

# *Epolene*® Polymers 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. 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. These improvements include: Reduced Flaking, Improved Adhesion, Increased Mileage, Improved Gloss, Greater Abrasion Resistance, Better Resistance to Thermal Shock, Higher Blocking Temperature and 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. Formulators can choose from many *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**

<b>Application</b>	<b>Epolene Wax</b>
Cable filling	N-21
Candles	C-15, 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-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 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 *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 improve 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 heatsealed 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 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<sup>a</sup> of *Epolene* C Waxes

	C-10	C-13	C-15	C-16	C-17	C-18
Ring and ball softening point, °C	104	110	102	106	133	102
Penetration hardness, 100 g/5 sec/25°C tenths of mm	3	3	4	3	2	4
Density, g/cc at 25°C	0.906	0.913	0.906	0.908	0.917	0.905
Acid number	<0.05	<0.05	<0.05	2.5	<0.05	2.5
Brookfield Thermosel viscosity, C cP at 150°C (302°F)	7,800	—	3,900	8,500	d	4,000
Melt index, 190°C	2,250	200	4,200	1,700	20	4,200
Color, Gardner scale	1	1	1	1	1	1
Molecular weight, GPC						
M <sub>w</sub>	23,800	68,200	20,200	23,400	107,000	17,400
M <sub>n</sub>	6,900	11,300	5,900	4,700	15,000	4,900
Cloud point, <sup>e</sup> °C	77	81	75	78	81	71

<sup>a</sup>Reported for information only. These figures are average values for typical production material and should not be construed as specifications.

<sup>c</sup>Conventional Brookfield viscosity = 01.15 x Brookfield Thermosel viscosity

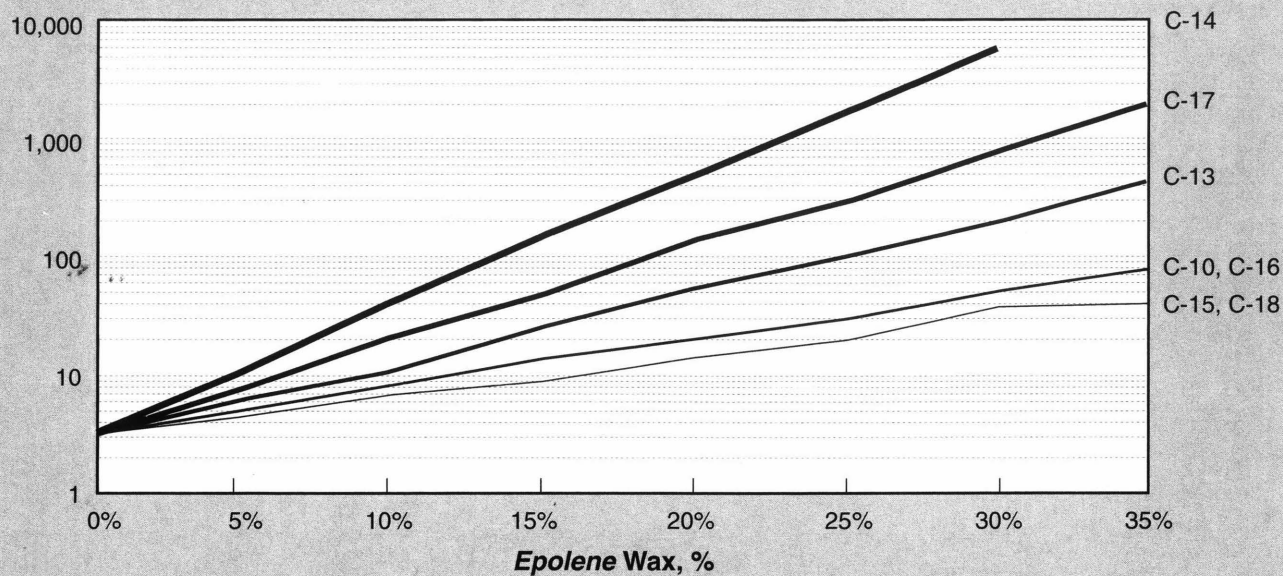
<sup>d</sup>Solid at this temperature

<sup>e</sup>2% in 130°F paraffin

**Figure 1**

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

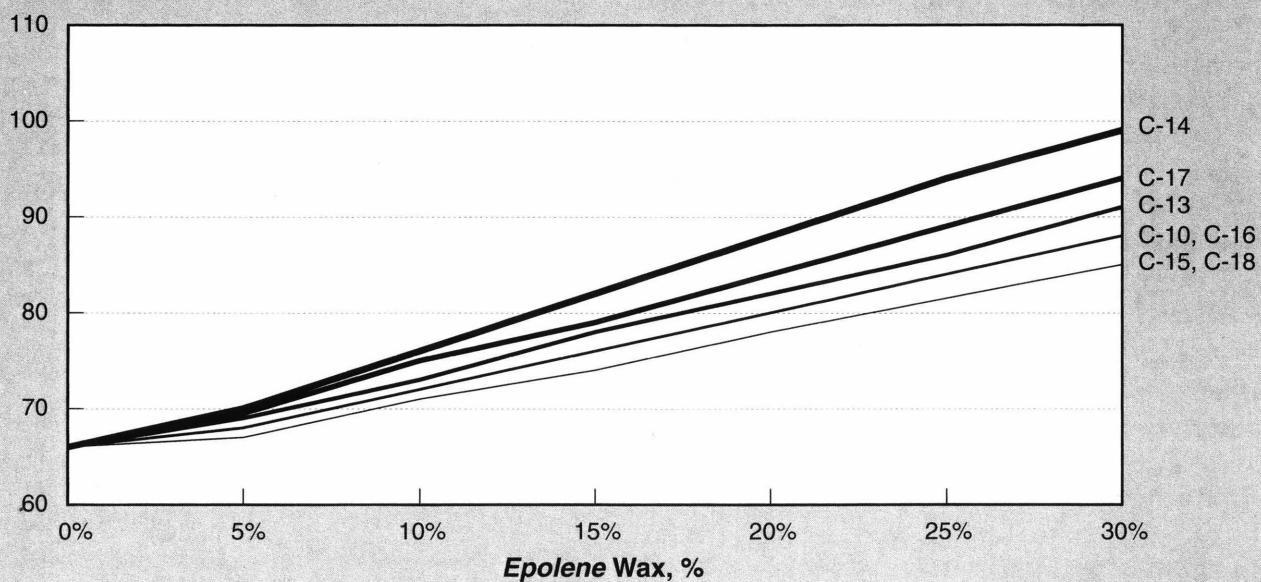
**Brookfield Viscosity, 250°F (121°C)**



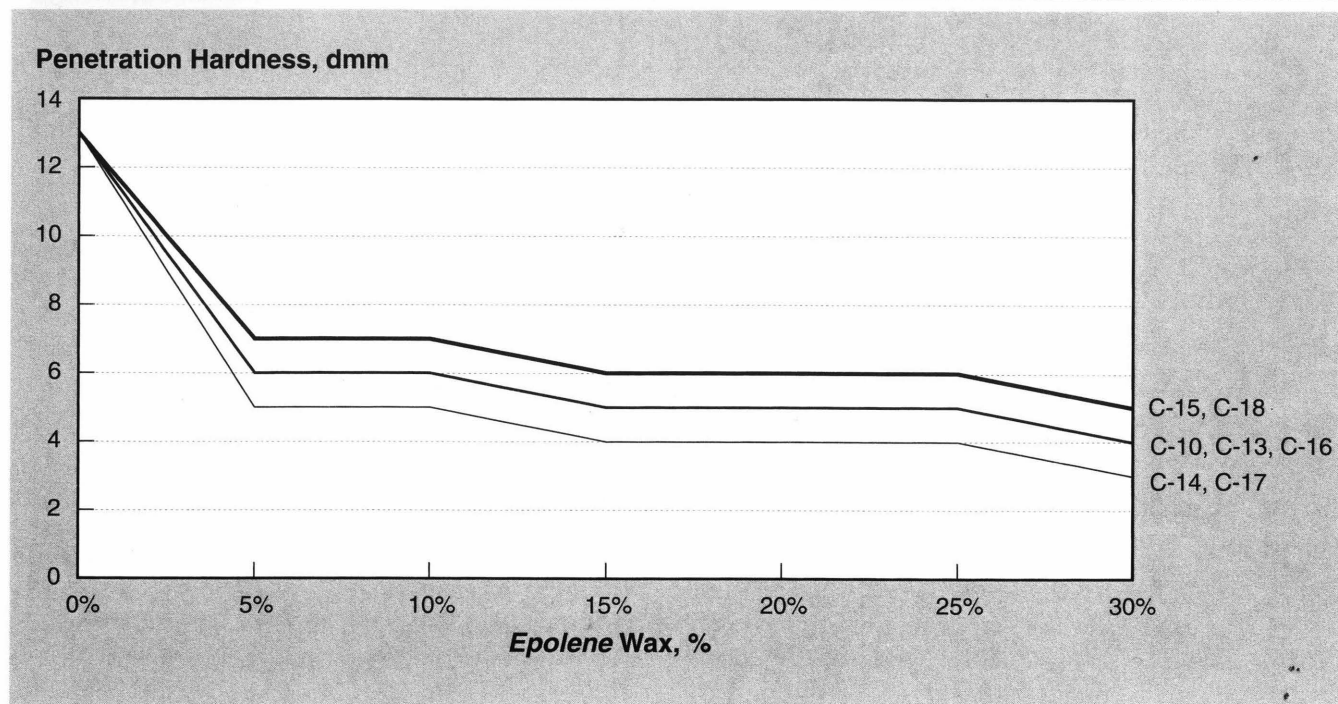
**Figure 2**

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

**Ring and Ball Softening Point, °C**







## 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.

Six *Epolene* N waxes 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 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-21 Wax***

This wax, which exhibits hardness, high density, and high melting point, is used to raise the blocking temperature of wax blends 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<sup>a</sup> of *Epolene* N Waxes**

	<b>N-10</b>	<b>N-11</b>	<b>N-14</b>	<b>N-15</b>	<b>N-21</b>	<b>N-34</b>
Ring and ball softening pint, °C	111	108	106	163	120	103
Penetration hardness, 100g/5sec/25°C tenths of mm	2	2	3	0.6	<0.1	5
Density, g/cc at 25°C	0.925	0.921	0.920	0.902	0.950	0.910
Acid number	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Brookfield Thermosel viscosity, <sup>b</sup> cP at 125°C (257°F)	1,500	350	150	c	c	450
150°C (302°F)	---	---	---	c	350	---
190°C (374°F)	---	---	---	600	---	---
Color, Gardner scale	1	1	1	1	1	1
Molecular weight, GPC						
Mw	10,100	5,400	3,700	22,700	5,900	6,500
Mn	2,900	1,400	1,300	10,500	2,600	2,300
Cloud point, <sup>d</sup> °C	82	80	80	104	87	76

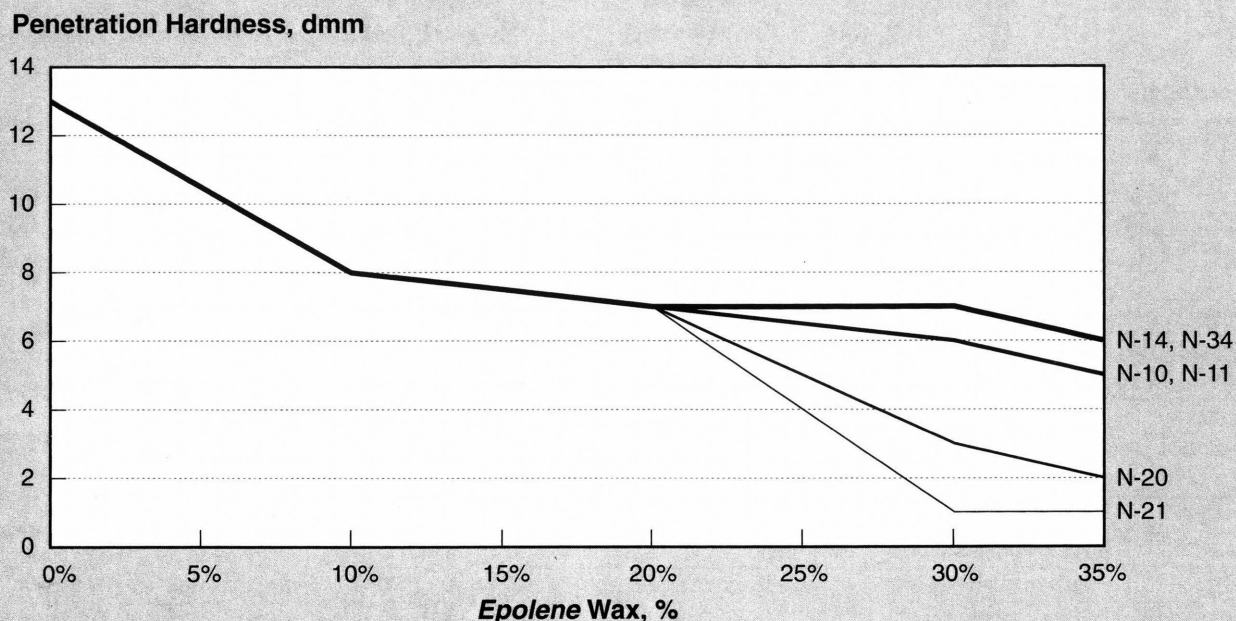
<sup>a</sup>Reported for information only. These figures are average values for typical production material and should not be construed as specifications.

<sup>c</sup>Solid at this temperature

<sup>d</sup>2% in 130°F paraffin

Figure **6**

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



## Compatibility

The C- and N-type *Epilene* 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 *Epilene* Waxes

In the United States, most of the *Epilene* waxes are lawful for use as components of food packaging materials under appropriate U.S. Food Additive Regulations. The status of each wax, however, depends on the particular application and the percentage of wax used.

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

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

**For additional information:**

**Customer Service**

**800-545-9577**