

Adhesives and Sealants Raw Materials

Cable Filling/Flooding
Hot-Melt Adhesives
Laminating
Liquid Adhesives
Pressure-Sensitive Adhesives
Roofing
Sealants and Caulks
Urethane Adhesives and Sealants
Wax Blending

***Epolene* Waxes as Petroleum Wax Modifiers**

A majority of petroleum wax production is consumed by the paper and packaging industry while the rest finds use in applications such as candles, investment casting, protective coatings, explosive desensitizers, and cable filling/flooding compounds. Wax characteristics which contribute to this wide range of applications include resistance to water and water vapor, solvent retention, and moldability. However, petroleum waxes have been restricted in many uses because of certain limitations, such as low tensile strength, elongation, elasticity, brittleness, flaking, and cracking.

The properties of petroleum waxes and wax blends can be improved through the incorporation of small amounts of *Epolene* waxes from Eastman Chemical Company. These improvements include:

- Reduced flaking
- Improved adhesion
- Increased mileage
- Improved gloss
- Greater abrasion resistance
- Better resistance to thermal shock
- Higher blocking temperature
- Increased toughness

Each type of *Epolene* wax contributes to the improvement of one or more of these properties, and the wide range of physical properties available in *Epolene* waxes

provides formulating flexibility never before possible. Formulators can choose from 14 *Epolene* waxes to improve existing wax formulations or to develop new ones. The narrow viscosity range of *Epolene* waxes makes possible the standardization of formulas to provide consistency in finished products. Furthermore, *Epolene* waxes offer the formulator a raw material of uniformly high quality and reliable supply. Thus, through selective blending, users can formulate waxes tailored to meet their particular equipment and performance requirements.

Table 1 lists several petroleum wax applications and suggests specific *Epolene* waxes useful for each. Information on the individual C- and N-type *Epolene* waxes is found in the remainder of this publication.

Table 1

Petroleum Wax Applications for C- and N-Type *Epolene* Waxes

Application	<i>Epolene</i> Wax
Cable filling/flooding compounds	N-21
Candles	C-15, N-10, N-11, N-34
Carbon paper	N-10, N-11, N-21
Crayons	C-15, N-14
Explosive desensitizers	C-15, N-14
Investment casting	N-11, N-21, N-14, N-34
Paper and paperboard coatings, fluting lubricants	C-10, C-13, C-14, C-15, C-16, C-17, C-18, N-11

General Characteristics of C-Type *Epolene* Waxes

The C-type (coating grade) *Epolene* waxes are higher in molecular weight and melt viscosity, but lower in density compared with the N-type waxes. C-type *Epolene* waxes, when added in small amounts, have the ability to improve the properties of paraffin waxes. Improvements are gained in gloss, flexibility, toughness, adhesion, and resistance to blocking and flaking. *Epolene* C waxes are readily dispersed in molten paraffin, and when added to paraffins, they reduce the tendency of the paraffin to crack and flake at low temperatures. Of further importance is the extended mileage, or coverage, of such blends which yields lower costs.

Seven C-type *Epolene* waxes are currently used as modifiers in petroleum wax formulations. These waxes, and their general performance characteristics, are discussed in this publication. Some typical physical properties of *Epolene* C waxes are shown in Table 2; compatibility with various waxes and resins is shown in Table 4. Figures 1, 2, and 3, respectively, show the melt viscosity, the softening point, and the penetration hardness of blends of *Epolene* wax and paraffin. Each of the *Epolene* C-type waxes has a similar effect on the penetration hardness of the blend with paraffin wax.

Epolene C-10 Wax

This is a low-density wax designed for use in hot-melt coatings for papers and packaging materials. Coatings produced with *Epolene* C-10 wax, or blends containing *Epolene* C-10 wax, exhibit high gloss, low moisture vapor transmission rates, good grease resistance, and good heat-sealability. *Epolene* C-10 can also be used as a paraffin modifier in slush molding, cast molding, hot-melt adhesives, and investment castings.

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

These waxes are designed for use in combination with the other *Epolene* waxes or in blends containing low molecular weight materials. As petroleum wax modifiers, these three *Epolene* waxes increase blend viscosity, which is important for controlling penetration into paper substrates. Blends of these *Epolene* waxes with paraffin offer improved grease resistance, higher blocking temperatures, better scuff resistance, and improved gloss. Other uses include additives for inks and ingredients for hot-melt adhesives.

Epolene C-15 Wax

As an additive for folding cartons, *Epolene C-15* wax imparts high gloss, good gloss retention, and improved holdout. Easily modified with low-cost resins, *Epolene C-15* is useful in formulating hot-melt adhesives and as a candle additive to provide gloss, sheen, opacity, and good mold release.

Epolene C-16 and C-18 Waxes

As hot-melt coatings for paper, *Epolene C-16* and *C-18* waxes provide glossy barrier coatings that may be heat-sealed readily to most paper products, metal foils, and polyolefin films. In petroleum wax coatings, *Epolene C-16* and *C-18* provide good gloss retention, scuff resistance, wet crush resistance, grease resistance, and, in certain formulations, heat sealability. As additives in wax copolymer coatings, *Epolene C-16* and *C-18* can provide increased hot tack, scuff resistance, and gloss stabilization.

Table 2

Typical Physical Properties^a
of *Epolene C* Waxes

	C-10	C-13	C-14	C-15	C-16	C-17	C-18
Ring and ball softening point, °C	104	110	>133	102	102	133	102
Penetration hardness, 100 g/5 sec/25°C tenths of mm	3	3	2	4	3	2	4
Density, g/cc @ 25°C	0.906	0.913	0.918	0.906	0.908	0.917	0.905
Acid number	<0.05	<0.05	<0.05	<0.05	5 ^b	<0.05	5 ^b
Brookfield Thermosel viscosity, ^c cP @ 150°C (302°F)	7,800	—	— ^d	3,900	8,500	— ^d	4,000
Melt index, 190°C	2,250	200	1.6	4,200	1,700	20	4,200
Color, Gardner scale	1	1	1	1	1	1	1
Molecular weight, GPC							
M _w	35,000	76,000	143,000	17,000	26,000	100,000	15,000
M _n	7,700	12,000	18,000	6,700	5,600	14,000	5,700
Cloud point, ^e °C	77	81	84	75	78	81	71

^aReported for information only. Figures are average values for typical production material and should not be construed as specifications.

^bSaponification number

^cConventional Brookfield viscosity = 1.15 x Brookfield Thermosel viscosity

^dSolid at this temperature

^e2% in 130°F paraffin

Figure 1

Melt Viscosity: Blends of *Epolene* C-Type Wax and Paraffin (140°F)

Brookfield Viscosity, 250°F (121°C)

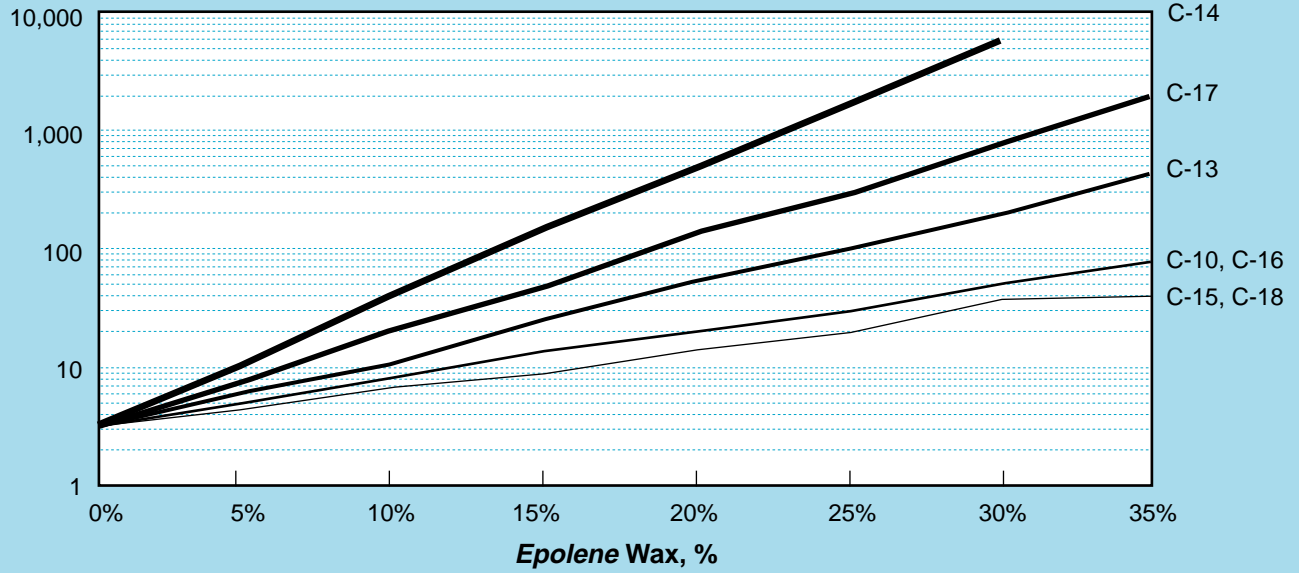


Figure 2

Ring and Ball Softening Point: Blends of *Epolene* C-Type Wax and Paraffin (140°F)

Ring and Ball Softening Point, °C

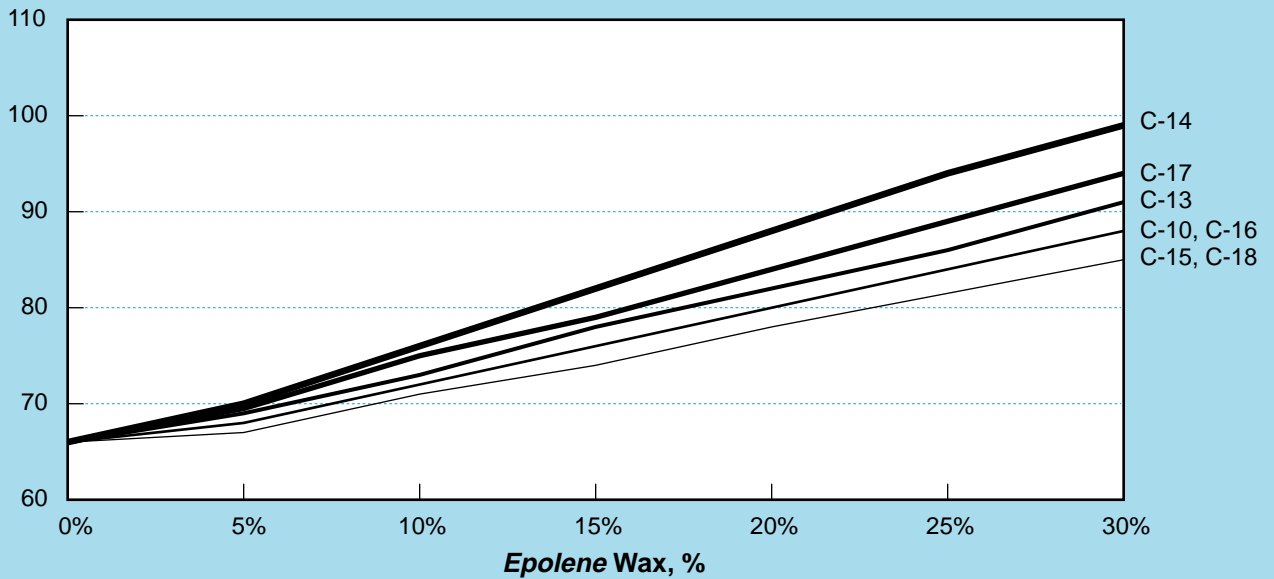
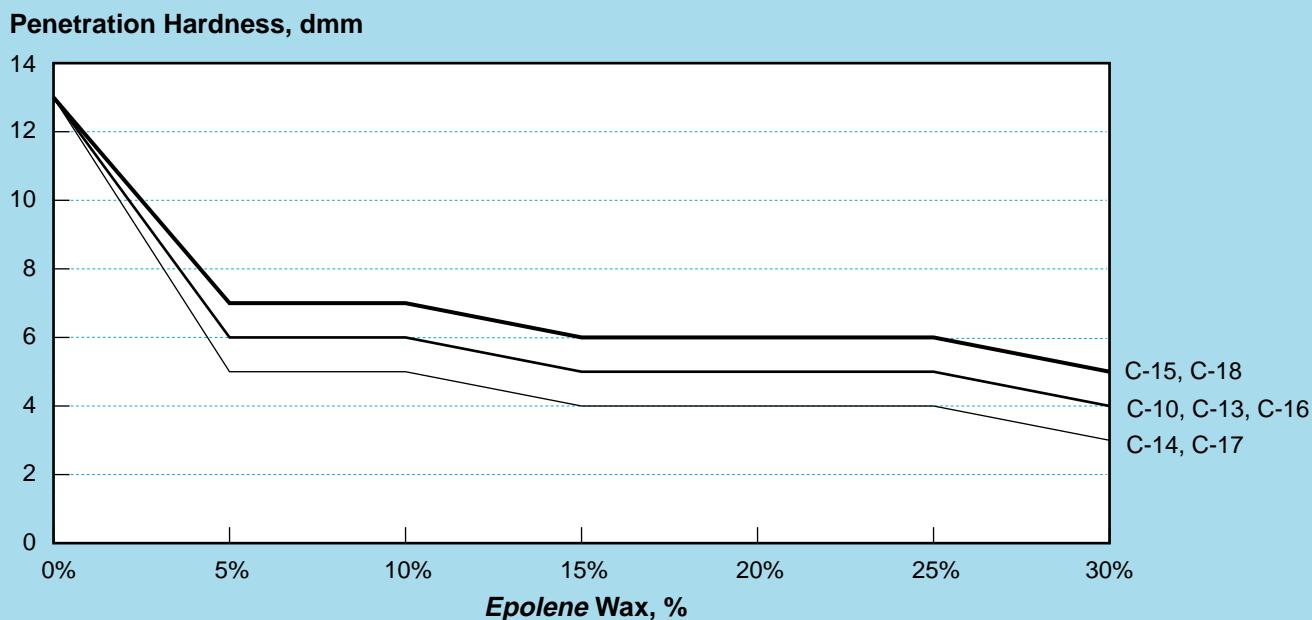


Figure 3

Penetration Hardness: Blends of *Epolene* C-Type Wax and Paraffin (140°F)



General Characteristics of N-Type *Epolene* Waxes

The N-type *Epolene* waxes are nonemulsifiable, low- to medium-viscosity, and medium- to high-density waxes. They may be used to increase the melting point of petroleum waxes. *Epolene* N waxes, when used in small amounts, have the potential to upgrade petroleum wax blends by increasing the tensile strength, raising the melting point, and improving scuff resistance and grease resistance. The low viscosity of *Epolene* N waxes permits a relatively low application temperature [107°–121°C (225°–275°F)], which allows the manufacturer to use existing equipment.

Described herein are seven *Epolene* N waxes which are used as modifiers in petroleum wax formulations. Several typical physical properties of *Epolene* N waxes are shown in Table 3, while compatibility with various waxes and resins is shown in Table 4. Melt viscosity, softening point, and penetration hardness of blends of *Epolene* wax and paraffin are shown in Figures 4, 5, and 6.

Epolene N-10 Wax

This is a nonemulsifiable wax with a medium density and a relatively low melting point. *Epolene* N-10 wax is easily blended with natural or synthetic waxes to gain improved tensile strength, abrasion resistance, and adhesion to fibrous substrates. For paper-coating applications such as folding cartons, *Epolene* N-10 increases wax mileage and provides a glossy, scuff-resistant finish. *Epolene* N-10 wax is also used in printing inks to improve resistance to scuffing and rub-off.

Epolene N-11, N-14, and N-34 Waxes

These *Epolene* N waxes are all lower in molecular weight and in density than *Epolene* N-10. Their applications are similar to those for *Epolene* N-10 wax, but they offer advantages where wax modifiers that have low viscosities and cloud points are needed. They are also used as mold-release additives in rubber molding, and as extrusion aids for vinyl processing.

Epolene N-20 and N-21 Waxes

These waxes, which exhibit hardness, high density, and high melting point, are used to raise the blocking temperature of wax blends and to upgrade low-melting paraffins.

Epolene N-15 Wax

Epolene N-15 is a low-density, low-viscosity polypropylene wax with a high melting point and a low penetration hardness. These features suggest its use as a modifier for petroleum waxes to increase blocking and resistance to scuffing and abrasion, and as a compounding wax for hot-melt adhesives.

Table 3

**Typical Physical Properties^a
of Epolene N Waxes**

	N-10	N-11	N-14	N-15	N-20	N-21	N-34
Ring and ball softening point, °C	111	108	106	163	119	120	103
Penetration hardness, 100 g/5 sec/25°C, dmm	2	2	3	<1.0	<1.0	<1.0	5
Density, g/cc @ 25°C	0.925	0.921	0.920	0.902	0.930	0.950	0.910
Acid number	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Brookfield Thermosel viscosity, ^b cP							
@ 125°C (257°F)	1,500	350	150	— ^c	— ^c	— ^c	450
150°C (302°F)	—	—	—	— ^c	3,725	350	—
190°C (374°F)	—	—	—	600	—	—	—
Color, Gardner scale	1	1	1	1	1	1	1
Molecular weight, GPC							
M _w	10,000	6,000	4,000	12,000	15,000	6,500	6,200
M _n	3,200	2,000	1,700	5,000	5,500	2,800	2,200
Cloud point, ^d °C	82	80	80	104	86	87	76

^aReported for information only. Figures are average values for typical production material and should not be construed as specifications.

^bConventional Brookfield viscosity = 1.15 x Brookfield Thermosel viscosity

^cSolid at this temperature

^d2% in 130°F paraffin

Figure 4

Melt Viscosity: Blends of *Epolene* N-Type Wax and Paraffin (140°F)

Brookfield Viscosity, 250°F (121°C)

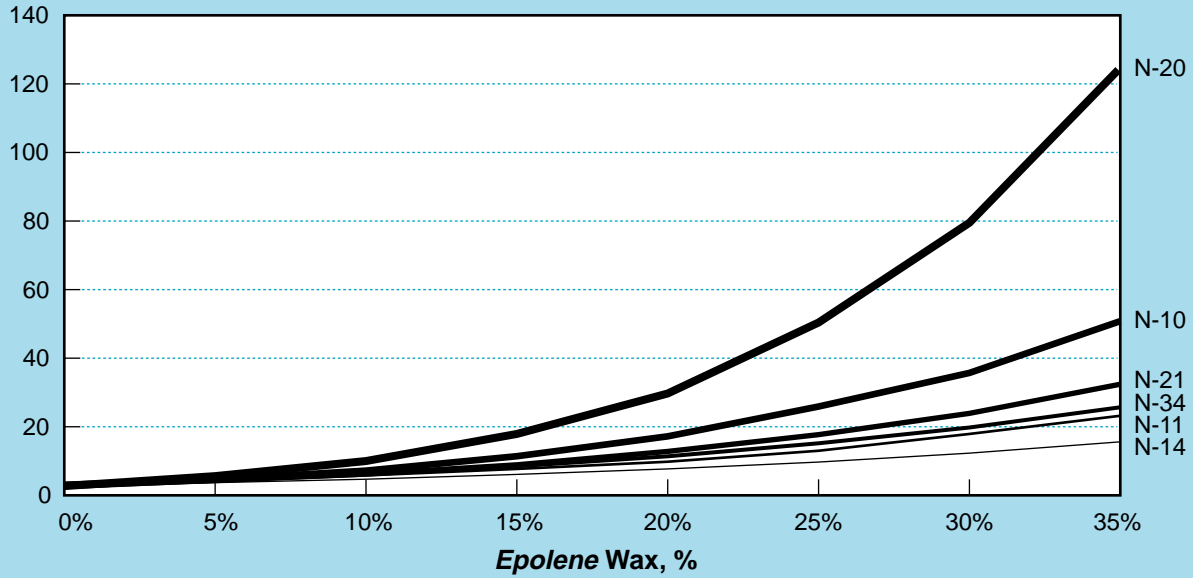


Figure 5

Ring and Ball Softening Point: Blends of *Epolene* N-Type Wax and Paraffin (140°F)

Ring and Ball Softening Point, °C

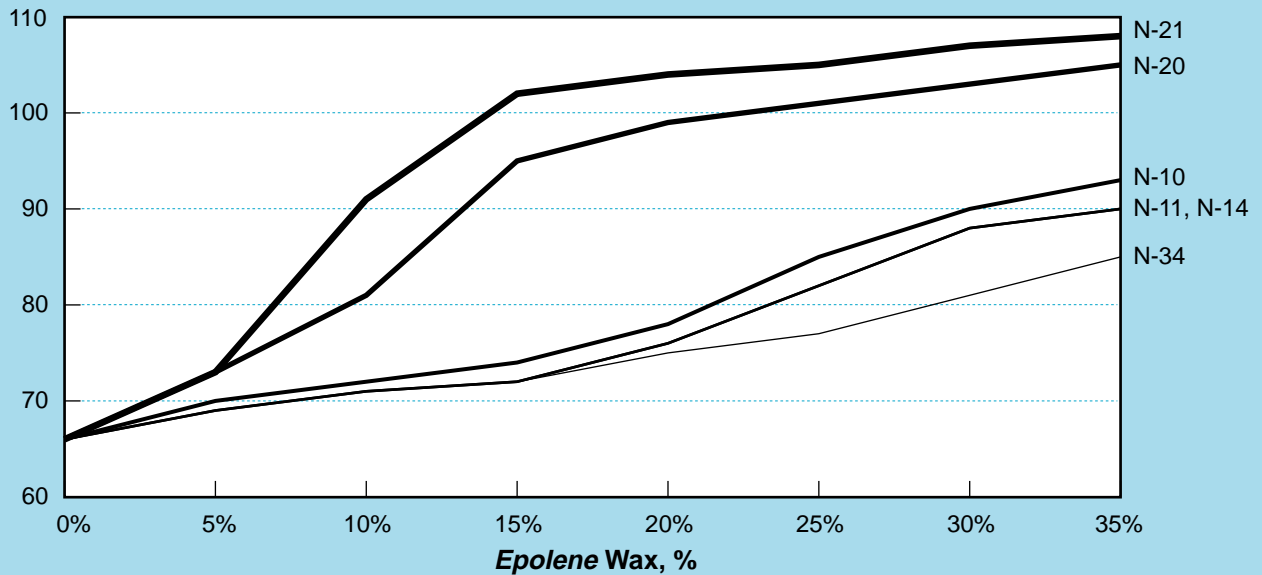
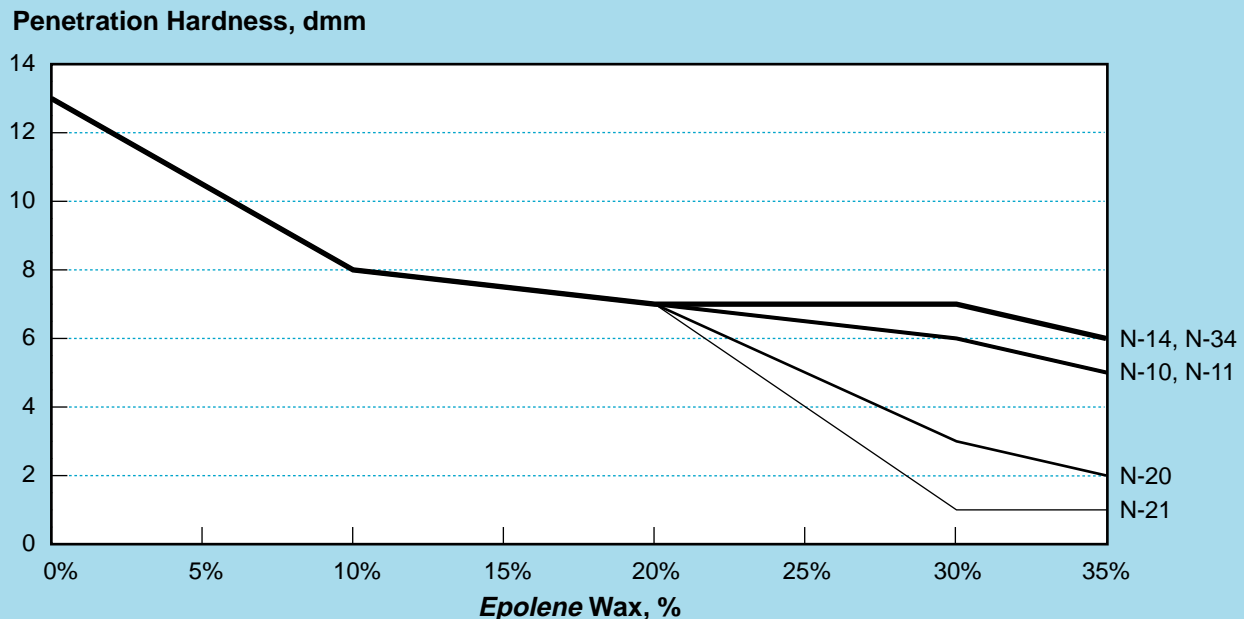


Figure 6

Penetration Hardness: Blends of *Epolene* N-Type Wax and Paraffin (140°F)



Compatibility

The C- and N-type *Epolene* waxes are compatible with many natural and synthetic waxes and resins. The results given in Table 4 were obtained by evaluating such blends. The major component of each blend was melted at 149°C

(300°F), and the minor component was then added slowly with agitation. Incompatibility was evidenced by the formation of a hazy melt or a phase separation on cooling.

FDA Status of *Epolene* Waxes

According to regulations administered by the United States Food and Drug Administration (FDA), most of the *Epolene* waxes are lawful for use as components of food-packaging materials. The status of each wax, however, depends on the particular application and the percentage of wax used.

For applications regulated by the FDA, the user must determine prior to use that the *Epolene* wax selected is lawful for use in the specific application and that any limitations are observed.

A reference to FDA regulations that are applicable to the use of *Epolene* waxes as components of foods and food-packaging materials is available from Eastman. Request a copy of Publication F-243, "A Guide to the Use of *Epolene* Waxes Under United States FDA Food Additive Regulations."

In other countries, the appropriate government regulatory agency should be contacted.

Table 4
Compatibility of *Epolene* Waxes With Various Resins and Waxes^a

Wax or Resin	Type	Ratio of <i>Epolene</i> N-Type to Wax or Resin			Ratio of <i>Epolene</i> C-Type to Wax or Resin			Suppliers
		1:3	1:1	3:1	1:3	1:1	3:1	
<i>Acrawax</i> "C"	Synthetic wax	I	I	C	I	I	C	Glycol Chemicals, Inc.
<i>Acryloid</i> B-72	Acrylic resin	I	I	I	I	I	I	Rohm and Haas Company
<i>Amberol</i> 750	Fortified rosin	I	I	I	I	I	I	Rohm and Haas Company
Bayberry	Vegetable wax	C	C	C	C	C	C	^b
Beeswax	Insect wax	C	C	C	C	C	C	^b
Candelilla	Vegetable wax	H	H	H	H	H	H	^b
<i>Carbowax</i> 6000	Polyethylene glycol	I	I	I	I	I	I	Union Carbide Corp., Chemicals & Plastics
Carnauba	Vegetable wax	C	C	C	C	C	C	^b
<i>Cellolyn</i> 104	Pentaerythritol ester of rosin	I	I	I	I	I	I	Hercules, Inc.
<i>Chlorowax</i> 70	Chlorinated paraffin	I	I	C	I	I	C	Diamond Shamrock Corp.
<i>Crown</i> 1035	Microcrystalline wax	C	C	C	C	C	C	Petrolite Corporation
<i>Eastotac</i> H-100	Hydrocarbon resin	C	C	C	C	C	C	Eastman Chemical Company
<i>Eastotac</i> H-115	Hydrocarbon resin	C	C	C	C	C	C	Eastman Chemical Company
<i>Eastotac</i> H-130	Hydrocarbon resin	C	C	C	C	C	C	Eastman Chemical Company
<i>Epolene</i> C-Type	Polyolefin	C	C	C	—	—	—	Eastman Chemical Company
<i>Epolene</i> E-Type	Polyolefin	C	C	C	C	C	C	Eastman Chemical Company
<i>Epolene</i> N-Type	Polyolefin	—	—	—	C	C	C	Eastman Chemical Company
Ester Gum 8L	Glycerol ester of rosin	I	I	I	I	I	I	Hercules, Inc.
<i>Indopol</i> H-1900	Polybutene	H	C	C	H	C	C	Amoco Chemical Company
Japan wax	Vegetable wax	C	C	C	C	C	C	^b
<i>Lewisol</i> 33	Maleic alkyd-modified rosin wax	I	I	I	I	I	I	Hercules, Inc.
Mineral oil	Hydrocarbon oil	C	C	C	C	C	C	^b
Montan	Mineral wax	C	C	C	C	C	C	^b
<i>Neville</i> R-29	Coumarone-indene	C	C	C	C	C	C	Neville Chemical Company
<i>Neville</i> R-52	Styrenated coumarone- indene	I	I	I	I	I	I	Neville Chemical Company
<i>Neville</i> LX-1000	Hydrocarbon	C	C	C	C	C	C	Neville Chemical Company
Oleic acid	Aliphatic acid	C	C	C	C	C	C	^b
Ouricury	Vegetable wax	I	I	I	I	I	I	^b
Ozokerite	Mineral wax	C	C	C	C	C	C	^b
<i>Paracin</i> 1C	Ethylene glycol mono- methyl ether ricinoleate	I	I	I	I	I	I	Baker Castor Oil Company
Paraffin	Petroleum wax	C	C	C	C	C	C	^b
<i>Piccopale</i> 100	Hydrocarbon	C	C	C	C	C	C	Hercules, Inc.
<i>Pliolite</i> S-5	Styrene-butadiene	I	I	I	I	I	I	Goodyear Tire and Rubber Co., Inc.
Stearic acid	Aliphatic acid	C	C	C	C	C	C	^b
<i>Staybelite</i>	Hydrogenated rosin	C	C	C	C	C	C	Hercules, Inc.
Sugar cane	Vegetable wax	C	C	C	C	C	C	^b
<i>Uformite</i> F-240	Urea-formaldehyde	I	I	I	I	I	I	Rohm and Haas Company
<i>Uformite</i> MM55	Melamine-formaldehyde	I	I	I	I	I	I	Rohm and Haas Company
<i>Vinsol</i>	Wood rosin fraction	I	I	I	I	I	I	Hercules, Inc.

^aC—clear and homogeneous H—hazy, some incompatibility I—incompatible, separates

^b Several sources

EASTMAN

■ NORTH AMERICA

Eastman Chemical Company Corporate Headquarters

P.O. Box 431
Kingsport, TN 37662-5280 U.S.A.

Telephone:
U.S.A. and Canada, 800-EASTMAN (800-327-8626)
Other Locations (1) 423-229-2000
Fax: (1) 423-229-1673
<http://www.eastman.com>

■ LATIN AMERICA

Eastman Chemical Latin America, Inc.

2333 Ponce de Leon Blvd.
Suite R-20
Coral Gables, FL 33134 U.S.A.

Telephone: (1) 305-461-8240
Fax: (1) 305-461-8254

■ EUROPE / MIDDLE EAST / AFRICA

Eastman Chemical, Europe, Middle East, and Africa Ltd.

Tobias Asserlaan 5
2517 KC The Hague
NETHERLANDS

Telephone: (31) 70 370 1711
Fax: (31) 70 370 1704

■ ASIA PACIFIC

Eastman Chemical Japan Ltd.

Yebisu Garden Place Tower, 32F
4-20-3 Ebisu
Shibuya-ku, Tokyo 150 JAPAN

Telephone: (81) 3-5424-1551
Fax: (81) 3-5424-1590

Eastman Chemical Asia Pacific Pte. Ltd.

#05-04 Winsland House
3 Killiney Road
Singapore 239519 SINGAPORE

Telephone: (65) 738-4877
Fax: (65) 732-4930

Material Safety Data Sheets providing safety precautions that should be observed in handling and storing Eastman products are available on request. You should obtain and review the available material safety information before handling any of these products. If any materials are mentioned that are not Eastman products, appropriate industrial hygiene and other safety precautions recommended by their manufacturers should be observed.

Neither Eastman Chemical Company nor its marketing affiliates shall be responsible for the use of this information, or of any product, method, or apparatus mentioned, and you must make your own determination of its suitability and completeness for your own use, for the protection of the environment, and for the health and safety of your employees and purchasers of your products. No warranty is made of the merchantability or fitness of any product, and nothing herein waives any of the Seller's conditions of sale.

Eastman, Eastotac, and Epolene are trademarks of Eastman Chemical Company.

© Eastman Chemical Company, 1997.

Publication WA-43A
July 1997