 21 CFR 172.260.

Epolene E-16 and E-17

Epolene E-16 is a low-density, oxidized polyethylene polymer having properties between those of E-10 and E-14. E-17 is similar to E-16, but it has a higher acid number than the other low-density *Epolene* E polymers. Both are commonly used to provide stable, low-color emulsions by both atmospheric and pressure emulsification methods for such end uses as textiles, floor polishes, inks, and paint rheological additives.

Epolene E-20

Epolene E-20 is a low molecular weight, medium-density oxidized polyethylene with exceptional hardness and low color. It has a low softening point and low viscosity that help it provide the desirable emulsification properties of a low-density polymeric wax. *Epolene* E-20P is commonly used as a lubricant for bottle molding PVC and in pipe extrusion of rigid PVC and HDPE. E-20 is an excellent performer in high-speed, buffable floor polish, textile lubricant/softener, and fruit-coating applications. In powder form, it is used as an extrusion lubricant for clear, rigid PVC compounds. Its higher density and softening point make it particularly attractive for use in citrus fruit coating emulsions. These properties contribute to the hardness, short drying time, and excellent gloss of the coatings.

Epolene E-25 and E-43

Epolene E-43 is a relatively low molecular weight, maleic anhydride modified polypropylene polymer with the greatest hardness and highest softening point of all the *Epolene* E emulsifiable polymers. It is commonly used to impart outstanding slip resistance to floor polishes. Because of its high melting point, pressure equipment is required for emulsification.

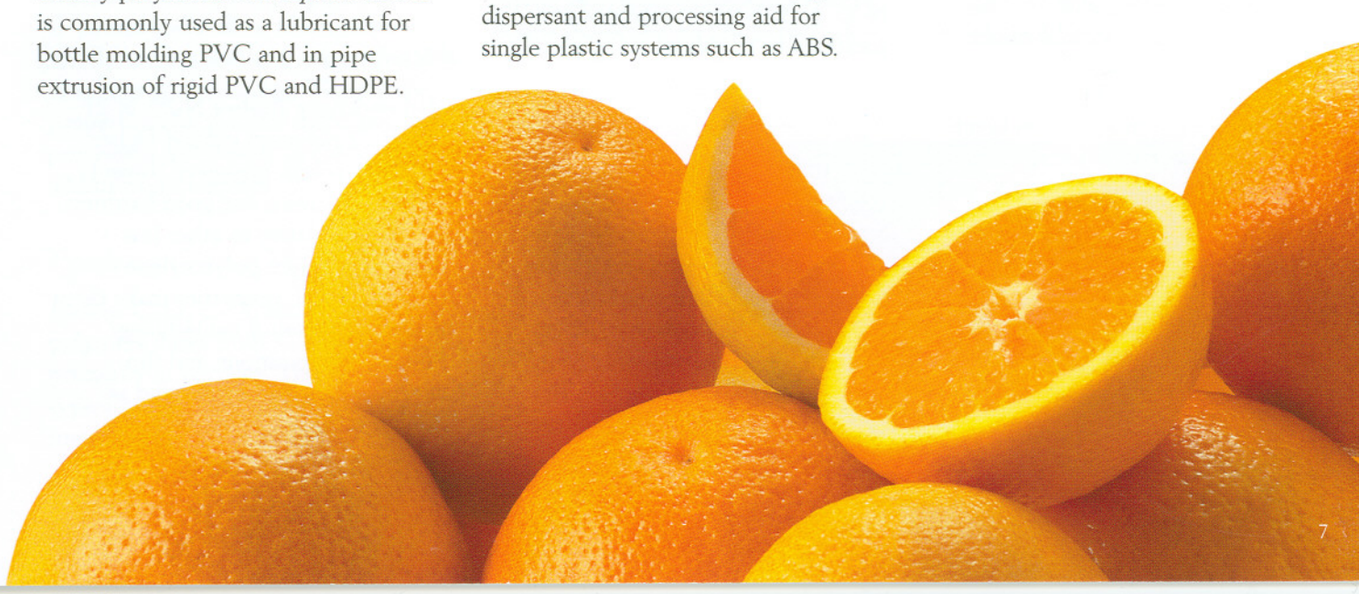
Because of its polarity and available anhydride functionality, E-43 is also useful as a compatibilizer in many plastic alloy systems. It can also be used as a coupling additive for filled polypropylene to increase tensile, modulus, and heat-deflection temperature of molded parts when fillers such as glass, mica, talc, $CaCO_3$, and wood flour are used with polypropylene. For the same reasons, E-43 also acts as an excellent pigment dispersant and processing aid for single plastic systems such as ABS. Maleic anhydride modified polymers are especially effective in dispersing polyamide-based fluorescent pigments in polyolefins.

Epolene E-25 is a lower acid number, lower color material than *Epolene* E-43 for use in those applications where color needs to be minimized.

Epolene G-3003 and G-3015

As with E-43, *Epolene* G-3003 and G-3015 are maleic anhydride modified polypropylene polymers. They differ primarily in acid number, color, and molecular weight. Their optimum functionality and molecular weights enable them to couple various fillers in polypropylene and in nylon/polypropylene composites. Small additions of as low as 1%–1.5% can result in a significant increase in most fiberglass-reinforced polypropylene and polypropylene/nylon composite physical properties. They also function well as compatibilizers in nylon/polypropylene alloys. G-3003 and G-3015 are commonly used as coupling agents when using fillers such as glass, mica, and wood flour with polypropylene.

Epolene G-3003 and G-3015 should be added to natural fiber composites at approximately 3% to achieve optimum physical properties in highly filled composites.



Nonemulsifiable Polymers

Epolene N-10

As a nonemulsifiable, medium-density, relatively low melting point polyethylene homopolymer, *Epolene* N-10 polymer can easily be melt-blended with natural or synthetic waxes to improve tensile strength, abrasion resistance, and adhesion to fibrous substrates. For paper coating applications such as folding cartons, N-10 can be used to improve paraffin wax mileage and provide a glossy, scuff-resistant finish. It is also commonly used in printing inks to improve resistance to scuffing and rub-off. Its low coefficient of friction characteristics and good wetting properties enable N-10 to act as a processing aid and pigment dispersant for polyolefin color concentrates.

Epolene N-11, N-14, N-30, N-34, and N-35

Epolene N-11, N-14, N-30, N-34, and N-35 polymers are lower in molecular weight and density than N-10 and differ primarily in viscosity. They are used in many of the same applications as N-10 but offer advantages where lower viscosities are desired. They are also useful as mold release additives and lubricants in rubber processing and as extrusion and calendering aids for vinyl. In powder form, they are used as pigment-dispersing aids for color concentrates used in various plastic applications.

N-14 is used as a mold release agent for solvent systems with urethane and HDPE.

N-34 is commonly used as a processing aid for blown-film extrusion of LLDPE, LDPE, and HDPE polymers. It can also be useful as a pigment dispersion aid or color-flushing medium when preparing color concentrates with polyethylene and polypropylene. N-35 is slightly higher in viscosity and lower in melt point than N-34. N-30 is significantly harder and higher in viscosity and melting point relative to N-34 and N-35. N-30 is commonly used as a paraffin wax modifier.

Epolene N-15

Epolene N-15 is a low-density, low viscosity polypropylene homopolymer. It has a relatively high softening point and exhibits great hardness. These features make it desirable as a paraffin wax modifier to improve blocking, scuff, and abrasion resistance. N-15 is also used in color concentrates and reprographic toner compounds. Its compatibility with plastic-grade polypropylene provides improved pigment dispersing properties, especially for polypropylene fiber applications.

Epolene N-20, N-21, and N-22

Higher-density *Epolene* N-20, N-21, and N-22 polymers exhibit higher softening points, improved solvent and oil resistance, and good hardness properties relative to other low molecular weight polyethylene polymers. Such properties make them useful in cosmetics, cable-filling/flooding compositions, and slip additives for printing inks and as modifiers for hot-melt highway marking.

N-20 is especially useful for improving production rates with extruded fractional melt, high-density polyethylene. Rates have been increased by as much as 31% without adversely affecting the physical properties of fabricated parts.

Because of its relatively high softening point and relatively low viscosity, N-21 is used as an additive to improve set speed in hot-melt adhesives. The higher density of N-21 makes it an excellent pigment dispersing aid for color concentrates used in HDPE.

Epolene N-22 has properties intermediate of N-20 and N-21. It is particularly useful in cable filling compositions.

Epolene C-10 and C-15

Epolene C-10 and C-15 are low-density, highly branched, medium molecular weight polyethylene polymers that are particularly useful as base polymers in hot-melt adhesives and coatings for various paper and packaging materials. They differ primarily in their viscosity. Coatings produced using these products exhibit high gloss, low moisture vapor transmission rates, and good heat-sealing properties. Both can also be useful as paraffin wax modifiers in slush molding, cast molding, candles, oil-based inks, and investment castings.

The low-density, low softening point and good lubrication properties of C-10 and C-15 allow them to be widely used as low-cost processing aids in rubber compounding. These same properties also provide dispersing and processing advantages in color and additive concentrates.

Epolene C-13, C-14, and C-17

Epolene C-13, C-14, and C-17 polymers differ from C-10 and C-15 primarily in viscosity. They are typically used with paraffin wax and lower molecular weight polymers as viscosity modifiers. Increased viscosity can be of importance for controlling penetration of the coatings into paper substrates and to improve cohesive strength in hot-melt adhesives.

Blending these *Epolene* polymers with paraffin wax offers improved grease resistance, higher blocking temperatures, better scuff resistance, and improved gloss. They can also be used as additives for inks and as base polymers for color concentrates. For example, *Epolene* C-17 polymer commonly replaces granular, linear low-density polyethylene (LLDPE) as the base polymer in many color concentrates because it's easier to process and has higher output rates.

C-14 and C-17 are lawful for use [21 CFR 177.1520(c)(2.1)] in all noncooking, food-contact applications including films, bottles, and coatings. The finished food-contact surfaces are subject to extractability limitations imposed by other regulations pertaining to specific uses. They are also lawful for use in manufacturing ion-exchange membranes intended for use in the production of grapefruit juice where the finish membranes must be manufactured as set forth by the regulations and limitations in regulation 21 CFR 173.20.

Epolene C-16 and C-18

Epolene C-16 and C-18 polymers are maleic anhydride-modified polymers of low molecular weight polyethylene. They differ primarily in their viscosity. When used as hot-melt coatings for paper, they provide a good glossy barrier coating that may be readily heat-sealed to many paper products, metal foils, and polyolefin films.

In paraffin wax coating formulations, C-16 and C-18 provide good gloss retention, scuff resistance, improved blocking resistance, superior wet corrugated crush strength and, in certain formulations, good heat sealability. Because of their functionality, these modified polyethylene polymers provide good wetting and dispersing properties for highly filled compositions. Both are also useful as dispersion aids for aluminum pigment concentrates with polyethylene and polypropylene. C-18 has also been very useful as an additive in basecoat/clearcoat automotive paints to impart improved metal flake orientation.

Because of their maleic anhydride functionality, C-16 and C-18 have a strong affinity for nylon, allowing them to be excellent dispersing aids for amide-based fluorescent pigments used in polyolefin color concentrates. In hot-melt adhesive formulations, their increased functionality allows for improved adhesion, greater filler tolerance, broader compatibilities, and improved aging properties. Unlike conventional polyethylene, these modified polyethylene polymers are compatible with most polyamides used in hot-melt formulations.

Packaging

Epolene polymers are supplied as free-flowing pellets, packaged in multiwall paper bags with a polyethylene-coated inner liner [22.67 kg (50 lb) net weight]. The bags are palletized and stretch-wrapped to prevent contamination during storage and shipment. Many *Epolene* polymers are also shipped in a variety of bulk containers.

Epolene E-14, E-20, E-43, C-10, C-13, C-16, C-17, and most *Epolene* N polymers are available in powder form.

For specific information on bulk shipments or availability of powder forms, contact your Eastman representative.

Typical Properties of *Epolene* Polymers[a]

Product	Polymer Type	Ring & Ball Softening Point, °C	Mettler Drop Point, °C ASTM D3954-94	Penetration Hardness, dmm ASTM D5[b]	Density @ 25°C, g/cm³	Acid No.	Brookfield Thermosel Viscosity, cP 125°C (257°F)	140°C (284°F)	150°C (302°F)	190°C (374°F)	Melt Index 190°C	Gardner Color (Molten)	Yellowness Index	Molecular Weight M_w	Molecular Weight M_n	Cloud Point, °C[c]
Coating Grade—Highly Branched Medium Molecular Weight																
C-10	PE	102	103	3	0.906	<0.05	18,600	16,650	8,200	3,550	2,250	1	—	35,000	7,700	77
C-13	PE	110	137	3	0.913	<0.05	—	—	—	—	190	1	—	76,000	12,000	81
C-14	PE	>133	>133	2	0.918	<0.05	—[d]	—	—	—	1.6	1	—	143,000	18,000	84
C-15	PE	101	101	4	0.906	<0.05	8,950	6,100	4,200	1,800	4,200	1	—	17,000	6,700	75
C-16	Ma-PE	102	103	3	0.908	2	16,650	10,000	8,100	2,850	1,700	1	—	26,000	5,600	78
C-17	PE	133	>133	2	0.917	<0.05	—[d]	—	—	—	19	1	—	100,000	14,000	81
C-18	Ma-PE	101	101	4	0.905	2	7,750	5,000	4,100	1,550	4,200	1	—	15,000	5,700	71
Nonemulsifiable—Low Molecular Weight																
N-10	PE	108	110	2	0.925	<0.05	1,500	1,100	—	—	—	1	—	10,000	3,200	82
N-11	PE	107	111	2	0.921	<0.05	350	250	—	—	—	1	—	6,000	2,000	80
N-14	PE	108	108	3	0.920	<0.05	150	100	—	—	—	1	—	4,000	1,700	80
N-15	PP	163	164	<1	0.902	<0.05	—[d]	—[d]	—[d]	600	—	1	—	12,000	5,000	104
N-20	PE	119	119	<1	0.930	<0.05	7,000	4,300	3,725	—	—	1	—	15,000	5,500	86
N-21	PE	120	121	<1	0.950	<0.05	600	400	350	—	—	1	—	6,500	2,800	87
N-22	PE	118	118	<1	0.943	<0.05	580	410	380	—	—	1	—	6,500	2,700	—
N-30	PE	110	110	2	0.924	<0.05	1,050	700	—	—	—	1	—	9,200	2,600	—
N-34	PE	103	104	5	0.910	<0.05	450	300	—	—	—	1	—	6,200	2,200	76
N-35	PE	103	104	3	0.913	<0.05	700	—	—	—	—	1	—	7,580	2,580	—
Emulsifiable—Oxidized Low Molecular Weight																
E-10	PE	106	105	2	0.942	17	800	525	—	—	—	1	—	6,100	1,700	—
E-14	PE	104	104	4	0.939	17	225	160	—	—	—	1	—	3,600	1,300	—
E-15	PE	100	100	7	0.925	17	350	200	—	—	—	1	—	4,200	1,400	—
E-16	PE	102	105	4	0.943	17	700	500	—	—	—	1	—	5,500	1,450	—
E-17	PE	100	104	4	0.941	24	500	—	—	—	—	1	—	4,200	1,050	—
E-20	PE	111	112	<1	0.960	17	1,500	900	—	—	—	1	—	7,500	1,600	—
Chemically Modified PP																
E-25	Ma-PP	157[e]	160	<1	0.921	25	—[d]	—[d]	—[d]	300	—	4	36	12,000	4,000	—
E-43	Ma-PP	157[e]	160	<1	0.934	45	—[d]	—[d]	—[d]	300	—	8	51	9,100	3,900	—
G-3003	Ma-PP	158[e]	174	<1	0.912	9	—[d]	—[d]	—[d]	60,000	—	—	25	52,000	27,200	—
G-3015	Ma-PP	156[e]	170	<1	0.913	15	—[d]	—[d]	—[d]	25,000	—	—	40	47,000	24,800	—

[a] *Typical properties are reported for information only. These figures are average values for typical production material and should not be construed as specifications.*

[b] *Needle under 100-g load for 5 s @ 25°C, tenths of mm*

[c] *2% in 54°C (130°F) paraffin*

[d] *Solid at this temperature*

[e] *DSC Tm, °C*

FDA Food Additive Regulation Status of *Epolene* Polymers

Applicable Regulations 21 CFR[a]	*Epolene* C Polymer											
	C-10	C-13	C-14	C-15	C-16	C-17	C-18	N-10	N-11	N-14	N-15	
Regulations Pe												
177.1520(c)(2.1)			•			•						
177.1520(c)(2.3)	•[b]	•[b]	•	•[b]		•		•[b]	•[b]	•[b]		
175.105	•	•	•	•	•	•	•	•	•	•	•	
175.125												
175.300	•[b]	•[b]	•	•[b]		•		•[b]	•[b]	•[b]		
175.320	•[b]	•[b]		•[b]				•[b]	•[b]	•[b]		
176.170	•[b]	•[b]	•	•[b]	•	•	•	•[b]	•[b]	•[b]		
176.180	•	•	•	•	•	•	•	•	•	•		
176.200	•	•	•	•		•		•	•	•		
176.210	•	•	•	•		•		•	•	•		
177.1200	•[b]	•[b]	•	•[b]		•		•[b]	•[b]	•[b]		
177.1210	•[b]	•[b]	•	•[b]		•		•[b]	•[b]	•[b]		
177.1320	•[b]	•[b]	•	•[b]		•		•[b]	•[b]	•[b]		
177.1620												
177.2600	•[e]	•[e]	•[e]	•[e]		•[e]		•[e]	•[e]	•[e]		
177.2800												
178.3570	•	•	•	•		•		•	•	•		
178.3850	•[b]	•[b]	•	•[b]		•		•[b]	•[b]	•[b]		
179.45			•			•		•[b]	•[b]	•[b]		
Regulations P												
172.260												
172.615	•	•	•	•		•		•	•			
173.20			•			•						

[a] *Before using any of these products in food-contact applications, refer to 21 CFR 174.5 (General Provisions Applicable to Indirect Food Additives) and the full text of each listed FDA regulation for applicable limitations or restrictions.*

[b] *Level of use cannot exceed 50% by weight of food-contact coating.*

[c] *Complies with 21 CFR 175.300(b)(3)(xix) only when blended with polypropylene homopolymer complying with 21 CFR 177.1520(c)(1.1) to produce a resin that has a combined maleic anhydride content of 0.8% or less and a minimum intrinsic viscosity of 0.9.*

[d] *Limitations are dependent on end use of food-contact article.*

[e] *Limited to 2% by weight of the finished article.*

Epolene N Polymer							*Epolene* E Polymer							*Epolene* G Polymer	
	N-20	N-21	N-22	N-30	N-34	N-35	E-10	E-14	E-15	E-17	E-20	E-25	E-43	G-3003	G-3015
to Direct Food Contact															
	●[b]	●[b]	●[b]	●[b]	●[b]	●[b]									
	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
							●	●	●		●				
	●[b]	●[b]	●[b]	●[b]	●[b]	●[b]	●	●	●		●			●[c]	●[c]
	●[b]	●[b]	●[b]	●[b]	●[b]	●[b]	●[b]	●[b]	●[b]		●[b]				
	●	●	●	●[b]	●[b]	●[b]	●[d]	●[d]	●[d]		●[d]				
	●	●	●	●	●	●	●	●	●		●				
	●	●	●	●	●	●	●	●	●		●				
	●	●	●	●	●	●	●	●	●		●				
	●[b]	●[b]	●[b]	●[b]	●[b]	●[b]	●	●	●		●				
	●[b]	●[b]	●[b]	●[b]	●[b]	●[b]	●[b]	●[b]	●[b]		●[b]				
	●[b]	●[b]	●[b]	●[b]	●[b]	●[b]									
							●	●	●		●				
	●[e]	●[e]	●[e]	●[e]	●[e]	●[e]	●[e]	●[e]	●[e]		●[e]				
							●	●	●		●				
	●	●	●	●	●	●									
	●[b]	●[b]	●[b]	●[b]	●[b]	●[b]									
	●[b]	●[b]	●[b]	●[b]	●[b]	●[b]	●[b]	●[b]	●[b]		●[b]				
to Food Components															
							●	●	●		●				
	●	●	●		●	●									

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Publication WA-5E
November 2002

Printed in U.S.A.