

Plasticizer Blue Book  
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## Largest Selection of Plasticizers From One Source

Monsanto offers you the largest assortment of plasticizers—both in number and variety—in the world. This broad line has unique advantages: you can select from one source the plasticizing system that offers you the optimum in processing and performance; you can obtain impartial technical guidance; you can take advantage of the savings in combined shipments; you can simplify your purchasing procedure.

The need for a selection of plasticizers is readily apparent. In the 1930's—when Monsanto pioneered the technology of plasticization—performance demands were relatively mild. Plasticizing was simple because applications were few and resins fewer. In the intervening years, many new resins were commercialized, countless applications have developed, and today there are rigorous specifications and a variety of needs for ease of processing, speed of cure, and particular performance qualities.

Confronted with the multiplicity of end-use requirements on one hand and a multitude of plasticizer and resin choice on the other—even the most experienced formulator is bewildered by the maze of possibilities of from which to select the one best system for his particular application.

This catalog has been designed to serve as one tool to help you solve the often perplexing problems of what plasticizer to use. It contains complete descriptions of the performance and processing characteristics of each of Monsanto's more than eighty plasticizers. It also includes tabulations of performance data of various plasticizers in several end-use applications and guides to superior plasticizers to develop compounds with special performance.

This catalog is not the final guide to plasticizer selection. It is primarily a guide to performance of types. However, if these data are used as a guide to plasticizer selection, Monsanto technical bulletins on individual plasticizers and on certain end-use applications will provide more complete information.

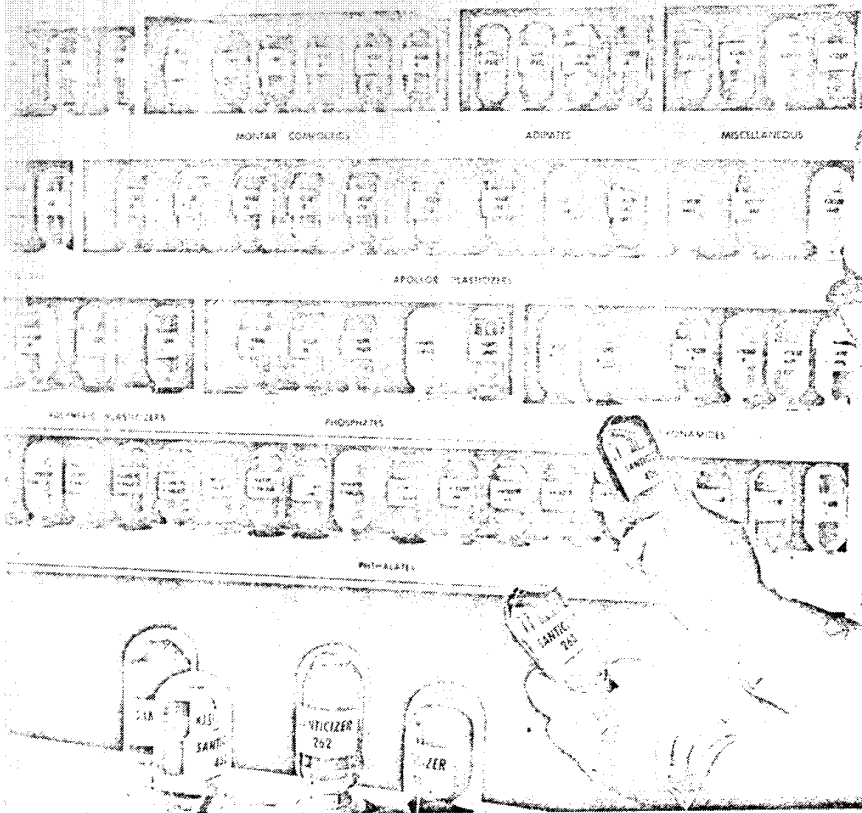
Specific consultation services are offered by Monsanto's Plasticizer Council. We hope these three sources of information will be helpful to you in your manufacture of plastics products, surface coatings, and adhesives.

0476047

TOWOLDMON0033017

# PLASTICIZERS

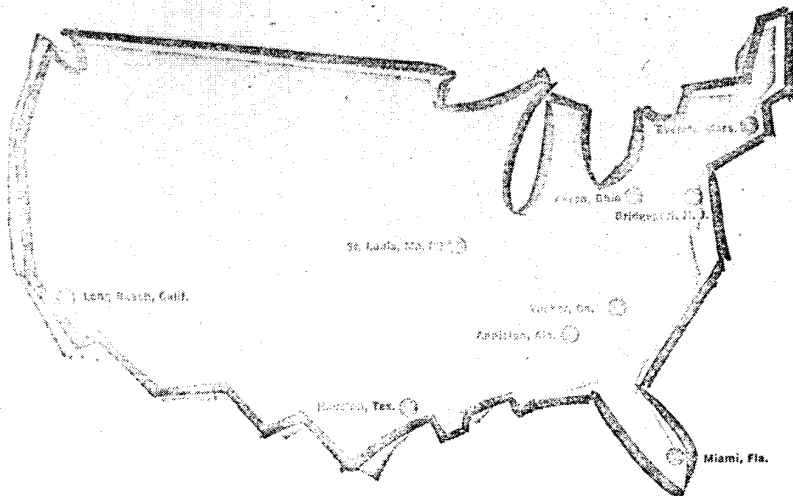
For the Widest Choice in the World



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0476048

TOWOLDMON0033018



## ten bulk station distribution points

To give rapid delivery and multi-product shipments, Monsanto maintains bulk station inventories at strategic industrial centers along the east coast, the south and southwest, the midwest and the west coast. These bulk stations are another customer service that enables plasticizer users to save money in the following ways:

**Lowest cost/lb.** With Monsanto's distribution, compounders can reduce their materials costs by purchasing in tank cars direct from the producing plant or by ordering tank truck shipments from the nearest bulk storage station. Bulk prices are about 10% lower than car- and truck-lot drum prices.

**Conservation of plant storage space** Since the Monsanto bulk stations are strategically located close to major manufacturing centers, minimum plasticizer storage space is needed. Supplies are available in most areas for fast, short-haul delivery.

**Compartmented shipments** With such a broad line of plasticizers, compounders can take the savings of bulk purchasing by ordering as many as three different plasticizers in a single order. The different plasticizers are shipped in compartmented tank

trucks. Multi-product combined shipments from bulk stations can also reduce in-plant inventory costs.

**Mixed Car- and Truck-lot Shipments** By offering such a full line of plasticizers, Monsanto can load out mixed drum orders in a single car or truck. This gives the buyer the cost economy of full carriers.

**Ordering, invoicing simplified** With this efficient distribution system, compounders can make additional savings by fewer shipments, fewer orders, and reduced paper work in clerical handling of invoices.

Monsanto is always ready to work with customers to establish and maintain convenient bulk station distribution centers wherever volume justifies a mutually convenient storage station.

## *specifications and physical characteristics*

### *of Monsanto plasticizers*

Monsanto plasticizers comprise both liquids and solids representing a variety of distinct chemical types, including

phthalate esters

adipate esters

permanent plasticizers

glycollates

sulfonamides

phosphate esters

aroclor® plasticizers

... plus a variety of "specialty" compounds and extenders.

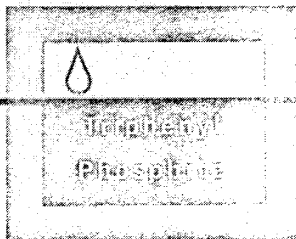
Each of these, in themselves, but primarily in combination offer special processing or end product quality advantages in particular applications. Specific plasticizers and specially researched combinations have been developed for formulation of plastisols for slush molding, fabric and paper coating; for adhesives and surface coatings; for extrusions both profile and cross section; for floor tile; and for cast or calendered free film.

The following pages describe physical properties of the various plasticizers of choice available from Monsanto.

0476050

TOWOLDMON0033020

## processing specialty color improver for alkyl resins



### General Description

Triphenyl phosphite is widely used as a stabilizer in polyvinyl chloride compositions. It serves a dual function: (a) When cadmium compounds are part of the composition, triphenyl phosphite solubilizes and removes the haze developed by the cadmium chloride formation; (b) When chlorine ions are split from polyvinyl chloride, double-bonds susceptible to oxygen-darkening are left behind on the polymer; triphenyl phosphite acts as an antioxidant and contributes to better light stability. [This function, also valuable in other resins, is covered by U. S. Patents 2,572,571 (Monsanto) and 2,564,646 (Argus Chemical Company)].

In alkyl resins, triphenyl phosphite improves the color of the resins which tend to oxidize at the 400-540°F. processing temperatures due to presence of free peroxides or iron soluble salts. If calcium hydroxide is used as an alcoholysis catalyst, the presence of triphenyl phosphite will improve the finished resin's clarity by solubilizing the calcium phthalate precipitate which forms. In polyester resin manufacture, small amounts of triphenyl phosphite reduce the reaction time and improve the resin's color. The same color improvement is obtainable in the manufacture of bodied oils made by the treatment of soya, linseed, and tall oils with maleic anhydride or fumaric acid. In phenolic resin manufacture, triphenyl phosphite promotes the formation of permanently light colored liquid phenol formaldehyde compositions (U. S. Patent 2,816,876, Monsanto Co.).

Triphenyl phosphite is considered only slightly toxic from the standpoint of oral ingestion and is not readily absorbed in lethal doses through the unbroken skin. Repeated or prolonged skin contact should be avoided, however, to prevent skin irritation. The material may cause irritation if there is accidental contact with eye tissues but no permanent damage should result. Prompt flushing of the eyes with water will reduce the degree of irritation. In laboratory studies, no deaths occurred among rats exposed for six hours to a saturated atmosphere of atomized triphenyl phosphite.

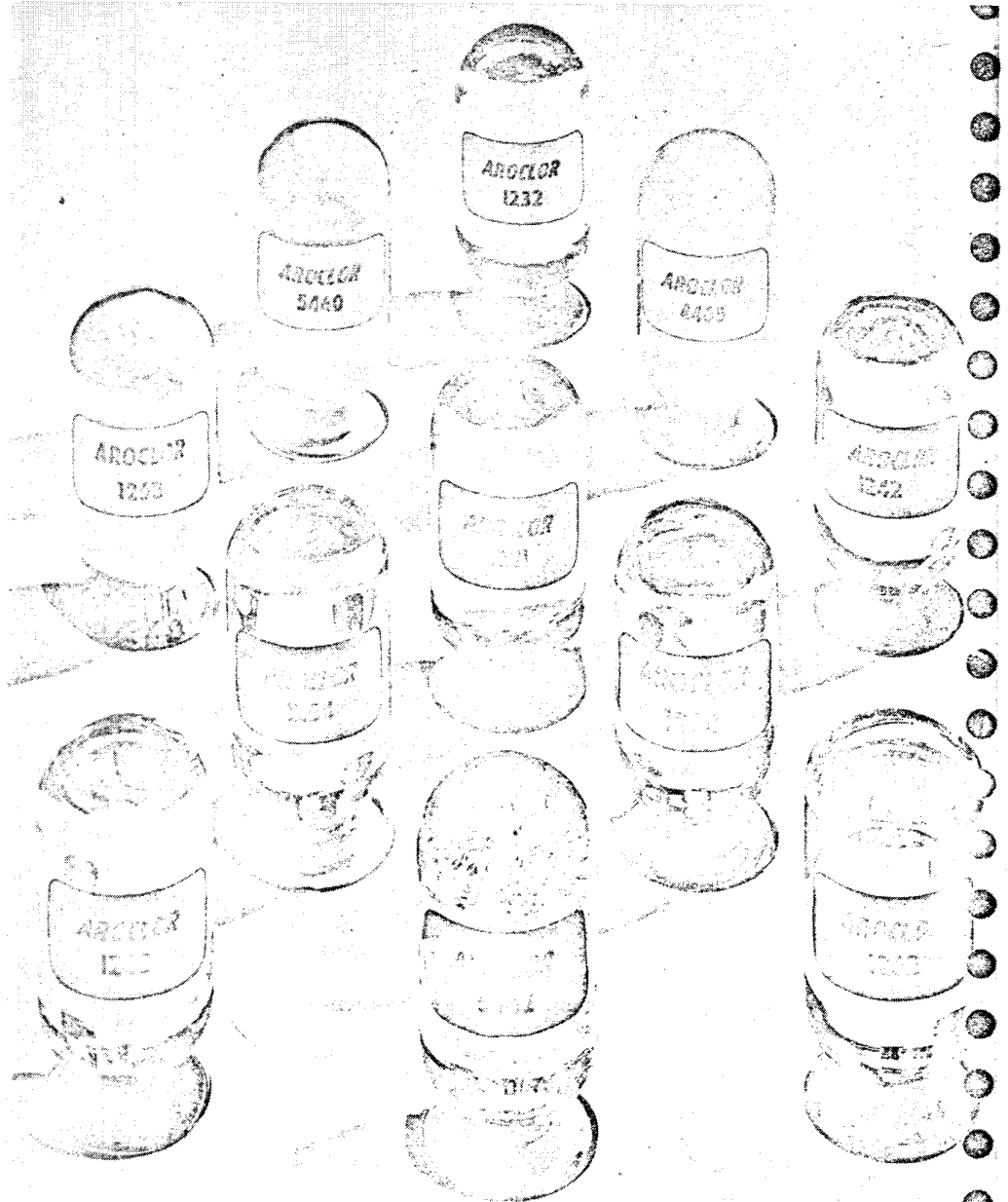
### Properties

|                                |                                   |
|--------------------------------|-----------------------------------|
| Chemical formula*              |                                   |
| Molecular weight               | 310.28                            |
| • Appearance                   | Oily liquid or light yellow solid |
| • Neutralization number        | 0.08 mg. KOH/gm. max.             |
| • Color                        | APHA 50 max.                      |
| • Hydrolyzable chlorine        | 0.010% max.                       |
| • Free phenol                  | 0.5% max.                         |
| • Refractive index @ 25°C.     | 1.5875 — 1.5900                   |
| • Specific gravity 30°/15.5°C. | 1.176 to 1.182                    |
| Weight per gallon @ 25°C.      | 9.83 lb.                          |
| Boiling point, 760 mm Hg       | 360°C.                            |
| Crystallizing point            | 25°C.                             |
| Flash point (C.O.C.)           | 375°F.                            |
| Fire point (C.O.C.)            | 525°F.                            |
| Vapor pressure @ 220°C.        | 11 mm Hg                          |
| Viscosity @ 25°C.              | 17.5 cks                          |
| Solubility in water @ 25°C.    | Hygroscopic                       |
| General solubility             | Soluble in common solvents        |

#### Specifications

0476051

TOWOLDMON0033021



0476052

TOWOLDMON0033022

# AROCLOR PLASTICIZERS AND RESIN EXTENDERS

The Aroclor polychlorinated polyphenyls range in form and appearance from mobile oily liquids to fine white crystals and hard yellow transparent resins. The Aroclor products are useful as low-cost, efficient plasticizers and resin extenders for vinyls, cellulose and rubber materials. The Aroclor compounds are compatible with most of the common plastic resins and numerous special resins.

These permanently thermoplastic materials are non-oxidizing; non-corrosive to metals; and not hydrolyzable by water, alkalis, or acids. They possess excellent electrical properties. The viscous liquids and resins will not support combustion when heated alone. The flexibility they impart to resins increases with the mobility of the particular Aroclor compound, while the degree of hardness imparted increases with the viscosity of the Aroclor selected.

In adhesives and surface coatings, the Aroclors impart outstanding adhesive qualities, good resistance to water and chemical action, and resistance to bacteria and fungi attack.

In vinyl resins, the Aroclors are used mainly as co-plasticizers with tricresyl phosphate, dioctyl phthalate and others. They impart plasticizing action, chemical and corrosion resistance, flame resistance, and reduced migration to nitrocellulose lacquers.

Used with dioctyl phthalate and Santicizer 141, the Aroclors are efficient co-plasticizers for vinyl organosols, plastisols or pastes for free films, and textile and paper coatings. In these applications, the Aroclors impart valuable fire resistance and serve as excellent grinding and dispersing media for pigments.

In polyvinyl acetate, the liquid Aroclor compounds make excellent low-cost, quick-tack adhesives. The more viscous and solid Aroclor compounds are widely used in hot-melt adhesives.

The Aroclors are highly compatible with ethyl cellulose. The liquids impart great flexibility, and the resins impart great hardness. Aroclor 5460 contributes high gloss and exceptional weathering qualities to coatings for rigid surfaces.

In cellulose acetate-butyrate, the Aroclor compounds are useful in making flame-resistant, low-cost formulations for applications such as paper coatings, lacquers, and strippable coatings.

In nitrocellulose, the Aroclors function both as plasticizers and resins. They may be used alone or with other plasticizers and resins to impart weather resistance, luster, adhesion, and decreased burning rate. Because of their excellent electrical characteristics (high dielectric strength and resistivity and low power factor) and their property of retarding the passage of moisture and gases through nitrocellulose, chlorinated rubber, and other similar plastics films, they are especially useful in coatings for electrical insulating materials.

In chlorinated rubber (Parlon) and copolymers of styrene-butadiene (Pliolite S-5), Aroclor 1254 is an excellent plasticizer; and Aroclor 5460 acts as a film fortifier in protective and decorative coatings for concrete and masonry structures, steel structures, railway tank and gondola cars, wood, and metal maritime equipment. Aroclor in these types of coatings imparts excellent resistance to flame, corrosion, acids, alkalis, and water; as well as good electrical insulating properties.

The Aroclors are most useful in natural and synthetic rubbers. The liquid Aroclors 1221, 1232, 1242 and 1248 provide a strong plasticizing action. Small amounts of Aroclor 1260 plasticize hard rubber and reduce brittleness. Milled into rubber, Aroclor 1254 and 1260 impart permanent tackiness and adhesion. As a plasticizer for crepe-rubber resin (formulated into paints), Aroclor 1262 increases the gloss and alkali resistance of the film and its adhesiveness toward steel. Aroclor 1268 has excellent working qualities at 225-325°F. as a plasticizer in injection moldings. Ground into powder and milled into rubber at a temperature below its melting point, Aroclor 1268 can be dispersed through the rubber and acts as an efficient flame retardant.

In epoxy resin coatings, the Aroclor compounds with their excellent chemical resistance, oxidation resistance, and adhesion enable the formulator to reduce costs without detracting from the saleable features of the epoxy resins. In plastic applications, a combination of an Aroclor compound plus antimony oxide make low-cost non-burning formulations.

The Aroclor compounds are also useful with phenolic resins, polyester resins, polyisobutylene, waxes, and rosin.

At ordinary temperatures, the Aroclor chlorinated polyphenyls have not presented industrial toxicological problems. When Aroclor compounds are used at elevated temperatures, engineering controls must be applied, either by the use of closed systems or by effective local-exhaust ventilation together with general workroom exhaust.

The threshold limits (maximum allowable concentration for an 8-hour working day) set by the American Conference of Government Hygienists are 1.0 milligram of the lower-chlorinated Aroclor compounds per cubic meter of air and 0.5 milligram of the more-highly-chlorinated compounds, such as Aroclor 1254, per cubic meter of air.

In skin patch tests, neither Aroclor 1254 alone or in a polyvinyl chloride film (11.5 per cent Aroclor) nor Aroclor 5460 in an alkyd resin coating (17 per cent Aroclor) on canvas irritated or sensitized the skin.

Continuous or repeated skin contact with the Aroclor compounds must be avoided because of the possible occurrence of chloracne.

## Aroclor 1221

### Properties

|                                |                           |
|--------------------------------|---------------------------|
| Appearance                     | Clear, mobile oil         |
| • Acidity                      | 0.014 mg.<br>KOH/gm. max. |
| • Color                        | APHA 100 max.             |
| Refractive index @ 20°C.       | 1.617 to 1.618            |
| • Specific gravity 25°/15.5°C. | 1.182 to 1.192            |
| Chlorine, %                    | 21.0 ± 0.5                |
| Weight per gallon @ 25°C.      | 9.85 lbs.                 |
| Boiling point, 760 mm Hg       | 275-320°C.                |
| Pour point (ASTM D-97)         | Crystals at 1°C.          |
| Flash point (C.O.C.)           | 286-302°F.                |
| Fire point (C.O.C.)            | 349°F.                    |
| Viscosity @ 37.8°C.*           | 38 to 41 SUS              |
| 54.4°C.                        | 35 to 37 SUS              |
| 98.9°C.                        | 30 to 31 SUS              |

\*Specifications

## Aroclor 1248

### Properties

|                                |                        |
|--------------------------------|------------------------|
| • Appearance                   | Clear, mobile oil      |
| • Acidity                      | 0.010 mg. KOH/gm. max. |
| • Color                        | APHA 100 max.          |
| • Moisture                     | 50 ppm max.            |
| Refractive index @ 20°C.       | 1.630 to 1.631         |
| • Specific gravity 65°/15.5°C. | 1.405 to 1.415         |
| Weight per gallon @ 25°C.      | 12.04 lb.              |
| Boiling point, 760 mm Hg       | 340 to 375°C.          |
| Pour point, (ASTM D-97)        | —7°C.                  |
| Flash point (C.O.C.)           | 379 to 384°F.          |
| Fire Point (C.O.C.)            | None to boiling point  |
| Viscosity @ 37.8°C.            | 185 to 240 SUS         |
| 54.4°C.*                       | 73 to 80 SUS           |
| 98.9°C.                        | 36 to 37 SUS           |

\*Specifications

## Aroclor 1254

### Properties

|                                |                             |
|--------------------------------|-----------------------------|
| • Appearance                   | Light-yellow viscous liquid |
| • Acidity                      | 0.010 mg. KOH/gm. max.      |
| • Color                        | APHA 100 max.               |
| • Moisture                     | 50 ppm max.                 |
| Refractive index @ 20°C.       | 1.639 to 1.641              |
| • Specific gravity 65°/15.5°C. | 1.495 to 1.505              |
| Weight per gallon @ 25°C.      | 12.82 lb.                   |
| Boiling point, 760 mm Hg       | 365 to 390°C.               |
| Pour point, (ASTM D-97)        | 10°C.                       |
| Flash point (C.O.C.)           | None to boiling point       |
| Fire point (C.O.C.)            | None to boiling point       |
| Viscosity @ 37.8°C.            | 1800 to 2500 SUS            |
| 54.4°C.                        | 260 to 340 SUS              |
| 98.9°C.                        | 44 to 48 SUS                |

\*Specifications

0476054

**Aroclor 1232****Properties**

|                              |                        |
|------------------------------|------------------------|
| Appearance                   | Clear, mobile oil      |
| Acidity                      | 0.014 mg. KOH/gm. max. |
| Color                        | APHA 100 max.          |
| Refractive index @ 20°C.     | 1.620-1.622            |
| Specific gravity 25°/15.5°C. | 1.270 to 1.280         |
| Chlorine, %                  | 32.0 ± 0.5             |
| Weight per gallon @ 25°C.    | 10.55 lb.              |
| Boiling point, 760 mm Hg     | 290 to 325°C.          |
| Pour point, (ASTM D-97)      | —35.5°C.               |
| Flash point (C.O.C.)         | 305-310°F.             |
| Fire point (C.O.C.)          | 460°F.                 |
| Viscosity @ 37.8°C.*         | 44 to 51 SUS           |
| 54.4°C.                      | 39 to 41 SUS           |
| 98.9°C.                      | 31 to 32 SUS           |

**\*Specifications****Aroclor 1242****Properties**

|                              |                       |
|------------------------------|-----------------------|
| Appearance                   | Clear, mobile oil     |
| Acidity                      | .015 mg. KOH/gm. max. |
| Color                        | APHA 100 max.         |
| Moisture                     | 50 ppm max.           |
| Refractive index @ 20°C.     | 1.627-1.629           |
| Specific gravity 25°/15.5°C. | 1.381 to 1.392        |
| Weight per gallon @ 25°C.    | 11.50 lb.             |
| Boiling point, 760 mm Hg     | 325 to 366°C.         |
| Pour point (ASTM D-97)       | —19°C.                |
| Flash point (C.O.C.)         | 348 to 356°F.         |
| Fire point (C.O.C.)          | None to boiling point |
| Viscosity @ 37.8°C.          | 82 to 92 SUS          |
| 54.4°C.                      | 49 to 56 SUS          |
| 98.9°C.                      | 34 to 35 SUS          |

**\*Specifications****Aroclor 1260****Properties**

|                              |                                  |
|------------------------------|----------------------------------|
| Appearance                   | Light-yellow, soft, sticky resin |
| Acidity                      | 0.014 mg. KOH/gm. max.           |
| Color                        | APHA 150 max.                    |
| Moisture                     | 50 ppm max.                      |
| Refractive index @ 20°C.     | 1.647 to 1.649                   |
| Specific gravity 90°/15.5°C. | 1.555 to 1.566                   |
| Weight per gallon @ 25°C.    | 13.50 lb.                        |
| Boiling point, 760 mm Hg     | 385 to 420°C.                    |
| Pour point, (ASTM D-97)      | 31°C.                            |
| Flash point (C.O.C.)         | None to boiling point            |
| Fire point (C.O.C.)          | None to boiling point            |
| Viscosity @ 54.4°C.          | 3200 to 4500 SUS                 |
| 98.9°C.*                     | 72 to 78 SUS                     |

**\*Specifications****Aroclor 1262****Properties**

|                              |                                    |
|------------------------------|------------------------------------|
| Appearance                   | Light-yellow, sticky viscous resin |
| Acidity                      | 0.014 mg. KOH/gm. max.             |
| Color                        | APHA 150 max.                      |
| Chlorine, %                  | 61.5 to 62.5                       |
| Refractive index @ 20°C.     | 1.6501 to 1.6517                   |
| Specific gravity 90°/15.5°C. | 1.572 to 1.583                     |
| Weight per gallon @ 25°C.    | 13.72 lb.                          |
| Boiling point, 760 mm Hg     | 390 to 425°C.                      |
| Pour point                   | 35 to 38°C.                        |
| Flash point (C.O.C.)         | None to boiling point              |
| Fire point (C.O.C.)          | None to boiling point              |
| Viscosity @ 71.0°C.          | 600 to 850 SUS                     |
| 98.9°C.*                     | 86 to 100 SUS                      |

**\*Specifications**

0476055

## Aroclor 1268

### Properties

|                               |                           |
|-------------------------------|---------------------------|
| • Appearance                  | White to off-white powder |
| • Acidity                     | 0.05 mg. KOH/gm. max.     |
| • Color (molten)              | 1.5 NPA                   |
| Specific gravity 25°/25°C.    | 1.807                     |
| Weight per gallon @ 25°C.     | 15.09 lb.                 |
| Boiling point, 760 mm Hg      | 435 to 450°C.             |
| • Softening point (ASTM E-28) | 150 to 170°C.             |
| Flash point (C.O.C.)          | None to boiling point     |
| Fire point (C.O.C.)           | None to boiling point     |

\*Specifications

## Aroclor 4465

### Properties

|                                  |                           |
|----------------------------------|---------------------------|
| • Appearance                     | Clear, light-yellow resin |
| Acidity                          | 0.05 mg. KOH/gm. max.     |
| • Color (molten)                 | 2 NPA max.                |
| Refractive index @ 20°C.         | 1.664 to 1.667            |
| Specific gravity 25°/25°C.       | 1.670                     |
| Weight per gallon @ 25°C.        | 13.91 lb.                 |
| Boiling point, 4 mm Hg           | 230 to 320°C.             |
| • Softening point (ASTM E28-51T) | 60 to 66°C.               |
| Flash point (C.O.C.)             | None to boiling point     |
| Fire point (C.O.C.)              | None to boiling point     |
| Viscosity @ 130°C.               | 90 to 150 SUS             |

\*Specifications

## Aroclor 5442

### Properties

|                                  |                             |
|----------------------------------|-----------------------------|
| • Appearance                     | Clear, yellow, sticky resin |
| Acidity                          | 0.05 mg. KOH/gm. max.       |
| • Color (molten)                 | 2 NPA max.                  |
| Specific gravity 25°/25°C.       | 1.470                       |
| Weight per gallon @ 25°C.        | 12.24 lb.                   |
| • Softening point (ASTM E28-51T) | 46 to 52°C.                 |
| Boiling point, 4 mm Hg           | 215 to 300°C.               |
| Pour point, (ASTM D-97)          | 46°C.                       |
| Flash point (C.O.C.)             | 477°F.                      |
| Fire point (C.O.C.)              | >662°F.                     |
| Viscosity @ 98.9°C.              | 300 to 400 SUS              |

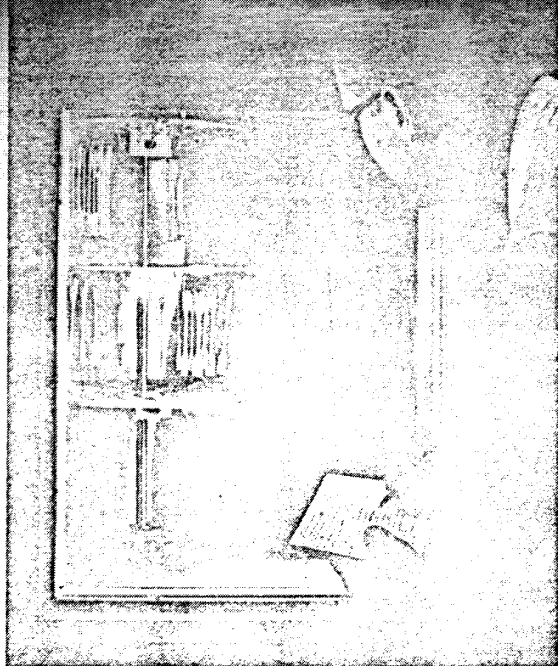
\*Specifications

## Aroclor 5460

### Properties

|                                  |                                                 |
|----------------------------------|-------------------------------------------------|
| • Appearance                     | Clear, yellow to amber, brittle resin or flakes |
| Acidity                          | 0.05 mg. KOH/gm. max.                           |
| • Color (molten)                 | 2 NPA max.                                      |
| Refractive index @ 20°C.         | 1.660 to 1.665                                  |
| Specific gravity 25°/25°C.       | 1.670                                           |
| Chlorine, %                      | 59.5                                            |
| Weight per gallon @ 25°C.        | 13.91                                           |
| Boiling point, 5 mm Hg           | 280 to 335°C.                                   |
| • Softening point (ASTM E28-51T) | 98 to 105°C.                                    |
| Flash point (C.O.C.)             | None to boiling point                           |
| Fire point (C.O.C.)              | None to boiling point                           |

\*Specifications



### Summary of Specifications and Typical Properties

For your convenience the following chart lists Monsanto's Permanent, Sulfonamide, and Miscellaneous plasticizers. If a specific property is ideally suited for a specific application simply find the optimum value of that property in the vertical column, the name of the plasticizer offering this value may be read from the left hand listing.



0476057

PERMANENT

SULFON-  
AMIDES

OTHER

|                     |        |                      |                                                             |                                     |               |
|---------------------|--------|----------------------|-------------------------------------------------------------|-------------------------------------|---------------|
| Santicizer 405      | —      | * 1.0                | * Clear, viscous liquid                                     | * 250 (50ml.: 50ml.)<br>95% Ethanol | * 0.15        |
| Santicizer 406      | —      | * 1.0                | * Clear, oily liquid                                        | * 200 (50ml.: 50ml.)<br>95% Ethanol | * 0.15        |
| Santicizer 409      | —      | * 1.5                | * Clear liquid                                              | * 150 (50ml.: 50ml.)<br>95% Ethanol | * 0.15        |
| Santicizer 411      | —      | * 1.0                | * Light yellow, viscous liquid<br>some solids on standing   | * 175 (50ml.: 50ml.)<br>95% Ethanol | * 0.15        |
| Santicizer 462      | —      | * 0.24               | * Clear, oily liquid                                        | * 150                               | * 0.15        |
| Santicizer 480      | —      | * 0.60               | * Clear, oily liquid                                        | * 200                               | * 0.15        |
| Santicizer 481      | —      | * 0.85               | * Clear, oily liquid                                        | * 300                               | * 0.15        |
| Santicizer 482      | —      | * 1.1                | * Clear, oily liquid                                        | * 325                               | * 0.15        |
| Santicizer 483      | —      | * 0.24               | * Clear, oily liquid                                        | * 125                               | * 0.15        |
| Santicizer 1-H      | 253.36 | —                    | * Yellow-brown fused mass                                   | * 300 (molten)                      | * 0.15        |
| Santicizer 3        | 199.23 | * 1.60               | * Practically white solid                                   | * 60 (molten)                       | * 0.25        |
| Santicizer 8        | 199.22 | * 0.80               | * Light-yellow, viscous liquid                              | * 200 (molten)                      | —             |
| Santicizer 9        | 171.1  | pH 4.0<br>(min.)     | * Fine, white to light-cream<br>granular particles          | * 85 (33-1/3 wt. %<br>in acetone)   | * 1.0         |
| Santolite MHP       | —      | 1.0<br>(mg KOH/g)    | * Hard, practically colorless resin                         | * 50 (25g:75g butyl<br>acetate)     | —             |
| Santolite MS-80%    | —      | —                    | * Light-colored, viscous liquid.<br>Free flowing above 20°C | * 80 (25g:35g butyl<br>acetate)     | —             |
| Aroclor 1221        | —      | * .014<br>(mg KOH/g) | Clear, mobile oil                                           | * 100                               | —             |
| Aroclor 1232        | —      | * .014<br>(mg KOH/g) | Clear, mobile oil                                           | * 100                               | —             |
| Aroclor 1242        | —      | * .015<br>(mg KOH/g) | * Clear, mobile oil                                         | * 100                               | * 50<br>(ppm) |
| Aroclor 1248        | —      | * .010<br>(mg KOH/g) | * Clear, mobile oil                                         | * 100                               | * 50<br>(ppm) |
| Aroclor 1254        | —      | * .010<br>(mg KOH/g) | Light-yellow viscous liquid                                 | * 100                               | * 50<br>(ppm) |
| Aroclor 1260        | —      | * .014<br>(mg KOH/g) | * Light-yellow, soft, sticky resin                          | * 150                               | * 50<br>(ppm) |
| Aroclor 1262        | —      | * .014<br>(mg KOH/g) | * Light-yellow, sticky,<br>viscous resin                    | * 150                               | —             |
| Aroclor 1268        | —      | * .05<br>(mg KOH/g)  | * White to off-white powder                                 | * 1.5 NPA (molten)                  | —             |
| Aroclor 4465        | —      | * .05<br>(mg KOH/g)  | * Clear, light-yellow resin                                 | 2 NPA max. (molten)                 | —             |
| Aroclor 5442        | —      | * .05<br>(mg KOH/g)  | * Clear, yellow, sticky resin                               | * 2 NPA max. (molten)               | —             |
| Aroclor 5460        | —      | * .05<br>(mg KOH/g)  | * Clear, yellow-to-amber<br>brittle resin or flakes         | * 2 NPA max. (molten)               | —             |
| HB-40               | —      | —                    | Clear, oily liquid                                          | * 100                               | * 125 p       |
| Mod-Epoxy           | —      | * 0.08<br>(mg KOH/g) | * Oily liquid or light-yellow solid                         | * 50                                | —             |
| Phosgard C-22-R     | 610.5  | * 5.0                | * Clear, viscous liquid                                     | * 50                                | —             |
| Triphenyl Phosphite | 310.28 | * 0.8<br>(mg. KOH/g) | * Oily liquid or light-yellow solid                         | * 50                                | —             |

# MONSANTO PLASTICIZERS

|                 |                                                             |                                     |                      |                               |                                             |
|-----------------|-------------------------------------------------------------|-------------------------------------|----------------------|-------------------------------|---------------------------------------------|
| 1.0             | * Clear, viscous liquid                                     | * 250 (50ml.: 50ml.)<br>95% Ethanol | * 0.15               | * Characteristic              | 1.476                                       |
| 1.0             | * Clear, oily liquid                                        | * 200 (50ml.: 50ml.)<br>95% Ethanol | * 0.15               | * Very slight, characteristic | 1.476                                       |
| 1.5             | * Clear liquid                                              | * 150 (50ml.: 50ml.)<br>95% Ethanol | * 0.15               | * Very faint, ester           | 1.4654                                      |
| 1.0             | * Light yellow, viscous liquid<br>some solids on standing   | * 175 (50ml.: 50ml.)<br>95% Ethanol | * 0.15               | * Slight, characteristic      | 1.4772                                      |
| 0.24            | * Clear, oily liquid                                        | * 150                               | * 0.15               | * Characteristic              | 1.508 to 1.510                              |
| 0.60            | * Clear, oily liquid                                        | * 200                               | * 0.15               | * Slight, characteristic      | 1.4943                                      |
| 0.85            | * Clear, oily liquid                                        | * 300                               | * 0.15               | * Slight, characteristic      | 1.4795                                      |
| 1.1             | * Clear oily liquid                                         | * 325                               | * 0.15               | * Slight, characteristic      | 1.4751                                      |
| 0.24            | * Clear, oily liquid                                        | * 125                               | * 0.15               | * Slight, characteristic      | * 1.5015 to 1.5050                          |
| —               | * Yellow-brown fused mass                                   | * 300 (molten)                      | * 0.15               | —                             | —                                           |
| 1.60            | * Practically white solid                                   | * 60 (molten)                       | * 0.25               | —                             | 1.512 to 1.532 (65°C)                       |
| 0.80            | * Light-yellow, viscous liquid                              | * 200 (molten)                      | —                    | * Slight, characteristic      | 1.540                                       |
| 1.40<br>(min.)  | * Fine, white to light-cream<br>granular particles          | * 85 (33-1/3 wt. %<br>in acetone)   | * 1.0                | * Essentially none            | —                                           |
| 1.0<br>g KOH/g  | * Hard, practically colorless resin                         | * 50 (25g:75g butyl<br>acetate)     | —                    | * Faint formaldehyde          | 1.4275 to 1.4325<br>(25g:75g butyl acetate) |
| —               | * Light-colored, viscous liquid.<br>Free flowing above 20°C | * 80 (25g:35g butyl<br>acetate)     | —                    | —                             | —                                           |
| 0.04<br>g KOH/g | Clear, mobile oil                                           | * 100                               | —                    | —                             | 1.617 to 1.618 (20°C)                       |
| 0.04<br>g KOH/g | Clear, mobile oil                                           | * 100                               | —                    | —                             | 1.620 to 1.622 (20°C)                       |
| 0.05<br>g KOH/g | * Clear, mobile oil                                         | * 100                               | * 50<br>(ppm max.)   | —                             | 1.627 to 1.629 (20°C)                       |
| 0.05<br>g KOH/g | * Clear, mobile oil                                         | * 100                               | * 50<br>(ppm max.)   | —                             | 1.630 to 1.631 (20°C)                       |
| 0.10<br>g KOH/g | Light-yellow viscous liquid                                 | * 100                               | * 50<br>(ppm max.)   | —                             | 1.639 to 1.641 (20°C)                       |
| 0.14<br>g KOH/g | * Light-yellow, soft, sticky resin                          | * 150                               | * 50 *<br>(ppm max.) | —                             | 1.647 to 1.649 (20°C)                       |
| 0.04<br>g KOH/g | * Light-yellow, sticky,<br>viscous resin                    | * 150                               | —                    | —                             | 1.6501 to 1.6517 (20°C)                     |
| 0.05<br>g KOH/g | * White to off-white powder                                 | * 1.5 NPA (molten)                  | —                    | —                             | —                                           |
| 0.5<br>g KOH/g  | * Clear, light-yellow resin                                 | 2 NPA max. (molten)                 | —                    | —                             | 1.664 to 1.667 (20°C)                       |
| 0.05<br>g KOH/g | * Clear, yellow, sticky resin                               | * 2 NPA max. (molten)               | —                    | —                             | —                                           |
| 0.05<br>g KOH/g | * Clear, yellow-to-amber<br>brittle resin or flakes         | * 2 NPA max. (molten)               | —                    | —                             | 1.660 to 1.665 (20°C)                       |
| —               | Clear, oily liquid                                          | * 100                               | * 125 ppm            | * Faint characteristic        | 1.5600 to 1.5750                            |
| 0.08<br>g KOH/g | * Oily liquid or light-yellow solid                         | * 50                                | —                    | —                             | * 1.587 to 1.590                            |
| 1.0             | * Clear, viscous liquid                                     | * 50                                | —                    | * Essentially none            | * 1.492 to 1.494                            |
| 0.8<br>g KOH/g  | * Oily liquid or light-yellow solid                         | * 50                                | —                    | —                             | * 1.5875 to 1.5900                          |

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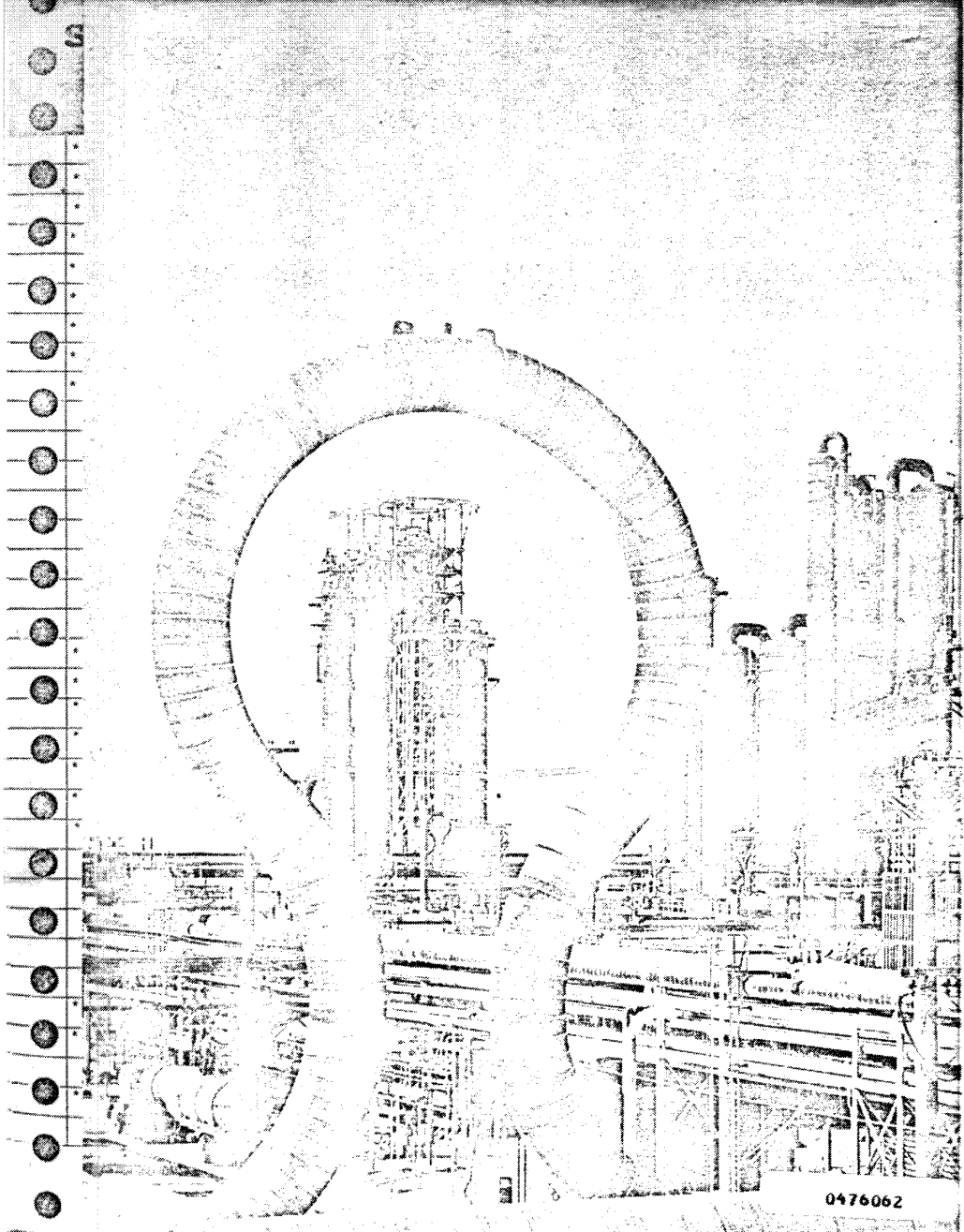
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# Summary of Specifications and Typical Properties

| * 1.126 to 1.132                 | 9.41  | —                                 | — 1.1                         | —                        | —              | —             | —   | —                            | —                            | 10500 to 13500 |
|----------------------------------|-------|-----------------------------------|-------------------------------|--------------------------|----------------|---------------|-----|------------------------------|------------------------------|----------------|
| * 1.086 to 1.091                 | 9.08  | —                                 | +16                           | —                        | —              | —             | —   | —                            | —                            | 8800 to 9500   |
| * 1.093 to 1.084                 | 9.01  | —                                 | 4                             | —                        | —              | —             | —   | —                            | —                            | 2900 to 3500   |
| * 1.104 to 1.110                 | 9.20  | —                                 | +21.1                         | —                        | —              | —             | —   | —                            | —                            | 9000 to 9800   |
| * 1.072 to 1.077                 | 8.95  | —                                 | -28                           | —                        | —              | —             | —   | —                            | —                            | 291            |
| * 1.039 to 1.046                 | 8.72  | —                                 | -1                            | —                        | —              | —             | —   | —                            | —                            | 556            |
| * 1.072 to 1.078                 | 8.96  | —                                 | 10                            | —                        | —              | —             | —   | —                            | —                            | 3878           |
| * 1.097 to 1.103                 | 9.16  | —                                 | 18                            | —                        | —              | —             | —   | —                            | —                            | 6422           |
| * 1.045 to 1.052                 | 8.74  | —                                 | -31                           | —                        | —              | —             | —   | —                            | —                            | 156            |
| 1.125                            | —     | (in vacuum jacket)<br>* 82.5 min. | —                             | 350                      | —              | —             | —   | —                            | —                            | —              |
| 1.166 to 1.176<br>(65°/65°C)     | —     | * 58.0 min.                       | 340                           | —                        | 0.8<br>(160°C) | —             | —   | —                            | —                            | —              |
| 1.190                            | 9.92  | <40                               | —                             | 340                      | 0.45           | 5.5           | —   | 10,000                       | 358.0                        | —              |
| 1.353 (solid)                    | —     | 105                               | —                             | 360 (approx.)            | 0.25           | 3.2           | —   | —                            | —                            | —              |
| 1.35                             | —     | 62                                | —                             | —                        | —              | —             | —   | —                            | —                            | —              |
| 1.256                            | 10.5  | —                                 | —                             | —                        | —              | —             | —   | —                            | —                            | —              |
| * 1.182 to 1.192                 | 9.85  | —                                 | Crystals @ 1°C<br>(ASTM D-97) | 275 to 320               | —              | —             | —   | * 38 to 41 SUS<br>(37.8°C)   | 35 to 37 SUS<br>(54.4°C)     | —              |
| * 1.270 to 1.280                 | 10.55 | —                                 | -35 (ASTM D-97)               | 290 to 325               | —              | —             | —   | * 44 to 51 SUS<br>(37.8°C)   | 39 to 41 SUS<br>(54.4°C)     | —              |
| * 1.381 to 1.392<br>(25°/15.5°C) | 11.50 | —                                 | -19 (ASTM D-97)               | 325 to 366               | —              | —             | —   | 82 to 92 SUS<br>(37.8°C)     | 49 to 56 SUS<br>(54.4°C)     | —              |
| * 1.406 to 1.415<br>(65°/15.5°C) | 12.04 | —                                 | -7 (ASTM D-97)                | 340 to 375               | —              | —             | —   | 185 to 240 SUS<br>(37.8°C)   | 73 to 80 SUS<br>(54.4°C)     | —              |
| * 1.495 to 1.505<br>(65°/15.5°C) | 12.82 | —                                 | 10 (ASTM D-97)                | 365 to 390               | —              | —             | —   | 1800 to 2500 SUS<br>(37.8°C) | 260 to 340 SUS<br>(54.4°C)   | —              |
| * 1.555 to 1.566<br>(90°/15.5°C) | 13.50 | —                                 | 31 (ASTM D-97)                | 385 to 420               | —              | —             | —   | —                            | 3200 to 4500 SUS<br>(54.4°C) | —              |
| * 1.572 to 1.583<br>(90°/15.5°C) | 13.72 | —                                 | 35 to 38                      | 390 to 425               | —              | —             | —   | —                            | 600 to 850 SUS<br>(71.0°C)   | —              |
| 1.807                            | 15.09 | —                                 | —                             | 435 to 450               | —              | —             | —   | —                            | —                            | —              |
| 1.670                            | 13.91 | —                                 | —                             | 230 to 320<br>(4 mm. Hg) | —              | —             | —   | —                            | —                            | —              |
| 1.470                            | 12.24 | —                                 | —                             | 215 to 300<br>(4 mm. Hg) | —              | —             | —   | —                            | —                            | —              |
| 1.670                            | 13.91 | —                                 | —                             | 280 to 335<br>(5 mm. Hg) | —              | —             | —   | —                            | —                            | —              |
| * 1.001 to 1.007<br>(25°/15.5°C) | 8.37  | —                                 | -26                           | 345 to 396               | 2              | 15            | 230 | 70.0                         | 29.0 (37.8°C)                | —              |
| * 1.176 to 1.182<br>(30°/15.5°C) | 9.83  | 25                                | —                             | 360                      | —              | 11<br>(220°C) | —   | —                            | —                            | —              |
| 1.425 to 1.445                   | 11.9  | None-glassy                       | 5                             | Not Distillable          | —              | —             | —   | —                            | —                            | —              |
| * 1.176 to 1.182<br>(30°/15.5°C) | 9.83  | 25                                | —                             | 360                      | —              | 11<br>(220°C) | —   | —                            | —                            | 17.5           |

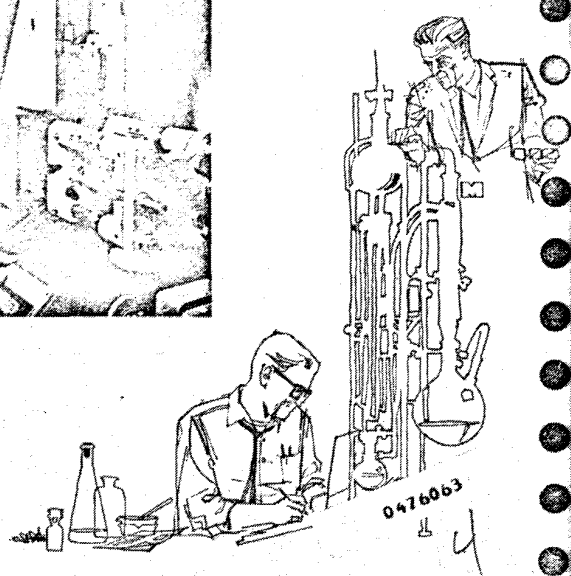
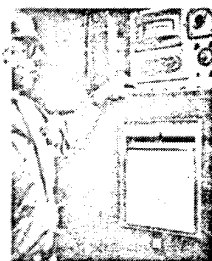
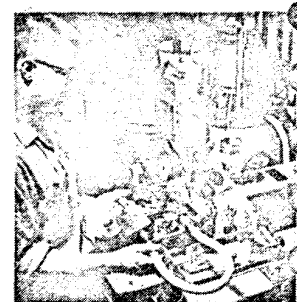
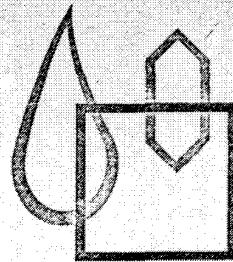
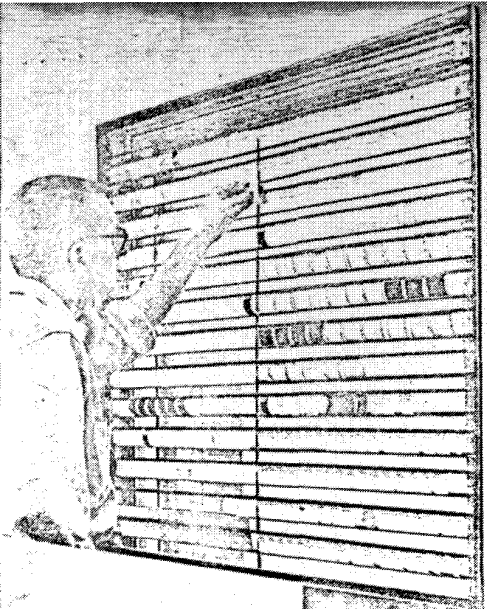
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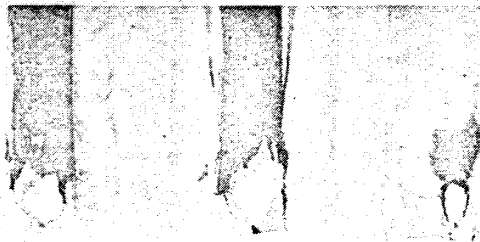
| 30 to 13500             | —                     | —           | —                  | 555                           | —                       | — | — | Practically insoluble |
|-------------------------|-----------------------|-------------|--------------------|-------------------------------|-------------------------|---|---|-----------------------|
| 30 to 9500              | —                     | —           | —                  | 535                           | —                       | — | — | Practically insoluble |
| 30 to 3500              | —                     | —           | 0.00071            | 530                           | 570                     | — | — | Practically insoluble |
| 30 to 9800              | —                     | —           | —                  | 540                           | —                       | — | — | Practically insoluble |
| 291                     | —                     | —           | —                  | —                             | —                       | — | — | Practically insoluble |
| 556                     | —                     | —           | —                  | 475                           | 535                     | — | — | Practically insoluble |
| 3878                    | —                     | —           | —                  | 485                           | 535                     | — | — | Practically insoluble |
| 6422                    | —                     | —           | —                  | 525                           | 580                     | — | — | Practically insoluble |
| 156                     | —                     | —           | —                  | 485                           | 525                     | — | — | Practically insoluble |
| —                       | —                     | —           | —                  | —                             | —                       | — | — | 0.00045 (30°C)        |
| —                       | —                     | —           | —                  | 371                           | —                       | — | — | Slight                |
| 358.0                   | 6.0                   | 44.5 (25°C) | —                  | 345                           | —                       | — | — | 0.13 (23°C)           |
| —                       | —                     | —           | —                  | 420                           | —                       | — | — | 1 (34°C)              |
| —                       | —                     | —           | —                  | —                             | —                       | — | — | Practically insoluble |
| —                       | —                     | —           | —                  | —                             | —                       | — | — | Nil                   |
| 30 to 37 SUS (54.4°C)   | 30 to 31 SUS          | —           | 0.00071 (15-40°C)  | 286 to 302                    | 349                     | — | — | Practically insoluble |
| 30 to 41 SUS (54.4°C)   | 31 to 32 SUS          | —           | 0.00073 (25-100°C) | 305 to 310                    | 460                     | — | — | Practically insoluble |
| 30 to 56 SUS (54.4°C)   | 34 to 35 SUS          | —           | 0.00068 (25-65°C)  | 348 to 356                    | None to boiling point   | — | — | Practically insoluble |
| 30 to 80 SUS (54.4°C)   | 36 to 37 SUS          | —           | 0.00070 (25-65°C)  | 379 to 384                    | None to boiling point   | — | — | Practically insoluble |
| 30 to 345 SUS (54.4°C)  | 44 to 48 SUS          | —           | 0.00066 (25-65°C)  | None to boiling point         | None to boiling point   | — | — | Practically insoluble |
| 30 to 4500 SUS (54.4°C) | * 72 to 78 SUS        | —           | 0.00067 (20-100°C) | * None to boiling point       | * None to boiling point | — | — | Practically insoluble |
| 30 to 650 SUS (71.0°C)  | * 86 to 100 SUS       | —           | 0.00064 (25-65°C)  | None to boiling point         | None to boiling point   | — | — | Practically insoluble |
| —                       | —                     | —           | 0.00067 (20-100°C) | None to boiling point         | None to boiling point   | — | — | Practically insoluble |
| —                       | 90 to 150 SUS (130°C) | —           | 0.00061 (25-65°C)  | None to boiling point         | None to boiling point   | — | — | Practically insoluble |
| —                       | 300 to 400 SUS        | —           | 0.00123 (25-99°C)  | 477                           | > 662                   | — | — | Practically insoluble |
| —                       | —                     | —           | 0.00179 (25-125°C) | None to boiling point         | None to boiling point   | — | — | Practically insoluble |
| 29.0 (37.8°C)           | 3.8                   | 40.1 (25°C) | —                  | 345                           | 385                     | — | — | —                     |
| —                       | —                     | —           | —                  | 375                           | 525                     | — | — | Hygroscopic           |
| —                       | * 40 to 60            | —           | —                  | No self supporting combustion |                         | — | — | Nil                   |
| 17.5                    | —                     | —           | —                  | 375                           | 525                     | — | — | Hygroscopic           |



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TOWOLDMON0033032





with  
DOP

with  
DOA

with  
SANTICIZER 141

## FLAME-RETARDANT MODIFIERS

Fire retardant plastics materials are growing in favor in many end uses. Recent Underwriters Laboratories' rulings on air conditioners, the California fire laws on plastics film, and the specifications of end-product users mark a trend toward greater safety consciousness. This awareness for possible dangers will increasingly put a limit upon the flammability of materials of manufacture, construction, and decoration.

Monsanto supplies a variety of plasticizers which provide molecular structures with tightly linked chlorine and phosphorus, to impart fire resistance to compositions containing them. These plasticizers represent a range of properties, in addition to the imparting of fire resistance, that make them efficient plasticizers for a variety of resins for uses in a large number of diverse applications. These plasticizers offer a choice of price and compatibilities; many offer outstanding chemical resistance, extraction resistance, and good permanence. By selecting a one, two, or three component plasticizer system based on these products, the formulator can develop fire-resistant compositions using a number of resins, offer a variety of end product characteristics, in a range of costs.

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The following are liquid and solid fire-retardant modifiers:

### **TRICRESYL PHOSPHATE**

Tricresyl phosphate is a standard flame retarding liquid plasticizer for polyvinyl chloride, cellulose (excepting acetate), and synthetic rubber. It has low volatility and offers good permanence; it is especially recommended for electrical insulation applications. It is also compatible with phenolics, imparts a degree of flexibility to phenolic electrical laminates.

### **TRIPHENYL PHOSPHATE**

Triphenyl phosphate is a solid plasticizer, particularly suited for producing flame retardant cellulosic compositions and coatings. It may also be used with synthetic rubber and with a variety of vinyl resins in conjunction with a solvating type plasticizer.

### **SANTICIZER 140**

Santicizer 140 is a phosphate type liquid plasticizer. It makes an excellent general purpose plasticizer as well as a means of making flame resistant products. On a pound for pound basis it is more efficient than tricresyl phosphate in vinyl resins and imparts a superior flexibility.

### **SANTICIZER 141**

Santicizer 141 is a liquid, phosphate-type general purpose plasticizer which is non-toxic. It imparts good low temperature flexibility, has low odor and improves the processing characteristics of most formulations because of its excellent resin solvating power.

### **AROCLOR PLASTICIZERS**

The Aroclor polychlorinated biphenyls and terphenyls are particularly effective in reducing flameout time and the glow termed "pinking." The Aroclor compounds are compatible in varying degrees with vinyls, cellulose, rubbers, polyethylene, and epoxies.

### **MONTAR PLASTICIZERS**

These polychlorinated polyphenyls are similar to Aroclors except for their dark color and lower cost. Although slightly compatible with vinyls (for use as low-cost, extender plasticizers where color can be tolerated), they are especially effective in asphalt, to which they impart instant flameout when present in concentrations of 25 to 30 per cent.

### **PHOSGARD C-22-R**

Phosgard C-22-R is a flame-retardant organophosphorus polymer for urethane foams, polymethylmethacrylate, phenolics, polyester resins and epoxies with optimum performance properties: high efficiency through high phosphorus and chlorine content, essentially non-volatile for lasting flame-retardant service life, excellent color stability on UV and heat exposure, easy formulating and non-complicated handling, long storage stability ("per se" or in formulation), and good hydrolytic stability.

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## SOLID PLASTICIZERS

Solid plasticizers perform unusual functions in adhesives, coatings and lacquers, foams, rigid compositions and films. Many times solid plasticizers are overlooked in solving processing problems or in obtaining unique product properties. A solid plasticizer often transforms a deficient product into a completely different, high performance product.

### HOT PROCESSING

Solid plasticizers offer processing advantages in hot processing applications. For example, in Banbury mixing, a solid plasticizer will melt at or below the processing temperature and function as a solvating or fluxing liquid; the lowered viscosity of the Banbury charge improves the flow resulting in faster and easier processing. Upon cooling, the plasticizer returns to a solid form producing a rigid or semi-rigid film or molded product. The solid plasticizer thus reduces processing costs as well as imparting unique properties to the finished product.

### SOLVENT PROCESSING

Certain solid plasticizers enable successful formulation of higher solids content in lacquers. This means fewer coats to build a surface and, therefore, reduced application costs. As the lacquer dries, the presence of the solid plasticizer helps reduce blushing, sweating and separation.

*Description of Monsanto Solid Plasticizers*

| Plasticizer            | Description             | Melting Point or Softening Range (°C) |                 |
|------------------------|-------------------------|---------------------------------------|-----------------|
|                        |                         | Melting Point                         | Softening Range |
| Aroclor 5442           | clear, yellow resin     |                                       | 46 to 52        |
| Triphenyl Phosphate    | white flakes            | 48.5                                  |                 |
| Montar 1               | black resin             |                                       | 54 to 160       |
| Santicizer 3           | practically white solid | 58                                    |                 |
| Aroclor 4465           | clear, yellow resin     |                                       | 60 to 66        |
| Santolite MHP          | hard, colorless resin   | 62                                    |                 |
| Dicyclohexyl Phthalate | white solid             | 63                                    |                 |
| Diphenyl Phthalate     | white solid             | 69                                    |                 |
| Montar 2               | black resin             |                                       | 70 to 170       |
| Santicizer 1-H         | yellow mass             | 82.5                                  |                 |
| Montar 3               | black solid             |                                       | 86 to 168       |
| Montar 4               | brown solid             |                                       | 92 to 206       |
| Aroclor 5460           | yellow-to-amber resin   |                                       | 98 to 105       |
| Santicizer 9           | white particles         | 105                                   |                 |
| Montar 9               | brown solid             |                                       | 130 to 175      |
| Aroclor 1268           | white flakes            |                                       | 150 to 170      |
| Montar 5               | brown solid             |                                       | 155 to 195      |

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## VERSATILITY IN APPLICATION

### FOR ADHESIVES . . . unusual properties

Delayed-tack and heat-seal adhesives owe their existence to solid plasticizers, because it is the solid plasticizer that makes delayed-tack and heat sealing possible. Delayed-tack adhesives are activated by heat, and once activated, remain tacky long enough to permit handling before the adhesive cools and sets. The sharp melting point of solid plasticizers provides a sharp activation point for the adhesive. This activation temperature varies with different solid plasticizers, and special adhesives can be easily formulated to fit handling methods by selecting the proper solid plasticizer. Delayed-tack adhesives are covered by several U.S. Patents.

### FOR FILMS . . . no blocking

Solid plasticizers can be used with other primary plasticizers to produce tough, clear films that feel dry and separate easily. Liquid plasticizers used alone often cause blocking due to a slight surface tackiness. Solid plasticizers also add resilience to films and impart exceptional resistance to extraction by kerosene, oils and grease.

### FOR RIGID PRODUCTS . . . easier processing

Processing of rigid vinyl products can be made easier by using solid plasticizers . . . without changing present equipment or methods. With heating, the solid melts and acts as a solvating liquid plasticizer for the resin. Upon cooling, the article becomes rigid because the plasticizing effect of the solid plasticizer is slight at room temperature. Used strictly as a processing aid, the solid plasticizer pays its own way by lowering processing costs.

### FOR HEAT-SEAL COATINGS . . . sharp activation temperature

Like adhesives, heat-seal coatings require the sharp melting points of solid plasticizers to give them the heat-seal property. By themselves, liquid plasticizers cannot endow coatings with a sharp activation temperature. Instead, the coatings tend to block and be tacky at temperatures beneath the activation temperature. In this type of coating, solid plasticizers can be chosen to provide an exact temperature at which the heat-seal property is activated. And beneath that critical temperature, the coating does not block or have tackiness.

### FOR RIGID FOAMS . . . toughness

In the chemically-blown foams, solid plasticizers can be used to add toughness to the finished foam.

In the plastisol foam process, solid plasticizers thicken the starting formulation to make possible more uniform cell formation as the gas is released. A uniform cellular structure makes the foam tough and provides uniform dimensional stability.

In chemically-blown vinyl foams made by milling or Banburying, the solid plasticizer acts as a liquid solvating plasticizer at the process temperature to make possible easy processing. At room temperature, the solid plasticizer's inefficiency results in a higher compression-resistant foam.

### FOR IMPREGNANTS . . . better flow

To get even dispersment of impregnating powders, solid plasticizers can be used as a flow aid for producing brake band linings. The flow aid property is also useful in certain types of adhesives, phenolic moldings, thermosetting ureas, and melamine coatings.

# APPLICATION RECOMMENDATIONS

## Heat-sealing coatings

Dicyclohexyl phthalate (DCHP), Diphenyl phthalate, Santolite\*  
MHP, Santicizer\* 1-H, Santicizer 9

## Rigid extrusions

Diphenyl phthalate, Aroclor\* 5460, Triphenyl phosphate  
Santicizer 1-H, DCHP

## Moldings and rigid foams

Triphenyl phosphate, Diphenyl phthalate, Aroclor 5460 and 1268,  
DCHP

## Break-away "glass"

Santolite MHP

## Phenolic brake linings

Santicizer 9, Aroclor 1268

## Surface coatings and composition wallboard

Cellulose acetate      Triphenyl phosphate

Nitrocellulose      DCHP, Diphenyl phthalate,  
Santolite MHP, Aroclor 5460

Melamine      Santicizer 9

Thermosetting resins      Santicizer 9, Santicizer 1-H, Triphenyl  
phosphate, Aroclor 5460 and 1268

## Urea molding compounds

Santicizer 9

## Melamine molding compounds

Santicizer 9

## Fire-resistant cellulose acetate

Triphenyl phosphate

## Crystallizing lacquers

Santicizer 1-H

## Polyamides

Santicizer 9, Santicizer 1-H

## Vinyl and other hot melts

Triphenyl phosphate, DCHP, Diphenyl phthalate, Aroclor 5460  
and 1268, Montar\* 4, 5, and 9

## Delayed-tack adhesives

Diphenyl phthalate, Santicizer 1-H  
DCHP

## Book-binding adhesives

Triphenyl phosphate, DCHP, Diphenyl phthalate, Aroclor 5460  
and 1268, Santolite MHP, Santicizer 1-H

\*Registered U.S. Pat. Off., Monsanto Company

0476069

TOWOLDMON0033039



## PLASTICIZER-RESIN COMPATIBILITY GUIDE

The following table shows a close approximation of the upper limit of compatibility of each of Monsanto's plasticizers with a particular type of resin.

0476070

## VINYL TYPE

|                         |     |    |     |     |     |     |     |     |    |     |     |     |     |     |     |     |     |
|-------------------------|-----|----|-----|-----|-----|-----|-----|-----|----|-----|-----|-----|-----|-----|-----|-----|-----|
| Polyvinyl Chloride      | 100 | 30 | 1   | 100 | 100 | 1   | 100 | 100 | 80 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Polyvinyl Acetate       | 100 | 50 | 100 | 1   | 1   | 100 | 1   | 1   | 70 | 1   | 100 | 1   | 10  | 1   | 1   | 40  | 75  |
| Polyvinyl Butyral       | 100 | 50 | 50  | 25  | 15  | 50  | 15  | 15  | 50 | 25  | 100 | 10  | 50  | 20  | 30  | 20  | 75  |
| Polyvinylidene Chloride | 75  | 20 | 75  | 10  | 25  | 50  | 25  | 25  | 20 | 10  | 75  | 50  | 25  | 10  | 15  | 25  | 50  |
| Polystyrene             | 100 | 20 | 100 | 100 | 100 | 100 | 100 | 50  | 70 | 100 | 100 | 100 | 75  | 75  | 100 | 50  | 75  |

## CELLULOSIC

|                              |     |    |     |     |     |     |     |     |    |     |     |     |    |    |     |     |     |
|------------------------------|-----|----|-----|-----|-----|-----|-----|-----|----|-----|-----|-----|----|----|-----|-----|-----|
| Nitrocellulose               | 100 | 50 | 100 | 100 | 100 | 60  | 100 | 100 | 80 | 100 | 100 | 100 | 40 | 40 | 40  | 100 | 100 |
| Ethyl Cellulose              | 100 | 50 | 100 | 100 | 100 | 100 | 100 | 100 | 30 | 100 | 100 | 100 | 75 | 75 | 100 | 100 | 75  |
| Cellulose Acetate            | 25  | 1  | 85  | 1   | 1   | 80  | 1   | 1   | 1  | 1   | 10  | 1   | 1  | 1  | 1   | 1   | 1   |
| Cellulose Acetate Butyrate   | 100 | 20 | 100 | 50  | 50  | 100 | 50  | 50  | 20 | 50  | 100 | 50  | 40 | 20 | 40  | 50  | 75  |
| Cellulose Acetate Propionate | 30  | 10 | 100 | 15  | 20  | 100 | 20  | 20  | 10 | 15  | 80  | 50  | 20 | 5  | 1   | 25  | 50  |

MISCELLANEOUS  
THERMOPLASTIC

|                        |     |    |     |     |     |     |    |    |    |     |    |     |    |    |     |    |    |
|------------------------|-----|----|-----|-----|-----|-----|----|----|----|-----|----|-----|----|----|-----|----|----|
| Chlorinated Rubber     | 100 | 20 | 25  | 100 | 100 | 25  | 50 | 33 | 20 | 100 | 80 | 100 | 25 | 25 | 100 | 30 | 50 |
| High Styrene-Butadiene | 50  | 20 | 25  | 50  | 50  | 20  | 50 | 50 | 20 | 50  | 50 | 50  | 40 | 40 | 40  | 50 | 30 |
| Protein Compounds      | 20  | 1  | 20  | 1   | 1   | 20  | 1  | 1  | 1  | 1   | 10 | 1   | 1  | 1  | 1   | 1  | 1  |
| Shplac                 | 1   | 1  | 5   | 1   | 1   | 5   | 1  | 1  | 1  | 1   | 1  | 1   | 1  | 1  | 1   | 1  | 1  |
| Acrylic Type Resins    | 70  | 25 | 100 | 25  | 25  | 100 | 25 | 25 | 25 | 25  | 70 | 25  | 15 | 1  | 20  | 70 | 50 |
| Polyamides             | 25  | 10 | 1   | 20  | 25  | 1   | 25 | 25 | 10 | 20  | 25 | 25  | 1  | 1  | 5   | 20 | 10 |

## THERMOSETTING

|                            |     |    |     |    |     |     |     |    |    |    |     |    |    |    |    |    |    |
|----------------------------|-----|----|-----|----|-----|-----|-----|----|----|----|-----|----|----|----|----|----|----|
| Polyester                  | 20  | 20 | 10  | 15 | 20  | 5   | 20  | 20 | 20 | 15 | 20  | 20 | 5  | 5  | 5  | 15 | 10 |
| Epoxy                      | 25  | 10 | 10  | 1  | 1   | 1   | 1   | 1  | 10 | 1  | 25  | 10 | 1  | 1  | 1  | 15 | 15 |
| Phenolic                   | 50  | 25 | 25  | 25 | 25  | 25  | 25  | 25 | 30 | 25 | 50  | 50 | 25 | 25 | 25 | 25 | 30 |
| Alkyd                      | 70  | 25 | 25  | 25 | 25  | 25  | 25  | 25 | 25 | 25 | 50  | 50 | 25 | 25 | 20 | 25 | 30 |
| Melamine                   | 1   | 1  | 1   | 1  | 1   | 1   | 1   | 1  | 1  | 1  | 1   | 1  | 1  | 1  | 1  | 1  | 1  |
| Polyurethane               | 25  | 10 | 15  | 25 | 25  | 15  | 25  | 25 | 10 | 25 | 25  | 25 | 20 | 20 | 20 | 25 | 15 |
| Nitrile & Neoprene Rubbers | 100 | 50 | 100 | 33 | 100 | 100 | 100 | 50 | 50 | 33 | 100 | 50 | 50 | 50 | 40 | 70 | 60 |

# Plasticizer-Resin Compatibility Guide

ADIPATES

PHOSPHATES

SULFONAMIDES

PTH  
GLYCOL

|  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |    |    |    |     |    |     |     |     |     |
|--|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|----|----|----|-----|----|-----|-----|-----|-----|
|  | 100 | 100 | 100 | 100 | 100 | 100 | 90  | 100 | 50  | 75  | 75  | 100 | 100 | 60  | 100 | 20 | 1  | 1  | 1   | 1  | 15  | 15  | 25  | 100 |
|  | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 40  | 50  | 40  | 40  | 80 | 50 | 50 | 100 | 50 | 50  | 50  | 100 | 100 |
|  | 25  | 25  | 25  | 25  | 20  | 25  | 5   | 20  | 1   | 25  | 1   | 100 | 100 | 50  | 100 | 50 | 50 | 50 | 100 | 50 | 50  | 50  | 100 | 100 |
|  | 15  | 20  | 25  | 25  | 10  | 25  | 20  | 10  | 10  | 15  | 15  | 75  | 75  | 50  | 75  | 20 | 20 | 25 | 50  | 20 | 25  | 25  | 75  | 75  |
|  | 100 | 100 | 100 | 100 | 75  | 100 | 60  | 75  | 25  | 100 | 20  | 15  | 50  | 100 | 15  | 20 | 10 | 10 | 20  | 10 | 10  | 10  | 30  | 50  |
|  | 100 | 100 | 50  | 60  | 40  | 100 | 70  | 40  | 35  | 35  | 35  | 100 | 100 | 100 | 100 | 75 | 75 | 80 | 80  | 50 | 100 | 100 | 100 | 100 |
|  | 100 | 100 | 100 | 100 | 75  | 100 | 80  | 75  | 100 | 100 | 50  | 70  | 100 | 50  | 70  | 30 | 80 | 60 | 60  | 75 | 75  | 75  | 75  | 75  |
|  | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 35  | 20  | 10  | 15  | 35 | 20 | 45 | 90  | 30 | 25  | 25  | 100 | 50  |
|  | 50  | 40  | 25  | 30  | 20  | 50  | 35  | 20  | 50  | 25  | 25  | 30  | 80  | 25  | 30  | 50 | 40 | 40 | 50  | 25 | 50  | 50  | 100 | 50  |
|  | 20  | 40  | 5   | 10  | 5   | 20  | 5   | 5   | 1   | 1   | 1   | 40  | 100 | 40  | 40  | 50 | 50 | 50 | 100 | 50 | 50  | 50  | 100 | 50  |
|  | 100 | 50  | 100 | 100 | 25  | 100 | 100 | 25  | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 50 | 25 | 25 | 50  | 25 | 50  | 50  | 80  | 50  |
|  | 50  | 50  | 40  | 40  | 40  | 50  | 35  | 40  | 20  | 20  | 20  | 50  | 50  | 50  | 50  | 20 | 25 | 25 | 25  | 25 | 25  | 25  | 50  | 50  |
|  | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 40  | 25  | 10  | 30  | 10 | 30 | 30 | 50  | 40 | 25  | 25  | 25  | 50  |
|  | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1  | 25 | 25 | 40  | 60 | 25  | 25  | 10  | 50  |
|  | 25  | 25  | 10  | 10  | 1   | 25  | 1   | 1   | 1   | 1   | 1   | 25  | 100 | 25  | 25  | 25 | 25 | 25 | 25  | 25 | 25  | 25  | 50  | 50  |
|  | 20  | 20  | 1   | 1   | 1   | 20  | 25  | 1   | 25  | 25  | 25  | 25  | 25  | 15  | 25  | 10 | 50 | 50 | 50  | 25 | 50  | 50  | 1   | 50  |
|  | 10  | 15  | 5   | 5   | 5   | 10  | 5   | 5   | 1   | 1   | 1   | 20  | 20  | 20  | 20  | 10 | 5  | 5  | 10  | 5  | 20  | 20  | 5   | 50  |
|  | 1   | 10  | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 25  | 25  | 25  | 25  | 10 | 20 | 20 | 50  | 50 | 25  | 25  | 25  | 50  |
|  | 25  | 25  | 25  | 25  | 25  | 25  | 25  | 25  | 25  | 25  | 25  | 50  | 50  | 50  | 50  | 50 | 50 | 50 | 50  | 50 | 50  | 50  | 50  | 50  |
|  | 25  | 25  | 25  | 25  | 25  | 25  | 25  | 25  | 25  | 50  | 25  | 70  | 70  | 50  | 70  | 50 | 40 | 30 | 25  | 25 | 25  | 25  | 70  | 50  |
|  | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1  | 25 | 25 | 50  | 80 | 25  | 25  | 1   | 50  |
|  | 25  | 25  | 20  | 20  | 20  | 25  | 20  | 20  | 15  | 15  | 15  | 25  | 25  | 25  | 25  | 10 | 10 | 10 | 20  | 10 | 25  | 25  | 25  | 50  |
|  | 50  | 50  | 50  | 50  | 50  | 50  | 65  | 50  | 33  | 20  | 33  | 33  | 40  | 50  | 55  | 50 | 50 | 50 | 50  | 50 | 50  | 50  | 50  | 50  |

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TOWOLDMON0033042

HYDRAULIC

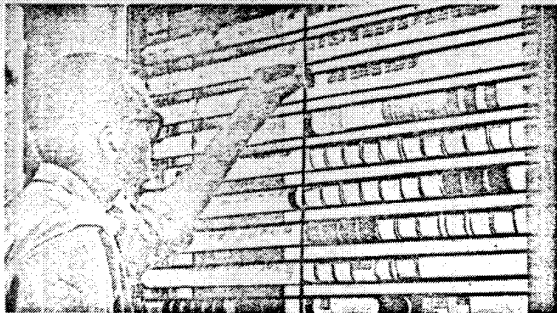
PERMANENT

MISCELLANEOUS

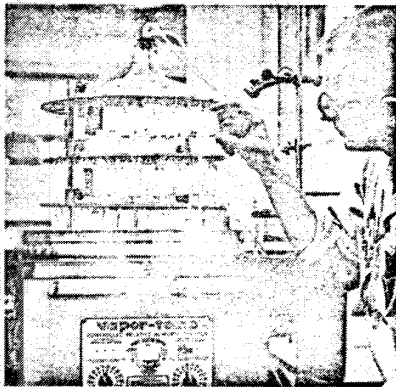
|   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |    |     |
|---|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|----|-----|
|   | 15  | 15  | 25  | 100 | 20  | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 35  | 40  | 10  | 10 | 10  |
| 5 | 50  | 50  | 100 | 100 | 100 | 75  | 80  | 100 | 75  | 1   | 20  | 50  | 100 | 1   | 50  | 1   | 1   | 10 | 1   |
| 5 | 50  | 50  | 100 | 100 | 100 | 40  | 40  | 75  | 40  | 15  | 30  | 30  | 50  | 15  | 50  | 50  | 1   | 10 | 1   |
| 5 | 25  | 25  | 75  | 75  | 75  | 10  | 10  | 25  | 10  | 25  | 10  | 10  | 15  | 25  | 50  | 20  | 1   | 10 | 1   |
| 5 | 10  | 10  | 30  | 30  | 30  | 1   | 1   | 50  | 1   | 50  | 40  | 20  | 1   | 50  | 100 | 100 | 1   | 10 | 1   |
| 5 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 10  | 1   | 10 | 1   |
| 5 | 75  | 75  | 75  | 75  | 75  | 10  | 10  | 33  | 10  | 100 | 50  | 75  | 25  | 100 | 75  | 100 | 5   | 15 | 5   |
| 5 | 25  | 25  | 100 | 50  | 100 | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1  | 1   |
| 5 | 50  | 50  | 100 | 50  | 100 | 100 | 100 | 100 | 100 | 50  | 70  | 60  | 80  | 50  | 50  | 30  | 5   | 10 | 5   |
| 5 | 50  | 50  | 100 | 50  | 100 | 50  | 50  | 10  | 50  | 20  | 40  | 40  | 50  | 20  | 10  | 1   | 1   | 1  | 1   |
| 5 | 50  | 50  | 80  | 80  | 100 | 50  | 50  | 50  | 50  | 50  | 70  | 50  | 50  | 50  | 100 | 100 | 5   | 10 | 5   |
| 5 | 25  | 25  | 50  | 50  | 50  | 15  | 15  | 25  | 10  | 33  | 30  | 20  | 20  | 40  | 50  | 25  | 1   | 20 | 1   |
| 5 | 25  | 25  | 25  | 40  | 20  | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1  | 1   |
| 5 | 25  | 25  | 10  | 30  | 10  | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1  | 1   |
| 5 | 25  | 25  | 50  | 70  | 60  | 1   | 1   | 1   | 1   | 70  | 10  | 10  | 10  | 50  | 10  | 20  | 1   | 1  | 1   |
| 5 | 50  | 50  | 1   | 20  | 1   | 1   | 1   | 1   | 1   | 25  | 20  | 15  | 1   | 25  | 25  | 1   | 1   | 10 | 1   |
| 5 | 20  | 20  | 5   | 20  | 5   | 5   | 5   | 10  | 5   | 20  | 15  | 20  | 10  | 20  | 25  | 1   | 5   | 10 | 1   |
| 5 | 25  | 25  | 25  | 25  | 25  | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 50  | 1   | 100 | 25 | 100 |
| 5 | 50  | 50  | 50  | 50  | 50  | 15  | 15  | 25  | 15  | 25  | 25  | 15  | 15  | 25  | 25  | 25  | 25  | 25 | 25  |
| 5 | 25  | 25  | 70  | 70  | 70  | 20  | 20  | 25  | 20  | 25  | 20  | 25  | 20  | 25  | 25  | 15  | 5   | 25 | 0.5 |
| 5 | 25  | 25  | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1  | 1   |
| 5 | 25  | 25  | 25  | 25  | 25  | 10  | 10  | 15  | 10  | 25  | 25  | 15  | 10  | 25  | 25  | 15  | 1   | 10 | 1   |
| 5 | 50  | 50  | 50  | 50  | 50  | 25  | 25  | 50  | 25  | 50  | 25  | 25  | 30  | 50  | 50  | 50  | 25  | 50 | 25  |

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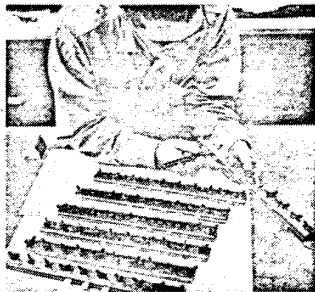
TOWOLDMON0033043



Both monomeric and polymeric plasticizers that contain unsaturation often become incompatible because of chemical instability. Epoxy stabilizers accelerate this exudation so that tack and dirt pick-up are frequently observed in a month or two. Completely saturated polymeric plasticizers, such as Santicizer 409, remain tack free upon exposure to North indirect daylight for more than one year.



Absence of exudation under conditions of high humidity is important in many vinyl applications. Plasticizers with good humidity compatibility do not exude from film specimens in 18 weeks' exposure at 60°C and 100-per cent relative humidity.



Potential plasticizers are quickly screened for compatibility with polyvinyl chloride by compressing loops of plasticized vinyl specimens for one week at 23°C and 50 per cent relative humidity. The amount of plasticizer squeezed out, if any, is determined by wiping the inside of the fold with cigarette paper.

8.

0476074



*guide to plasticizer performance*

*in* **PROTECTIVE COATINGS**

*for metal, wood, fabric, paper*



0476075

# PERFORMANCE

| RESIN                                          | 1B-100-100-100                                                                                                    | 100-100-100                                                                               | 100-100-100                                                                                 | 100-100-100                                                                                   |
|------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|
| Cellulose Nitrate                              | Triphenyl Phosphate<br>Santicizer 1-H<br>Santicizer 160<br>Santicizer 262<br>Santolite MHP<br>Diphenyl Phthalate  | Santicizer 8<br>Santicizer 160<br>Santicizer 262<br>Tricresyl Phosphate<br>Santicizer 165 | Aroclor<br>Santolite MHP<br>Santicizer 8<br>Santicizer B-16                                 | Dibutyl Phthalate<br>Diocetyl Phthalate<br>Santicizer 160<br>Santicizer 165<br>Santicizer 262 |
| Cellulose Acetate                              | Santicizer 1-H<br>Santicizer 8<br>Santicizer M-17<br>Santolite MHP                                                | Santicizer 8<br>Diethyl Phthalate<br>Santicizer E-15                                      | Santicizer 8<br>Santicizer M-17<br>Santolite MHP<br>Santolite MS-80%                        | Diethyl Phthalate<br>Santicizer 8<br>Santicizer M-17                                          |
| Cellulose Acetate-Butyrate                     | Santicizer 1-H<br>Santicizer 8<br>Santicizer M-17<br>Dicyclohexyl Phthalate                                       | Santicizer 8<br>Diethyl Phthalate<br>Santicizer E-15                                      | Santicizer 8<br>Santicizer M-17<br>Santolite MHP<br>Aroclor                                 | Santicizer 141<br>Diocetyl Phthalate<br>Dibutyl Phthalate                                     |
| Cellulose Propionate                           | Santicizer 1-H<br>Santicizer 8<br>Santicizer M-17                                                                 | Santicizer 8<br>Diethyl Phthalate<br>Santicizer E-15                                      | Santicizer 8<br>Santicizer M-17<br>Santolite MHP<br>Santolite MS-80%                        | Santicizer 8<br>Santicizer M-17                                                               |
| Ethyl Cellulose                                | Santicizer 1-H<br>Santolite MHP<br>Diphenyl Phthalate<br>Dicyclohexyl Phthalate                                   | Santicizer 9<br>Diphenyl Phthalate<br>Santicizer 8<br>Santicizer M-17                     | Santicizer 8<br>Santicizer 9<br>Santolite MHP<br>Aroclor                                    | Diocetyl Adipate<br>Diisodecyl Adipate<br>Di(n-octyl, n-decyl)<br>Adipate                     |
| Acrylic                                        | Dicyclohexyl Phthalate<br>Santicizer 1-H<br>Diphenyl Phthalate                                                    | Santicizer 160<br>Santicizer 141<br>Santicizer B-16<br>Santicizer 262                     | Santicizer 8<br>Santolite MHP<br>Santicizer 160<br>Santicizer 262<br>Dicyclohexyl Phthalate | Santicizer 160<br>Santicizer 141<br>Santicizer B-16<br>Santicizer 262                         |
| Polystyrene                                    | Diphenyl Phthalate<br>Santicizer 9<br>Santolite MHP<br>Aroclor                                                    | Santicizer B-16<br>Santicizer 160                                                         | Santicizer 8<br>Santicizer 9<br>Santolite MHP<br>Aroclor                                    | Dibutyl Phthalate<br>Santicizer 141                                                           |
| Polyvinyl Chloride                             | Diphenyl Phthalate<br>Tricresyl Phosphate<br>Santicizer 140<br>Santicizer 278<br>Santicizer 160<br>Santicizer 262 | Santicizer 160<br>Santicizer 141<br>Diocetyl Adipate<br>Di(n-octyl, n-decyl)<br>Adipate   | Santicizer 160<br>Aroclor<br>Santolite MHP<br>Santicizer 278<br>Santicizer 262              | Diocetyl Adipate<br>Di(n-octyl, n-decyl)<br>Adipate<br>Diisodecyl Adipate                     |
| Polyvinyl Butyral                              | Diphenyl Phthalate<br>Dicyclohexyl Phthalate<br>Tricresyl Phosphate<br>Santicizer 140                             | Santicizer 160<br>Santicizer 141                                                          | Santicizer 160<br>Santicizer B-16                                                           | Santicizer 141<br>Santicizer B-16                                                             |
| Polyvinyl Acetate                              | Aroclor<br>Tricresyl Phosphate<br>Santicizer B-16                                                                 | Santicizer 8<br>Tricresyl Phosphate<br>Santicizer B-16                                    | Santicizer 8<br>Aroclor<br>Diethyl Phthalate<br>Dimethyl Phthalate                          | Dibutyl Phthalate<br>Santicizer 141                                                           |
| Polyvinyl Alcohol                              | Santicizer 8<br>Santicizer 9<br>Santicizer M-17                                                                   | Santicizer 8<br>Santicizer M-17                                                           | Santicizer 9                                                                                | Santicizer M-17<br>Santicizer E-15                                                            |
| Polyvinylidene Chloride                        | Aroclor                                                                                                           | Santicizer B-16<br>Santicizer 160                                                         | Aroclor                                                                                     | Santicizer 141<br>Dibutyl Phthalate<br>Santicizer B-16<br>Santicizer 160                      |
| Epoxy                                          | Aroclor<br>Mod-Epoxy<br>Santicizer 8                                                                              | Santicizer B-16                                                                           | Mod-Epoxy<br>Aroclor                                                                        | Santicizer B-16                                                                               |
| Chlorinated Rubber (Parlon)                    | Triphenyl Phosphate<br>Santicizer 140<br>Aroclor                                                                  | Dibutyl Phthalate<br>Santicizer 141<br>Santicizer 160                                     | Aroclor<br>Santicizer 160<br>Triphenyl Phosphate<br>Tricresyl Phosphate                     | Santicizer 141<br>Dibutyl Phthalate<br>Santicizer 160                                         |
| Styrene-Butadiene Rubber (Pliolite and Marbon) | Tricresyl Phosphate<br>Aroclor<br>Dibutyl Phthalate                                                               | Santicizer M-17<br>Santicizer 160<br>Santicizer 141                                       | Aroclor<br>Tricresyl Phosphate<br>Triphenyl Phosphate                                       | Santicizer 160<br>Santicizer 141<br>Santicizer B-16                                           |
| Casein, Zein                                   | Santicizer 9                                                                                                      | Santicizer 8                                                                              | Santicizer 8<br>Santicizer 9                                                                | Santicizer 8                                                                                  |

0476076

TOWOLDMON0033046

# PERFORMANCE

| ITEM                                                                                       | PROPERTY                                                                      | HARDNESS                                                                                               | LOSS                                                                                          | CHANGE REACTION                                                            | HEAT STABILITY                                                                               |
|--------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| butyl Phthalate<br>dioctyl Phthalate<br>Santicizer 160<br>Santicizer 165<br>Santicizer 262 | Dibutyl Phthalate<br>Santicizer 165<br>Santicizer 8<br>Triphenyl Phosphate    | Dicyclohexyl Phthalate<br>Diphenyl Phthalate<br>Tricresyl Phosphate<br>Santicizer 409<br>Santolite MHP | Santicizer B-16<br>Santicizer 8<br>Diphenyl Phthalate<br>Santolite MHP                        | Aroclor<br>Tricresyl Phosphate<br>Santicizer 141<br>Triphenyl Phosphate    | Dioctyl Phthalate<br>Santicizer 165<br>Santicizer 160<br>Santicizer 262<br>Dibutyl Phthalate |
| diethyl Phthalate<br>Santicizer 8<br>Santicizer M-17                                       | Triphenyl Phosphate<br>Santicizer 8<br>Santicizer E-15                        | Santicizer 9<br>Santicizer I-H<br>Triphenyl Phosphate<br>Santolite MHP                                 | Santicizer 8<br>Santicizer M-17<br>Santicizer 3<br>Santicizer E-15<br>Santolite MHP           | Triphenyl Phosphate<br>Santicizer 141<br>Santicizer 140                    | Santicizer M-17<br>Santicizer E-15<br>Diethyl Phthalate<br>Dimethyl Phthalate                |
| Santicizer 141<br>dioctyl Phthalate<br>dibutyl Phthalate                                   | Triphenyl Phosphate<br>Santicizer 140<br>Santicizer 8                         | Santicizer I-H<br>Triphenyl Phosphate<br>Diphenyl Phthalate<br>Aroclor                                 | Santicizer 8<br>Santicizer M-17<br>Santicizer E-15<br>Santolite MHP                           | Santicizer 141<br>Tricresyl Phosphate<br>Triphenyl Phosphate<br>Aroclor    | Santicizer M-17<br>Santicizer 409<br>Santicizer B-16<br>Dioctyl Phthalate                    |
| Santicizer 8<br>Santicizer M-17                                                            | Triphenyl Phosphate<br>Santicizer 140<br>Santicizer 8                         |                                                                                                        | Santicizer 8<br>Santicizer M-17<br>Santicizer E-15<br>Santolite MHP                           | Triphenyl Phosphate<br>Santicizer 140                                      | Santicizer M-17<br>Santicizer E-15<br>Diethyl Phthalate                                      |
| dioctyl Adipate<br>disodecyl Adipate<br>Di(n-octyl, n-decyl)<br>Adipate                    | Santicizer M-17<br>Diphenyl Phthalate<br>Santicizer 8                         | Santicizer I-H<br>Diphenyl Phthalate                                                                   | Santicizer 8<br>Diphenyl Phthalate                                                            | Tricresyl Phosphate<br>Santicizer 141<br>Aroclor<br>Triphenyl Phosphate    | Dioctyl Adipate<br>Di(n-octyl, n-decyl)<br>Adipate<br>Dioctyl Phthalate                      |
| Santicizer 160<br>Santicizer 141<br>Santicizer B-16<br>Santicizer 262                      | Santicizer 160<br>Santicizer B-16<br>Santicizer 262                           | Dicyclohexyl Phthalate<br>Diphenyl Phthalate                                                           | Santicizer 8<br>Santicizer B-16<br>Santicizer 160<br>Santicizer 262<br>Dicyclohexyl Phthalate | Tricresyl Phosphate<br>Santicizer 141<br>Santicizer 140<br>Phosgard C-22-R | Santicizer 160<br>Santicizer B-16<br>Santicizer 262                                          |
| Dibutyl Phthalate<br>Santicizer 141                                                        | Santicizer 141<br>Santicizer 160<br>Santicizer B-16                           | Diphenyl Phthalate<br>Triphenyl Phosphate                                                              | Santicizer 8<br>Santicizer 9<br>Santicizer B-16                                               | Aroclor<br>Tricresyl Phosphate<br>Santicizer 141                           | Dibutyl Phthalate<br>Santicizer 160                                                          |
| Dioctyl Adipate<br>Di(n-octyl, n-decyl)<br>Adipate<br>Disodecyl Adipate                    | Dioctyl Adipate<br>Di(n-octyl, n-decyl)<br>Adipate<br>Disodecyl Adipate       | Diphenyl Phthalate<br>Santicizer 213<br>Aroclor<br>Santicizer 409                                      | Santicizer B-16<br>Santicizer 141<br>Santicizer 160                                           | Tricresyl Phosphate<br>Santicizer 140<br>Santicizer 141<br>Aroclor         | Dioctyl Phthalate<br>Disodecyl Phthalate<br>Santicizer 409                                   |
| Santicizer 141<br>Santicizer B-16                                                          | Santicizer 141<br>Santicizer 160<br>Santicizer B-16                           | Diphenyl Phthalate<br>Dicyclohexyl Phthalate<br>Tricresyl Phosphate                                    | Santicizer B-16<br>Santicizer 160                                                             | Tricresyl Phosphate<br>Santicizer 141<br>Santicizer 140                    | Santicizer 160<br>Santicizer B-16<br>Dicyclohexyl Phthalate                                  |
| Dibutyl Phthalate<br>Santicizer 141                                                        | Santicizer 8<br>Triphenyl Phosphate<br>Santicizer B-16<br>Dibutyl Phthalate   | Diphenyl Phthalate<br>Santicizer I-H<br>Triphenyl Phosphate<br>Dicyclohexyl Phthalate                  | Santicizer 8<br>Dibutyl Phthalate<br>Santicizer 160                                           | Aroclor<br>Tricresyl Phosphate<br>Triphenyl Phosphate<br>Santicizer 141    | Dibutyl Phthalate<br>Santicizer 160<br>Diethyl Phthalate<br>Santicizer B-16                  |
| Santicizer M-17<br>Santicizer E-15                                                         | Santicizer M-17<br>Santicizer E-15                                            | Santicizer 9<br>Triphenyl Phosphate                                                                    | Santicizer 8<br>Santicizer 9                                                                  | Triphenyl Phosphate<br>Tricresyl Phosphate                                 | Santicizer M-17<br>Santicizer E-15<br>Santicizer B-16                                        |
| Santicizer 141<br>Dibutyl Phthalate<br>Santicizer B-16<br>Santicizer 160                   | Dibutyl Phthalate<br>Santicizer 160                                           | Aroclor                                                                                                | Santicizer 160<br>Diethyl Phthalate                                                           | Aroclor<br>Santicizer 141<br>Tricresyl Phosphate                           | Santicizer B-16<br>Santicizer E-15<br>Diethyl Phthalate                                      |
| Santicizer B-16                                                                            | Santicizer B-16                                                               | Mod-Epoxy<br>Santicizer 8<br>Aroclor                                                                   | Santicizer B-16<br>Santicizer 160<br>Mod-Epoxy                                                | Aroclor<br>Mod-Epoxy<br>Tricresyl Phosphate<br>Santicizer 140              | Santicizer B-16                                                                              |
| Santicizer 141<br>Dibutyl Phthalate<br>Santicizer 160                                      | Santicizer B-16<br>Dibutyl Phthalate<br>Santicizer 141<br>Tricresyl Phosphate | Aroclor<br>Triphenyl Phosphate<br>Tricresyl Phosphate<br>Santicizer 140                                | Dibutyl Phthalate<br>Santicizer B-16<br>Santicizer M-17                                       | Aroclor<br>Tricresyl Phosphate<br>Santicizer 141                           | Santicizer B-16<br>Santicizer 160<br>Dibutyl Phthalate                                       |
| Santicizer 160<br>Santicizer 141<br>Santicizer B-16                                        | Santicizer 160<br>Santicizer 141<br>Santicizer B-16                           | Tricresyl Phosphate<br>Santicizer 140<br>Triphenyl Phosphate<br>Aroclor                                | Santicizer 160<br>Santicizer B-16<br>Santicizer 141                                           | Aroclor<br>Tricresyl Phosphate<br>Santicizer 141                           | Santicizer 160<br>Santicizer B-16<br>Dibutyl Phthalate                                       |
| Santicizer 8                                                                               | Santicizer 8                                                                  | Santicizer 9                                                                                           | Santicizer 8<br>Santicizer 9                                                                  |                                                                            |                                                                                              |

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# PERMANENCE

| FOOTWEAR                                                                                                               | LOW VOCATILITY                                                                                    | CHEMICAL RESISTANCE                                     | SOLVENT RESISTANCE                                                                         | WATER RESISTANCE                                                                                     | LIGHT STABILITY                                                                                                |
|------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|---------------------------------------------------------|--------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|
| Santicizer E-15<br>Santicizer B-16<br>Santicizer 141<br>Santicizer 160<br>Diocetyl Phthalate*<br>Diocetyl Adipate      | Tricresyl Phosphate<br>Santicizer 140<br>Santicizer 141<br>Santicizer 262<br>Diocetyl Phthalate   | Aroclor<br>Tricresyl Phosphate<br>Diocetyl Phthalate    | Santicizer 160<br>Tricresyl Phosphate<br>Santicizer 8<br>Santicizer 262<br>Santicizer M-17 | Diocetyl Phthalate<br>Santicizer 160<br>Santicizer 141<br>Santicizer 262<br>Santolite MHP<br>Aroclor | Dibutyl Phthalate<br>Santicizer 160<br>Diocetyl Phthalate<br>Santicizer 165<br>Santicizer 262<br>Santolite MHP |
| Santicizer E-15<br>Diethyl Phthalate<br>Santicizer 141                                                                 | Santicizer 8<br>Santicizer M-17<br>Santicizer E-15                                                | Diethyl Phthalate                                       | Santicizer M-17<br>Santicizer E-15<br>Santicizer 8                                         | Santicizer 8<br>Santicizer M-17<br>Santolite MHP                                                     | Santicizer E-15<br>Santicizer M-17<br>Santolite MHP                                                            |
| Santicizer E-15<br>Santicizer B-16<br>Santicizer 141<br>Diocetyl Phthalate*<br>Diocetyl Adipate                        | Santicizer 140<br>Tricresyl Phosphate<br>Santicizer 409                                           | Aroclor<br>Diocetyl Phthalate<br>Tricresyl Phosphate    | Santicizer M-17<br>Santicizer 8<br>Triphenyl Phosphate<br>Santicizer 409                   | Santicizer 140<br>Santicizer 8<br>Santicizer M-17                                                    | Santicizer M-17<br>Santicizer E-15                                                                             |
| Santicizer E-15<br>Diethyl Phthalate<br>Diocetyl Adipate                                                               | Santicizer 140<br>Santicizer 8<br>Santicizer M-17                                                 | Santicizer 140<br>Diethyl Phthalate                     | Santicizer 8<br>Santicizer M-17<br>Triphenyl Phosphate                                     | Santicizer 140<br>Santicizer 8<br>Santicizer M-17                                                    | Santicizer M-17<br>Santicizer E-15                                                                             |
| Santicizer B-16<br>Santicizer E-15<br>Santicizer 141<br>Diocetyl Phthalate*                                            | Tricresyl Phosphate<br>Diocetyl Phthalate<br>Santicizer 409<br>Santicizer 141                     | Aroclor<br>Diocetyl Phthalate<br>Tricresyl Phosphate    | Santicizer M-17<br>Santicizer E-15<br>Triphenyl Phosphate<br>Santicizer 8                  | Diocetyl Phthalate<br>Santicizer 409<br>Diisooctyl Phthalate                                         | Triphenyl Phosphate<br>Santicizer 1-H<br>Santicizer 8                                                          |
| Santicizer B-16<br>Santicizer 141                                                                                      | Santicizer 160<br>Santicizer 141<br>Santicizer 262                                                | Santicizer 160<br>Tricresyl Phosphate<br>Santicizer 262 | Santicizer M-17<br>Santicizer 8<br>Santicizer 160<br>Santicizer 262                        | Santicizer 160<br>Santicizer 141<br>Santicizer 262                                                   | Santicizer B-16<br>Santicizer 160<br>Dibutyl Phthalate<br>Santicizer 262                                       |
| Santicizer B-16<br>Santicizer 141<br>Diocetyl Adipate                                                                  | Santicizer 141<br>Diphenyl Phthalate<br>Santicizer 160                                            | Aroclor<br>Santicizer 141                               | Santicizer 9<br>Santicizer 160                                                             | Diphenyl Phthalate<br>Dicyclohexyl Phthalate<br>Santicizer 160                                       | Santicizer 160<br>Santicizer B-16                                                                              |
| Santicizer 141<br>Santicizer B-16<br>Santicizer 160<br>Diocetyl Phthalate*<br>Diisooctyl Phthalate<br>Diocetyl Adipate | Santicizer 409<br>Santicizer 262<br>Diisodecyl Phthalate<br>Tricresyl Phosphate<br>Santicizer 140 | Aroclor<br>Diocetyl Phthalate<br>Tricresyl Phosphate    | Santicizer 160<br>Tricresyl Phosphate<br>Santicizer 409<br>Santicizer 262                  | Diisodecyl Phthalate<br>Santicizer 409<br>Diocetyl Phthalate<br>Santicizer 262                       | Diocetyl Phthalate<br>Santicizer 141<br>Santicizer B-16<br>Santicizer 165                                      |
| Santicizer B-16<br>Santicizer 141<br>Diocetyl Adipate                                                                  | Tricresyl Phosphate<br>Santicizer 141<br>Santicizer 140<br>Santicizer 160                         | Tricresyl Phosphate<br>Santicizer 160                   | Tricresyl Phosphate<br>Santicizer 140<br>Santicizer B-16<br>Santicizer 141                 | Santicizer 141<br>Santicizer 160<br>Tricresyl Phosphate                                              | Santicizer 160<br>Santicizer 141<br>Santicizer B-16                                                            |
| Diethyl Phthalate<br>Santicizer B-16<br>Santicizer E-15<br>Santicizer 160                                              | Tricresyl Phosphate<br>Santicizer 141<br>Diphenyl Phthalate<br>Triphenyl Phosphate                | Aroclor<br>Tricresyl Phosphate<br>Diethyl Phthalate     | Santicizer 8<br>Santicizer M-17<br>Triphenyl Phosphate                                     | Santicizer 8<br>Santicizer B-16<br>Triphenyl Phosphate                                               | Dibutyl Phthalate<br>Santicizer B-16<br>Santicizer 141                                                         |
| Santicizer E-15<br>Diocetyl Adipate                                                                                    | Santicizer B-16<br>Triphenyl Phosphate<br>Tricresyl Phosphate                                     | Santicizer E-15                                         | Santicizer 8<br>Santicizer M-17                                                            | Santicizer 8<br>Santicizer M-17                                                                      | Santicizer B-16<br>Santicizer M-17                                                                             |
| Diethyl Phthalate<br>Santicizer E-15<br>Santicizer B-16<br>Diocetyl Adipate<br>Santicizer 141<br>Santicizer 160        | Tricresyl Phosphate<br>Santicizer 141<br>Santicizer B-16                                          | Aroclor<br>Santicizer 141                               | Santicizer M-17<br>Santicizer E-15<br>Santicizer 160<br>Santicizer 141                     | Aroclor<br>Santicizer 141                                                                            | Santicizer 160<br>Santicizer E-15<br>Santicizer B-16                                                           |
| Santicizer B-16<br>Santicizer E-15                                                                                     | Mod-Epoxy<br>Aroclor<br>Santicizer 8                                                              | Aroclor<br>Mod-Epoxy                                    | Tricresyl Phosphate<br>Santicizer E-15<br>Mod-Epoxy                                        | Mod-Epoxy<br>Aroclor                                                                                 |                                                                                                                |
| Santicizer 141<br>Santicizer B-16<br>Diocetyl Adipate                                                                  | Aroclor<br>Tricresyl Phosphate<br>Santicizer 140<br>Santicizer 141                                | Aroclor<br>Tricresyl Phosphate<br>Santicizer 141        | Aroclor<br>Santicizer M-17<br>Tricresyl Phosphate<br>Santicizer 141                        | Tricresyl Phosphate<br>Santicizer 140<br>Aroclor<br>Santicizer 141                                   | Santicizer B-16<br>Santicizer 160<br>Santicizer 141<br>Dibutyl Phthalate                                       |
| Santicizer B-16<br>Santicizer 141<br>Diocetyl Adipate                                                                  | Tricresyl Phosphate<br>Santicizer 140<br>Santicizer 141<br>Aroclor                                | Aroclor<br>Tricresyl Phosphate                          | Santicizer M-17<br>Santicizer 140<br>Aroclor                                               | Tricresyl Phosphate<br>Santicizer 141<br>Santicizer B-16<br>Aroclor                                  | Santicizer B-16<br>Santicizer 160<br>Santicizer 140<br>Dibutyl Phthalate                                       |
|                                                                                                                        | Santicizer 8<br>Santicizer 9                                                                      | Santicizer 8                                            | Santicizer 8                                                                               | Santicizer 8<br>Santicizer 9                                                                         | Santicizer 8                                                                                                   |

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### Polyamides

Santicizer 8 imparts flexibility without adversely affecting tensile strength, abrasion resistance, or oil resistance. Santicizer 9, Santicizer 1-H and Santolite MHP each impart property improvements in particular applications.

### Polyesters

Aroclor compounds impart flame resistance and improve adhesion, chemical and oxidation resistance.

### Phenol-Formaldehyde

Santicizer 8 and Santicizer 9 improve flow and adhesion. Tricresyl Phosphate, Santicizer 160, Dibutyl Phthalate, Santicizer 140 and liquid Aroclor compounds improve punchability of laminates. Tricresyl Phosphate, Santicizer 140, Santicizer 141 and Aroclor compounds impart flame resistance.

### Melamine-Formaldehyde

Santicizer 9 improves solution and color stability, gloss, flow, adhesion, and impact resistance of melamine coatings.

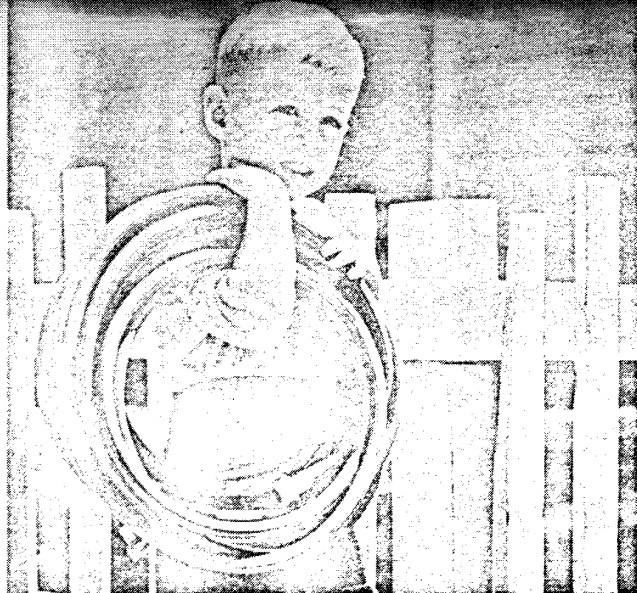
### Urea-Formaldehyde

Santicizer 9 improves flow and acts as a hardening agent.

### Alkyds

Aroclor plasticizers impart improved adhesion, chemical and oxidation resistance.

9  
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## **PLASTICIZER PERFORMANCE IN MOLDING AND EXTRUDING**

The following table will assist compounders select plasticizers for formulation evaluation on the basis of those properties most critical in the final molded part or extrusion. The plasticizers shown provide the optimum effect for each designated property when used with the resin shown. When the same plasticizer appears under two or more of the properties desired in the final product—that plasticizer definitely merits evaluation.

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**PERFORMANCE  
IN MOLDING  
AND EXTRUDING**

**RESIN**

**Polyvinyl  
Chloride**

Santicizer 160  
Santicizer 141  
Santicizer 140  
Tricresyl Phosphate  
Santicizer 278

Diocetyl Adipate  
Di(n-octyl, n-decyl)  
Adipate  
Diisodecyl Adipate

Diphenyl Phthalate  
Santicizer 160  
Santicizer 409  
Tricresyl Phosphate  
Santicizer 262

Santicizer 160  
Santicizer 141  
Diocetyl Adipate  
Santicizer 262

**Polyvinylidene  
Chloride**

Diethyl Phthalate  
Santicizer E-15

Santicizer 141  
Dibutyl Phthalate  
Santicizer B-16

Aroclor

Santicizer 141  
Santicizer B-16

**Polyvinyl  
Alcohol**

Santicizer 9  
Santicizer 8  
Santicizer M-17

Santicizer M-17  
Santicizer E-15

Santicizer 9  
Santicizer 8  
Santicizer M-17

Santicizer 8  
Santicizer M-17

**Polystyrene**

Santicizer 160  
Dibutyl Phthalate

Dibutyl Phthalate  
Santicizer 141

Diphenyl Phthalate

**Cellulose  
Acetate**

Santicizer M-17  
Diethyl Phthalate  
Santicizer E-15

Diethyl Phthalate  
Santicizer 8  
Santicizer M-17

Santicizer 8  
Santicizer 1-H  
Triphenyl Phosphate  
Diphenyl Phthalate

Dimethyl Phthalate  
Diethyl Phthalate  
Santicizer E-15  
Santicizer 8

**Cellulose  
Acetate  
Butyrate**

Santicizer 160  
Santicizer 141  
Santicizer E-15  
Santicizer M-17  
Santicizer 278  
Santicizer 262

Santicizer 141  
Diocetyl Phthalate  
Dibutyl Phthalate

Triphenyl Phosphate  
Santicizer 8  
Diphenyl Phthalate  
Aroclor

Dibutyl Phthalate  
Tricresyl Phosphate  
Santicizer 140

**Cellulose  
Nitrate**

Dibutyl Phthalate  
Santicizer 160  
Santicizer 165  
Santicizer 278  
Santicizer 262

Dibutyl Phthalate  
Diocetyl Phthalate  
Santicizer 165

Dicyclohexyl Phthalate  
Diphenyl Phthalate  
Tricresyl Phosphate  
Aroclor

Diocetyl Phthalate  
Dibutyl Phthalate  
Santicizer 165

**Ethyl Cellulose**

Santicizer 160  
Dibutyl Phthalate  
Santicizer 278  
Santicizer 262

Diocetyl Adipate  
Diisodecyl Adipate  
Di(n-octyl, n-decyl)  
Adipate

Santicizer 1-H  
Diphenyl Phthalate  
Dicyclohexyl Phthalate

Santicizer 8  
Diocetyl Phthalate  
Santicizer 160

**Styrene Butadiene  
Rubber (GRS)**

Tricresyl Phosphate  
Dibutyl Phthalate  
Aroclor  
Santicizer 160  
Santicizer 278  
Santicizer 262

Diocetyl Phthalate  
Diocetyl Adipate  
Santicizer 141

Tricresyl Phosphate  
Dibutyl Phthalate

Santicizer 160  
Santicizer 141

**Butadiene  
Acrylonitrile  
Rubber (Buna N)**

Santicizer 160  
Tricresyl Phosphate  
Santicizer 141

Diocetyl Adipate  
Diisodecyl Adipate  
Di(n-octyl, n-decyl)  
Adipate

Triphenyl Phosphate  
Tricresyl Phosphate  
Diphenyl Phthalate

Santicizer 160  
Santicizer 141  
Santicizer B-16

**Acrylic**

Santicizer 160  
Santicizer 141  
Santicizer 262

Santicizer B-16  
Santicizer 160  
Santicizer 262

Dicyclohexyl Phthalate  
Santicizer 1-H  
Diphenyl Phthalate

Santicizer 160  
Santicizer 141  
Santicizer B-16  
Santicizer 262

**Casein**

Santicizer 8  
Santicizer 9

Santicizer 8

Santicizer 9

Santicizer 8

**Phenol  
Formaldehyde**

Santicizer 9  
Santicizer 160

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| HAZARD                                                                                   | TEST AND                                                                | TESTING                                                                                     | TESTING                                                              | TESTING                                                                       | TESTING                                                                                                                 |
|------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|----------------------------------------------------------------------|-------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| Diphenyl Phthalate<br>Aroclor<br>Tricresyl Phosphate<br>Santicizer 409<br>Santicizer 278 | Tricresyl Phosphate<br>Santicizer 140<br>Santicizer 141<br>Aroclor      | Santicizer 160<br>Santicizer 141<br>Tricresyl Phosphate<br>Santicizer 262<br>Santicizer 278 | Santicizer 160<br>Santicizer 141<br>Santicizer 262<br>Santicizer 278 | Diocetyl Phthalate<br>Diisodecyl Phthalate<br>Santicizer 409                  | Diocetyl Phthalate*<br>Diisooctyl Phthalate*<br>Santicizer 141<br>Santicizer 160<br>Santicizer B-16<br>Diocetyl Adipate |
| Aroclor                                                                                  | Aroclor<br>Santicizer 141<br>Tricresyl Phosphate                        |                                                                                             |                                                                      | Santicizer B-16<br>Santicizer E-15<br>Diethyl Phthalate                       | Diethyl Phthalate<br>Santicizer E-15<br>Santicizer B-16<br>Santicizer 141<br>Diocetyl Adipate                           |
| Santicizer 9<br>Triphenyl Phosphate                                                      | Triphenyl Phosphate<br>Tricresyl Phosphate                              |                                                                                             |                                                                      | Santicizer M-17<br>Santicizer E-15<br>Santicizer B-16                         | Santicizer E-15<br>Santicizer B-16<br>Diocetyl Adipate                                                                  |
| Diphenyl Phthalate<br>Triphenyl Phosphate                                                | Aroclor<br>Tricresyl Phosphate<br>Santicizer 141                        |                                                                                             |                                                                      | Dibutyl Phthalate<br>Santicizer 160                                           | Santicizer 141<br>Santicizer B-16<br>Santicizer E-15<br>Diethyl Phthalate<br>Diocetyl Adipate                           |
| Santicizer 9<br>Santicizer I-H<br>Triphenyl Phosphate                                    | Triphenyl Phosphate<br>Santicizer 141<br>Santicizer 140                 | Triphenyl Phosphate<br>Diethyl Phthalate                                                    |                                                                      | Santicizer M-17<br>Santicizer E-15<br>Diethyl Phthalate<br>Dimethyl Phthalate | Santicizer E-15<br>Diethyl Phthalate<br>Santicizer 141                                                                  |
| Santicizer 9<br>Santicizer I-H<br>Diphenyl Phthalate<br>Aroclor                          | Santicizer 141<br>Tricresyl Phosphate<br>Triphenyl Phosphate<br>Aroclor | Triphenyl Phosphate<br>Diphenyl Phthalate<br>Santicizer 160<br>Santicizer 278               |                                                                      | Santicizer M-17<br>Santicizer 409<br>Santicizer B-16<br>Diocetyl Phthalate    | Santicizer B-16<br>Santicizer 141<br>Diocetyl Phthalate*<br>Diisooctyl Phthalate*<br>Diocetyl Adipate                   |
| Dicyclohexyl Phthalate<br>Diphenyl Phthalate<br>Tricresyl Phosphate<br>Santicizer 409    | Aroclor<br>Tricresyl Phosphate<br>Santicizer 140<br>Santicizer 141      | Diphenyl Phthalate<br>Dicyclohexyl Phthalate<br>Santicizer 160<br>Santicizer 278            | Santicizer 160<br>Dibutyl Phthalate                                  | Diocetyl Phthalate<br>Santicizer 165<br>Santicizer 160<br>Dibutyl Phthalate   | Santicizer 141<br>Diocetyl Phthalate*<br>Diisooctyl Phthalate*<br>Santicizer B-16<br>Diocetyl Adipate                   |
| Santicizer I-H<br>Diphenyl Phthalate                                                     | Tricresyl Phosphate<br>Santicizer 140<br>Santicizer 141<br>Aroclor      |                                                                                             |                                                                      | Diocetyl Adipate<br>Di(n-octyl, n-decyl)<br>Adipate<br>Diocetyl Phthalate     | Santicizer 141<br>Santicizer B-16<br>Diocetyl Phthalate*<br>Diisooctyl Phthalate*                                       |
| Tricresyl Phosphate<br>Triphenyl Phosphate<br>Diphenyl Phthalate<br>Aroclor              | Tricresyl Phosphate<br>Triphenyl Phosphate<br>Santicizer 141<br>Aroclor |                                                                                             |                                                                      | Diocetyl Phthalate<br>Santicizer 160                                          | Santicizer 141<br>Diocetyl Phthalate*<br>Santicizer B-16<br>Diisooctyl Phthalate*<br>Diocetyl Adipate                   |
| Diphenyl Phthalate<br>Dicyclohexyl Phthalate<br>Triphenyl Phosphate<br>Santicizer 409    | Tricresyl Phosphate<br>Santicizer 140<br>Santicizer 141<br>Aroclor      |                                                                                             |                                                                      | Diocetyl Phthalate<br>Santicizer B-16<br>Santicizer 409                       | Santicizer 141<br>Santicizer B-16<br>Diocetyl Phthalate*<br>Diisooctyl Phthalate*                                       |
| Dicyclohexyl Phthalate<br>Diphenyl Phthalate                                             | Tricresyl Phosphate<br>Santicizer 141<br>Santicizer 140                 | Dicyclohexyl Phthalate                                                                      |                                                                      | Santicizer 160<br>Santicizer 262                                              | Santicizer 141<br>Santicizer B-16                                                                                       |
| Santicizer 9                                                                             |                                                                         |                                                                                             |                                                                      |                                                                               | Santicizer 141<br>Santicizer B-16                                                                                       |
| Santicizer 9<br>Aroclor                                                                  | Aroclor<br>Tricresyl Phosphate<br>Santicizer 140<br>Santicizer 141      |                                                                                             |                                                                      |                                                                               |                                                                                                                         |

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| ACRYLATE                                                                                                            | ACRYLATE                                                                                    | ACRYLATE                                                                                    | ACRYLATE                                            | ACRYLATE                                                                                                 | ACRYLATE                                                                |
|---------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|-----------------------------------------------------|----------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|
| Diethyl Phthalate*<br>Diisobutyl Phthalate*<br>Santizer 141<br>Santizer 160<br>Diethyl Phthalate<br>Diethyl Adipate | Santizer 262<br>Santizer 409<br>Tricresyl Phosphate<br>Diisobutyl Phthalate<br>Santizer 278 | Santizer 262<br>Santizer 409<br>Tricresyl Phosphate<br>Santizer 160<br>Santizer 278         | Aroclor<br>Diethyl Phthalate<br>Tricresyl Phosphate | Santizer 262<br>Diisobutyl Phthalate<br>Santizer 409<br>Diethyl Phthalate<br>Aroclor                     | Diethyl Phthalate<br>Diisobutyl Phthalate<br>Santizer 141               |
| Diethyl Phthalate<br>Santizer E-15<br>Santizer B-16<br>Santizer 141<br>Diethyl Adipate                              | Santizer 141<br>Santizer B-16                                                               | Santizer M-17<br>Santizer E-15                                                              | Aroclor                                             | Santizer 141<br>Aroclor                                                                                  | Santizer B-16<br>Santizer E-15<br>Santizer M-17<br>Santizer 141         |
| Santizer E-15<br>Santizer B-16<br>Diethyl Adipate                                                                   | Santizer E-15<br>Santizer B-16<br>Triphenyl Phosphate                                       | Santizer 8<br>Santizer M-17<br>Triphenyl Phosphate                                          | Tricresyl Phosphate<br>Santizer B-16                | Santizer 8<br>Santizer M-17                                                                              | Santizer M-17<br>Santizer B-16<br>Santizer E-15                         |
| Santizer 141<br>Santizer B-16<br>Santizer E-15<br>Diethyl Phthalate<br>Diethyl Adipate                              | Tricresyl Phosphate<br>Santizer 141<br>Santizer 160                                         | Santizer M-17<br>Santizer E-15                                                              | Aroclor<br>Tricresyl Phosphate                      | Tricresyl Phosphate<br>Santizer 141                                                                      | Santizer B-16<br>Diethyl Phthalate                                      |
| Santizer E-15<br>Diethyl Phthalate<br>Santizer 141                                                                  | Santizer 141<br>Triphenyl Phosphate<br>Santizer E-15<br>Santizer 8                          | Santizer 8<br>Santizer M-17<br>Santizer I-H                                                 | Diethyl Phthalate<br>Santizer 141                   | Santizer E-15<br>Santizer M-17<br>Diethyl Phthalate<br>Santizer I-H                                      | Santizer M-17<br>Santizer E-15<br>Diethyl Phthalate                     |
| Santizer B-16<br>Santizer 141<br>Diethyl Phthalate*<br>Diisobutyl Phthalate*<br>Diethyl Adipate                     | Santizer 409<br>Tricresyl Phosphate<br>Santizer 140<br>Santizer 141                         | Santizer 278<br>Santizer 8<br>Santizer M-17<br>Santizer 160<br>Santizer I-H<br>Santizer 262 | Aroclor<br>Diethyl Phthalate<br>Tricresyl Phosphate | Santizer 262<br>Diethyl Phthalate<br>Tricresyl Phosphate<br>Santizer 141<br>Santizer 160<br>Santizer 278 | Diethyl Phthalate<br>Diethyl Phthalate<br>Santizer 141<br>Santizer B-16 |
| Santizer 141<br>Diethyl Phthalate*<br>Diisobutyl Phthalate*<br>Santizer B-16<br>Diethyl Adipate                     | Santizer 409<br>Tricresyl Phosphate<br>Diethyl Phthalate<br>Santizer 140                    | Santizer 409<br>Santizer 8<br>Santizer M-17<br>Diethyl Phthalate                            | Aroclor<br>Diethyl Phthalate<br>Tricresyl Phosphate | Diethyl Phthalate<br>Tricresyl Phosphate<br>Aroclor                                                      | Diethyl Phthalate<br>Diethyl Phthalate<br>Santizer 141<br>Santizer 165  |
| Santizer 141<br>Santizer B-16<br>Diethyl Phthalate*<br>Diisobutyl Phthalate*                                        | Santizer 409<br>Tricresyl Phosphate<br>Diisobutyl Phthalate                                 | Santizer 8<br>Santizer M-17<br>Triphenyl Phosphate                                          | Aroclor<br>Diethyl Phthalate<br>Tricresyl Phosphate | Diethyl Phthalate<br>Diisobutyl Phthalate<br>Santizer 165<br>Santizer 160<br>Santizer 278                | Diethyl Phthalate<br>Diethyl Adipate<br>Di(n-octyl, n-decyl)<br>Adipate |
| Santizer 141<br>Diethyl Phthalate*<br>Santizer B-16<br>Diisobutyl Phthalate*<br>Diethyl Adipate                     | Santizer 409<br>Tricresyl Phosphate                                                         | Santizer M-17<br>Santizer 141<br>Tricresyl Phosphate                                        | Aroclor<br>Diethyl Phthalate<br>Tricresyl Phosphate | Diethyl Phthalate<br>Santizer 141<br>Santizer 165<br>Santizer 160<br>Santizer 278                        | Santizer B-16<br>Diethyl Phthalate<br>Santizer 141                      |
| Santizer 141<br>Santizer B-16<br>Diethyl Phthalate*<br>Diisobutyl Phthalate*                                        | Santizer 409<br>Tricresyl Phosphate<br>Diethyl Phthalate<br>Santizer 141                    | Santizer M-17<br>Tricresyl Phosphate<br>Santizer 140                                        | Aroclor<br>Tricresyl Phosphate<br>Diethyl Phthalate | Diethyl Phthalate<br>Tricresyl Phosphate<br>Santizer 141                                                 | Diisobutyl Phthalate<br>Santizer 165<br>Santizer 141                    |
| Santizer 141<br>Santizer B-16                                                                                       | Santizer 141<br>Santizer 160<br>Santizer 262                                                | Santizer M-17<br>Santizer 8<br>Santizer 160<br>Santizer 262                                 | Tricresyl Phosphate<br>Santizer 160<br>Santizer 262 | Santizer 141<br>Santizer 160<br>Santizer 262                                                             | Santizer 160<br>Santizer 262                                            |
| Santizer 141<br>Santizer B-16                                                                                       | Santizer 8<br>Santizer 9                                                                    | Santizer 8                                                                                  | Santizer 8                                          | Santizer 8<br>Santizer 9                                                                                 |                                                                         |
|                                                                                                                     | Aroclor<br>Tricresyl Phosphate<br>Santizer 141                                              |                                                                                             | Aroclor<br>Tricresyl Phosphate                      | Aroclor                                                                                                  |                                                                         |

0476083

Diphenyl Phthalate  
Aroclor  
Tricresyl Phosphat  
Santicizer 409  
Santicizer 278

Aroclor

Santicizer 9  
Triphenyl Phosphat

Diphenyl Phthalate  
Triphenyl Phosphat

Santicizer 9  
Santicizer 1-H  
Triphenyl Phosphat

Santicizer 9  
Santicizer 1-H  
Diphenyl Phthalate  
Aroclor

Dicyclohexyl Phtha  
Diphenyl Phthalate  
Tricresyl Phosphat  
Santicizer 409

Santicizer 1-H  
Diphenyl Phthalate

Tricresyl Phosphat  
Triphenyl Phosphat  
Diphenyl Phthalate  
Aroclor

Diphenyl Phthalate  
Dicyclohexyl Phtha  
Triphenyl Phosphat  
Santicizer 409

Dicyclohexyl Phtha  
Diphenyl Phthalate

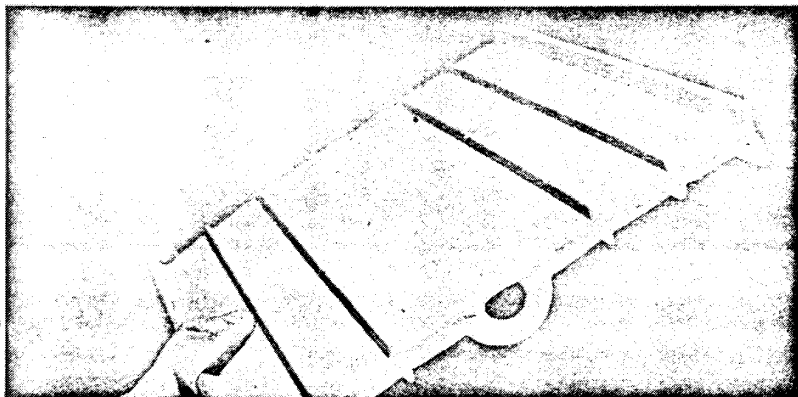
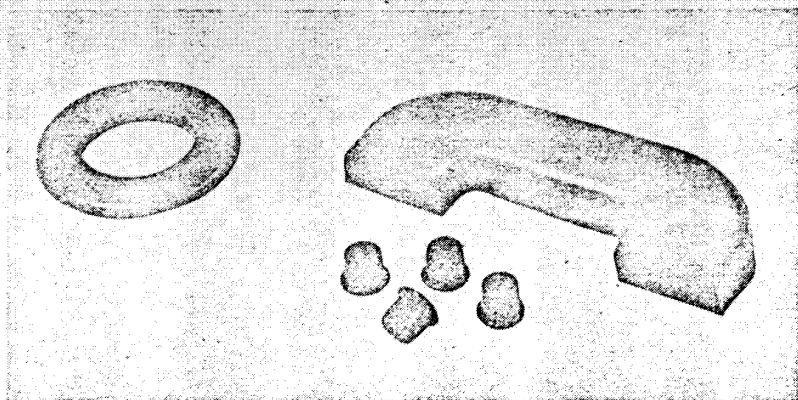
Santicizer 9

Santicizer 9  
Aroclor

● lift flap for chart

| PLASTICIZER                                                                                                     | CHARACTERISTICS                                                                   | REMARKS                                                                 |
|-----------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------|
| Santicizer 8 is the most efficient plasticizer. Santicizer 1-H, Santicizer 9 and Santolite MHP are also useful. | Santicizer 9 useful for improving gloss, flow characteristics, and as a hardener. | Santicizer 9 used for improving flow characteristics and as a hardener. |

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10



## **PLASTICIZER PERFORMANCE IN FILM AND SHEETING**

The following table will assist resin compounders select plasticizers for formulation evaluation on the basis of those properties most critical in the finished film or heavy sheeting. The plasticizers shown provide the optimum effect for each designated property when used with the resin shown. When the same plasticizer appears under two or more of the properties desired in the finished film or sheeting—that plasticizer definitely merits evaluation.

0476086

TOWOLDMON0033056

# PLASTICIZER PERFORMANCE IN FILM AND SHEETING

## PERFORMANCE

### RESIN

### PLASTICIZER

### PLASTICIZER

### PLASTICIZER

### PLASTICIZER

Polyvinyl  
Chloride

Santicizer 278  
Santicizer 160  
Santicizer 141  
Santicizer 140  
Tricresyl Phosphate

Diethyl Adipate  
Di(n-octyl, n-decyl)  
Adipate  
Diisodecyl Adipate

Santicizer 262  
Diphenyl Phthalate  
Santicizer 160  
Santicizer 409  
Tricresyl Phosphate  
Santicizer 278

Santicizer 160  
Santicizer 141  
Diethyl Adipate  
Santicizer 262

Polyvinylidene  
Chloride

Diethyl Phthalate  
Santicizer E-15

Santicizer 141  
Dibutyl Phthalate  
Santicizer B-16

Aroclor

Santicizer 141  
Santicizer B-16

Polyvinyl  
Alcohol

Santicizer 9  
Santicizer 8  
Santicizer M-17

Santicizer M-17  
Santicizer E-15

Santicizer 9  
Santicizer 8  
Santicizer M-17

Santicizer 8  
Santicizer M-17

Polystyrene

Santicizer 160  
Dibutyl Phthalate

Dibutyl Phthalate  
Santicizer 141

Diphenyl Phthalate

Cellulose  
Acetate

Santicizer M-17  
Diethyl Phthalate  
Santicizer E-15

Diethyl Phthalate  
Santicizer 8  
Santicizer M-17

Santicizer 8  
Santicizer 1-H  
Triphenyl Phosphate  
Diphenyl Phthalate

Dimethyl Phthalate  
Diethyl Phthalate  
Santicizer E-15  
Santicizer 8

Cellulose  
Acetate-  
Butyrate

Santicizer 160  
Santicizer 141  
Santicizer E-15  
Santicizer M-17

Santicizer 141  
Diethyl Phthalate  
Dibutyl Phthalate

Triphenyl Phosphate  
Santicizer 8  
Diphenyl Phthalate  
Aroclor

Dibutyl Phthalate  
Tricresyl Phosphate  
Santicizer 140

Cellulose  
Nitrate

Dibutyl Phthalate  
Santicizer 160  
Santicizer 165

Dibutyl Phthalate  
Diethyl Phthalate  
Santicizer 165

Dicyclohexyl Phthalate  
Diphenyl Phthalate  
Tricresyl Phosphate  
Aroclor

Diethyl Phthalate  
Dibutyl Phthalate  
Santicizer 165

Ethyl Cellulose

Santicizer 160  
Dibutyl Phthalate

Diethyl Adipate  
Diisodecyl Adipate  
Di(n-octyl, n-decyl)  
Adipate

Santicizer 1-H  
Diphenyl Phthalate  
Dicyclohexyl Phthalate

Santicizer 8  
Diethyl Phthalate  
Santicizer 160

Styrene-Butadiene  
Rubber (GRS)

Tricresyl Phosphate  
Dibutyl Phthalate  
Aroclor  
Santicizer 160

Diethyl Phthalate  
Diethyl Adipate  
Santicizer 141

Tricresyl Phosphate  
Dibutyl Phthalate

Santicizer 160  
Santicizer 141

Butadiene-  
Acrylonitrile  
Rubber (Buna N)

Santicizer 160  
Tricresyl Phosphate  
Santicizer 141

Diethyl Adipate  
Diisodecyl Adipate  
Di(n-octyl, n-decyl)  
Adipate

Triphenyl Phosphate  
Tricresyl Phosphate  
Diphenyl Phthalate

Santicizer 160  
Santicizer 141  
Santicizer B-16

Polyamide

Santicizer 8 is the most efficient plasticizer. Santicizer 1-H, Santicizer 9 and Santolite MHP are also useful.

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TOWOLDMON0033057

# PERFORMANCE

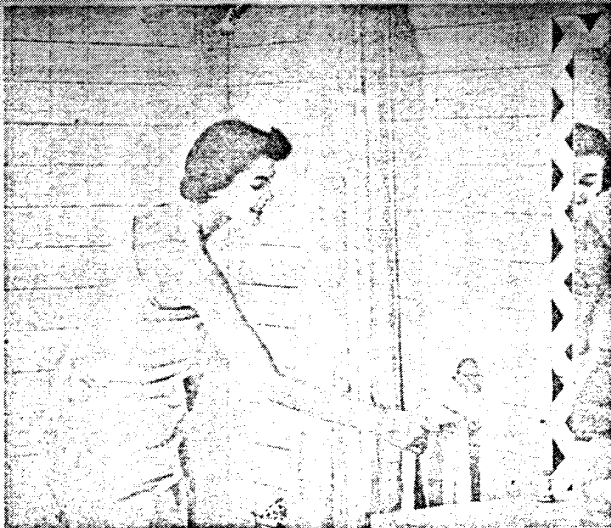
|                                                                                       |                                                                         |                                                                                             |                                                                      |                                                                               |                                                                                                    |
|---------------------------------------------------------------------------------------|-------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|----------------------------------------------------------------------|-------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|
| Diphenyl Phthalate<br>Aroclor<br>Tricresyl Phosphate<br>Santicizer 409                | Tricresyl Phosphate<br>Santicizer 140<br>Santicizer 141<br>Aroclor      | Santicizer 262<br>Santicizer 160<br>Santicizer 141<br>Tricresyl Phosphate<br>Santicizer 278 | Santicizer 262<br>Santicizer 160<br>Santicizer 141<br>Santicizer 278 | Diocetyl Phthalate<br>Diisooctyl Phthalate<br>Santicizer 409                  | Diocetyl Phthalate*<br>Diisooctyl Phthalate<br>Santicizer 141<br>Santicizer B-16<br>Santicizer 160 |
| Aroclor                                                                               | Aroclor<br>Santicizer 141<br>Tricresyl Phosphate                        |                                                                                             |                                                                      | Santicizer B-16<br>Santicizer E-15<br>Diethyl Phthalate                       | Diethyl Phthalate<br>Santicizer E-15<br>Santicizer B-16<br>Santicizer 141                          |
| Santicizer 9<br>Triphenyl Phosphate                                                   | Triphenyl Phosphate<br>Tricresyl Phosphate                              |                                                                                             |                                                                      | Santicizer M-17<br>Santicizer E-15<br>Santicizer B-16                         | Santicizer E-15<br>Santicizer B-16                                                                 |
| Diphenyl Phthalate<br>Triphenyl Phosphate                                             | Aroclor<br>Tricresyl Phosphate<br>Santicizer 141                        |                                                                                             |                                                                      | Dibutyl Phthalate<br>Santicizer 160                                           | Santicizer 141<br>Santicizer B-16<br>Santicizer E-15<br>Diethyl Phthalate                          |
| Santicizer 9<br>Santicizer 1-H<br>Triphenyl Phosphate                                 | Triphenyl Phosphate<br>Santicizer 141<br>Santicizer 140                 | Triphenyl Phosphate<br>Diethyl Phthalate                                                    |                                                                      | Santicizer M-17<br>Santicizer E-15<br>Diethyl Phthalate<br>Dimethyl Phthalate | Santicizer E-15<br>Diethyl Phthalate<br>Santicizer 141                                             |
| Santicizer 9<br>Santicizer 1-H<br>Diphenyl Phthalate<br>Aroclor                       | Santicizer 141<br>Tricresyl Phosphate<br>Triphenyl Phosphate<br>Aroclor | Triphenyl Phosphate<br>Diphenyl Phthalate<br>Santicizer 160                                 |                                                                      | Santicizer M-17<br>Santicizer 409<br>Santicizer B-16<br>Diocetyl Phthalate    | Santicizer B-16<br>Santicizer 141<br>Diocetyl Phthalate*<br>Diisooctyl Phthalate                   |
| Dicyclohexyl Phthalate<br>Diphenyl Phthalate<br>Tricresyl Phosphate<br>Santicizer 409 | Aroclor<br>Tricresyl Phosphate<br>Santicizer 140<br>Santicizer 141      | Diphenyl Phthalate<br>Dicyclohexyl Phthalate<br>Santicizer 160                              | Santicizer 160<br>Dibutyl Phthalate                                  | Diocetyl Phthalate<br>Santicizer 165<br>Santicizer 160<br>Dibutyl Phthalate   | Santicizer 141<br>Diocetyl Phthalate*<br>Diisooctyl Phthalate<br>Santicizer B-16                   |
| Santicizer 1-H<br>Diphenyl Phthalate                                                  | Tricresyl Phosphate<br>Santicizer 140<br>Santicizer 141<br>Aroclor      |                                                                                             |                                                                      | Diocetyl Adipate<br>Di(n-octyl, n-decyl)<br>Adipate<br>Diocetyl Phthalate     | Santicizer 141<br>Santicizer B-16<br>Diocetyl Phthalate*<br>Diisooctyl Phthalate                   |
| Tricresyl Phosphate<br>Triphenyl Phosphate<br>Diphenyl Phthalate<br>Aroclor           | Tricresyl Phosphate<br>Triphenyl Phosphate<br>Santicizer 141<br>Aroclor |                                                                                             |                                                                      | Diocetyl Phthalate<br>Santicizer 160                                          | Santicizer 141<br>Diocetyl Phthalate*<br>Santicizer B-16<br>Diisooctyl Phthalate                   |
| Diphenyl Phthalate<br>Dicyclohexyl Phthalate<br>Triphenyl Phosphate<br>Santicizer 409 | Tricresyl Phosphate<br>Santicizer 140<br>Santicizer 141<br>Aroclor      |                                                                                             |                                                                      | Diocetyl Phthalate<br>Santicizer B-16<br>Santicizer 409                       | Santicizer 141<br>Santicizer B-16<br>Diocetyl Phthalate*<br>Diisooctyl Phthalate                   |

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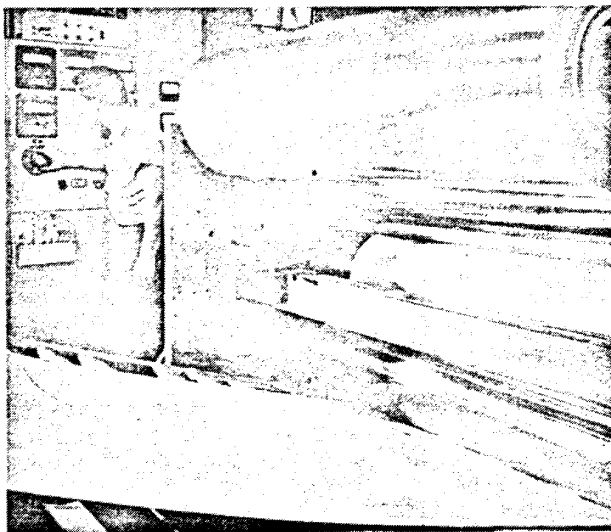
TOWOLDMON0033058

## P E R M A N E N C E

|                                                                                                     |                                                                                                                                       |                                                                                                                                 |                                                      |                                                                                                             |                                                                              |
|-----------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|
| Diocetyl Phthalate*<br>Diisooctyl Phthalate*<br>Santicizer 141<br>Santicizer B-16<br>Santicizer 160 | Santicizer 278<br>Santicizer 409<br>Santicizer 262<br>Tricresyl Phosphate<br>Diisodecyl Phthalate<br>Santicizer 406<br>Santicizer 411 | Santicizer 278<br>Santicizer 409<br>Tricresyl Phosphate<br>Santicizer 160<br>Santicizer 406<br>Santicizer 411<br>Santicizer 262 | Aroclor<br>Diocetyl Phthalate<br>Tricresyl Phosphate | Santicizer 262<br>Diisodecyl Phthalate<br>Santicizer 409<br>Diocetyl Phthalate<br>Aroclor<br>Santicizer 406 | Diocetyl Phthalate<br>Diisodecyl Phthalate<br>Santicizer 141                 |
| Diethyl Phthalate<br>Santicizer E-15<br>Santicizer B-16<br>Santicizer 141                           | Santicizer 141<br>Santicizer B-16                                                                                                     | Santicizer M-17<br>Santicizer E-15                                                                                              | Aroclor                                              | Santicizer 141<br>Aroclor                                                                                   | Santicizer B-16<br>Santicizer E-15<br>Santicizer M-17<br>Santicizer 141      |
| Santicizer E-15<br>Santicizer B-16                                                                  | Santicizer E-15<br>Santicizer B-16<br>Triphenyl Phosphate                                                                             | Santicizer 8<br>Santicizer M-17<br>Triphenyl Phosphate                                                                          | Tricresyl Phosphate<br>Santicizer B-16               | Santicizer 8<br>Santicizer M-17                                                                             | Santicizer M-17<br>Santicizer B-16<br>Santicizer E-15                        |
| Santicizer 141<br>Santicizer B-16<br>Santicizer E-15<br>Diethyl Phthalate                           | Tricresyl Phosphate<br>Santicizer 141<br>Santicizer 160                                                                               | Santicizer M-17<br>Santicizer E-15                                                                                              | Aroclor<br>Tricresyl Phosphate                       | Tricresyl Phosphate<br>Santicizer 141                                                                       | Santicizer B-16<br>Dibutyl Phthalate                                         |
| Santicizer E-15<br>Diethyl Phthalate<br>Santicizer 141                                              | Santicizer 141<br>Triphenyl Phosphate<br>Santicizer E-15<br>Santicizer 8                                                              | Santicizer 8<br>Santicizer M-17<br>Santicizer I-H                                                                               | Diethyl Phthalate<br>Santicizer 141                  | Santicizer E-15<br>Santicizer M-17<br>Diethyl Phthalate<br>Santicizer I-H                                   | Santicizer M-17<br>Santicizer E-15<br>Diethyl Phthalate                      |
| Santicizer B-16<br>Santicizer 141<br>Diocetyl Phthalate*<br>Diisooctyl Phthalate*                   | Santicizer 409<br>Tricresyl Phosphate<br>Santicizer 140<br>Santicizer 141                                                             | Santicizer 8<br>Santicizer M-17<br>Santicizer 160<br>Santicizer I-H                                                             | Aroclor<br>Diocetyl Phthalate<br>Tricresyl Phosphate | Diocetyl Phthalate<br>Tricresyl Phosphate<br>Santicizer 141<br>Santicizer 160                               | Diocetyl Phthalate<br>Dibutyl Phthalate<br>Santicizer 141<br>Santicizer B-16 |
| Santicizer 141<br>Diocetyl Phthalate*<br>Diisooctyl Phthalate*<br>Santicizer B-16                   | Santicizer 409<br>Tricresyl Phosphate<br>Diocetyl Phthalate<br>Santicizer 140<br>Santicizer 411                                       | Santicizer 409<br>Santicizer 8<br>Santicizer M-17<br>Diethyl Phthalate<br>Santicizer 411                                        | Aroclor<br>Diocetyl Phthalate<br>Tricresyl Phosphate | Diocetyl Phthalate<br>Tricresyl Phosphate<br>Aroclor                                                        | Diocetyl Phthalate<br>Dibutyl Phthalate<br>Santicizer 141<br>Santicizer 165  |
| Santicizer 141<br>Santicizer B-16<br>Diocetyl Phthalate*<br>Diisooctyl Phthalate*                   | Santicizer 409<br>Tricresyl Phosphate<br>Diisodecyl Phthalate<br>Santicizer 411                                                       | Santicizer 8<br>Santicizer M-17<br>Triphenyl Phosphate                                                                          | Aroclor<br>Diocetyl Phthalate<br>Tricresyl Phosphate | Diocetyl Phthalate<br>Diisodecyl Phthalate<br>Santicizer 165<br>Santicizer 160                              | Diocetyl Phthalate<br>Diocetyl Adipate<br>Di(n-octyl, n-decyl)<br>Adipate    |
| Santicizer 141<br>Diocetyl Phthalate*<br>Santicizer B-16<br>Diisooctyl Phthalate*                   | Santicizer 409<br>Tricresyl Phosphate                                                                                                 | Santicizer M-17<br>Santicizer 141<br>Tricresyl Phosphate                                                                        | Aroclor<br>Diocetyl Phthalate<br>Tricresyl Phosphate | Diocetyl Phthalate<br>Santicizer 141<br>Santicizer 165<br>Santicizer 160                                    | Santicizer B-16<br>Diocetyl Phthalate<br>Santicizer 141                      |
| Santicizer 141<br>Santicizer B-16<br>Diocetyl Phthalate*<br>Diisooctyl Phthalate*                   | Santicizer 409<br>Tricresyl Phosphate<br>Diocetyl Phthalate<br>Santicizer 141                                                         | Santicizer M-17<br>Tricresyl Phosphate<br>Santicizer 140                                                                        | Aroclor<br>Tricresyl Phosphate<br>Diocetyl Phthalate | Diocetyl Phthalate<br>Tricresyl Phosphate<br>Santicizer 141                                                 | Diocetyl Phthalate<br>Santicizer 165<br>Santicizer 141                       |

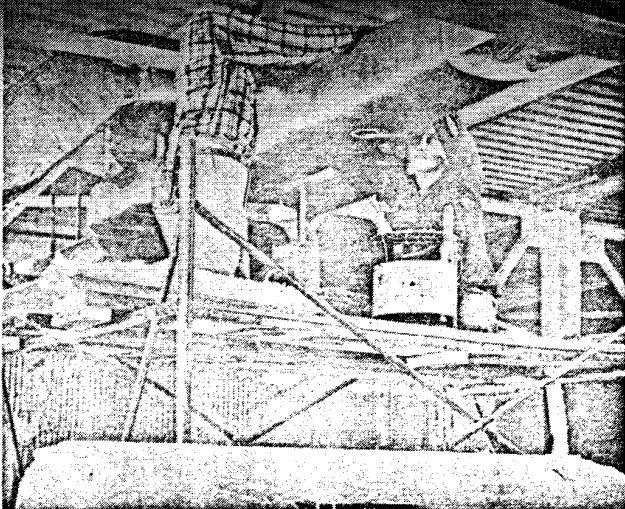


Diisodecyl Phthalate is widely used in shower curtains, baby pants, and similar articles because of its superior resistance to hot soapy water.



Santicizer 160 is unrivaled for rapid processing on the calender and for high tear-strength.

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## **PLASTICIZER PERFORMANCE IN ADHESIVES**

The following table will assist formulators of adhesives select plasticizers for evaluation on the basis of those properties most critical in the finished formulation. The plasticizers shown provide the optimum effect for each property when used with the particular resin shown. When the same plasticizer appears under two or more of the desired properties important to the finished adhesive—that plasticizer definitely merits evaluation.

0476091

**PLASTICIZER  
PERFORMANCE  
IN ADHESIVES**

**P E R F O R M A N C E**

**RESIN**

13.1

13.2

13.3

13.4

|                                                |                                                                                       |                                                                          |                                                                                               |                                                                                      |
|------------------------------------------------|---------------------------------------------------------------------------------------|--------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| Cellulose Nitrate                              | Triphenyl Phosphate<br>Santicizer 1-H<br>Santicizer 160<br>Diphenyl Phthalate         | Santicizer 8<br>Santicizer 160<br>Tricresyl Phosphate<br>Santicizer 165  | Dibutyl Phthalate<br>Santicizer 165<br>Santicizer 9<br>Triphenyl Phosphate                    | Aroclor<br>Santolite MHP<br>Santicizer 8<br>Santicizer B-16                          |
| Cellulose Acetate                              | Santicizer 1-H<br>Santicizer 8<br>Santicizer M-17<br>Santolite MHP                    | Santicizer 8<br>Diethyl Phthalate<br>Santicizer E-15                     | Triphenyl Phosphate<br>Santicizer 8<br>Santicizer E-15                                        | Santicizer 8<br>Santicizer M-17<br>Santolite MHP<br>Santolite MS-80%                 |
| Cellulose Acetate-Butyrate                     | Santicizer 1-H<br>Santicizer 8<br>Santicizer M-17<br>Dicyclohexyl Phthalate           | Santicizer 8<br>Diethyl Phthalate<br>Santicizer E-15                     | Triphenyl Phosphate<br>Santicizer 140<br>Santicizer 8                                         | Santicizer 8<br>Santicizer M-17<br>Santolite MHP<br>Aroclor                          |
| Cellulose Propionate                           | Santicizer 1-H<br>Santicizer 8<br>Santicizer M-17                                     | Santicizer 8<br>Diethyl Phthalate<br>Santicizer E-15                     | Triphenyl Phosphate<br>Santicizer 140<br>Santicizer 8                                         | Santicizer 8<br>Santicizer M-17<br>Santolite MHP<br>Santolite MS-80%                 |
| Ethyl Cellulose                                | Santicizer 1-H<br>Santolite MHP<br>Diphenyl Phthalate<br>Dicyclohexyl Phthalate       | Santicizer 9<br>Diphenyl Phthalate<br>Santicizer 8<br>Santicizer M-17    | Santicizer M-17<br>Diphenyl Phthalate<br>Santicizer 8                                         | Santicizer 8<br>Santicizer 9<br>Santolite MHP<br>Aroclor                             |
| Acrylic                                        | Dicyclohexyl Phthalate<br>Santicizer 1-H<br>Diphenyl Phthalate                        | Santicizer 160<br>Santicizer 141<br>Santicizer B-16                      | Santicizer 160<br>Santicizer B-16                                                             | Santicizer 8<br>Santolite MHP<br>Santicizer 160                                      |
| Polystyrene                                    | Diphenyl Phthalate<br>Santicizer 9<br>Santolite MHP<br>Aroclor                        | Santicizer B-16<br>Santicizer 160                                        | Santicizer 141<br>Santicizer 160<br>Santicizer B-16                                           | Santicizer 8<br>Santicizer 9<br>Santolite MHP<br>Aroclor                             |
| Polyvinyl Chloride                             | Diphenyl Phthalate<br>Dicyclohexyl Phthalate<br>Tricresyl Phosphate<br>Santicizer 160 | Santicizer 160<br>Santicizer 141<br>Di(n-octyl, n-decyl)<br>Adipate      | Di(n-octyl, n-decyl)<br>Adipate<br>Diisodecyl Adipate                                         | Santicizer 160<br>Aroclor<br>Santolite MHP                                           |
| Polyvinyl Butyral                              | Diphenyl Phthalate<br>Dicyclohexyl Phthalate<br>Tricresyl Phosphate<br>Santicizer 140 | Santicizer 160<br>Santicizer 141                                         | Santicizer 141<br>Santicizer 160<br>Santicizer B-16                                           | Santicizer 160<br>Santicizer B-16                                                    |
| Polyvinyl Acetate                              | Aroclor<br>Tricresyl Phosphate<br>Santicizer B-16<br>Santicizer 160                   | Santicizer 8<br>Tricresyl Phosphate<br>Santicizer B-16<br>Santicizer 160 | Santicizer 8<br>Triphenyl Phosphate<br>Santicizer B-16<br>Dibutyl Phthalate<br>Santicizer 160 | Santicizer 8<br>Aroclor<br>Diethyl Phthalate<br>Dimethyl Phthalate<br>Santicizer 160 |
| Polyvinyl Alcohol                              | Santicizer 8<br>Santicizer 9<br>Santicizer M-17                                       | Santicizer 8<br>Santicizer M-17                                          | Santicizer M-17<br>Santicizer E-15                                                            | Santicizer 9                                                                         |
| Polyvinylidene Chloride                        | Aroclor<br>Santicizer 160                                                             | Santicizer B-16<br>Santicizer 160                                        | Dibutyl Phthalate<br>Santicizer 160                                                           | Aroclor                                                                              |
| Epoxy                                          | Aroclor<br>Mod-Epoxy<br>Santicizer 8                                                  | Santicizer B-16                                                          | Santicizer B-16                                                                               | Mod-Epoxy<br>Aroclor                                                                 |
| Chlorinated-Rubber (Parlon)                    | Triphenyl Phosphate<br>Santicizer 140<br>Aroclor                                      | Dibutyl Phthalate<br>Santicizer 141<br>Santicizer 160                    | Santicizer B-16<br>Dibutyl Phthalate<br>Santicizer 141<br>Tricresyl Phosphate                 | Aroclor<br>Santicizer 160<br>Triphenyl Phosphate<br>Tricresyl Phosphate              |
| Styrene-Butadiene Rubber (Pliolite and Marbon) | Tricresyl Phosphate<br>Aroclor<br>Dibutyl Phthalate                                   | Santicizer M-17<br>Santicizer 160<br>Santicizer 141                      | Santicizer 160<br>Santicizer 141<br>Santicizer B-16                                           | Aroclor<br>Tricresyl Phosphate<br>Triphenyl Phosphate                                |
| Casein, Zein                                   | Santicizer 9                                                                          | Santicizer 8                                                             | Santicizer 8                                                                                  | Santicizer 8<br>Santicizer 9                                                         |

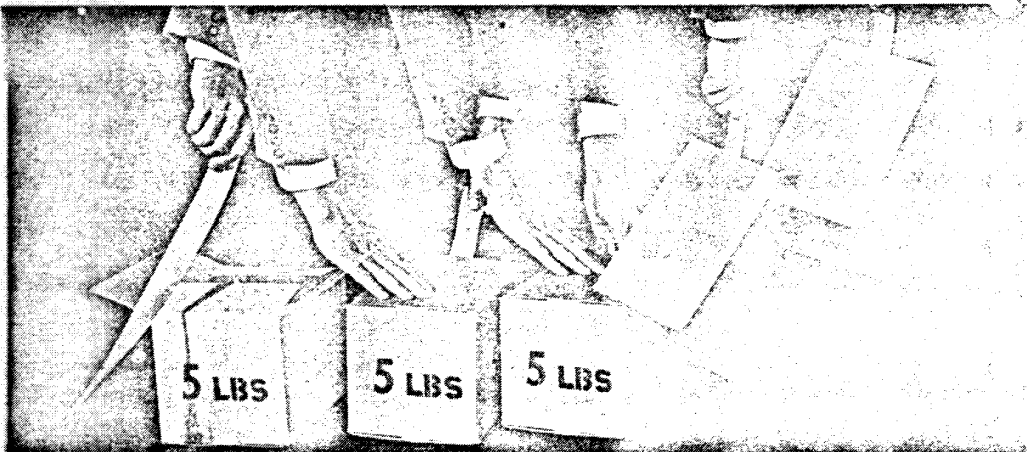
0476092

TOWOLDMON0033062

## P E R M A N E N C E

| FOUR REGULATED                                                                              | CHEMICAL RESISTANCE                                                   | SOLVENT/RESIN RESISTANCE                                                   | WATER RESISTANCE                                                         | LOW VOLATILE                                                                       |
|---------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|----------------------------------------------------------------------------|--------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| Santicizer E-15<br>Santicizer B-16<br>Santicizer 141<br>Diocetyl Phthalate*                 | Aroclor<br>Tricresyl Phosphate<br>Diocetyl Phthalate                  | Santicizer 160<br>Tricresyl Phosphate<br>Santicizer 8<br>Santicizer M-17   | Diocetyl Phthalate<br>Santicizer 160<br>Santicizer 141<br>Aroclor        | Tricresyl Phosphate<br>Santicizer 140<br>Santicizer 141<br>Diocetyl Phthalate      |
| Santicizer E-15<br>Diethyl Phthalate<br>Santicizer 141                                      | Diethyl Phthalate                                                     | Santicizer M-17<br>Santicizer E-15<br>Santicizer 8<br>Santolite MHP        | Santicizer 8<br>Santicizer M-17                                          | Santicizer 8<br>Santicizer M-17<br>Santicizer E-15                                 |
| Santicizer E-15<br>Santicizer B-16<br>Santicizer 141<br>Diocetyl Phthalate*                 | Aroclor<br>Diocetyl Phthalate<br>Tricresyl Phosphate                  | Santicizer M-17<br>Santicizer 8<br>Triphenyl Phosphate<br>Santicizer 409   | Santicizer 140<br>Santicizer 8<br>Santicizer M-17                        | Santicizer 140<br>Tricresyl Phosphate<br>Santicizer 409                            |
| Santicizer E-15<br>Diethyl Phthalate                                                        | Santicizer 140<br>Diethyl Phthalate                                   | Santicizer 8<br>Santicizer M-17<br>Triphenyl Phosphate                     | Santicizer 140<br>Santicizer 8<br>Santicizer M-17                        | Santicizer 140<br>Santicizer 8<br>Santicizer M-17                                  |
| Santicizer B-16<br>Santicizer E-15<br>Santicizer 141<br>Diocetyl Phthalate*                 | Aroclor<br>Diocetyl Phthalate<br>Tricresyl Phosphate                  | Santicizer M-17<br>Santicizer E-15<br>Triphenyl Phosphate<br>Santicizer 8  | Diocetyl Phthalate<br>Santicizer 409<br>Diisooctyl Phthalate             | Tricresyl Phosphate<br>Diocetyl Phthalate<br>Santicizer 409<br>Santicizer 141      |
| Santicizer B-16<br>Santicizer 141                                                           | Tricresyl Phosphate<br>Santicizer 160                                 | Santicizer M-17<br>Santicizer 8<br>Santicizer 160                          | Santicizer 160<br>Santicizer 141                                         | Santicizer 141<br>Santicizer 160                                                   |
| Santicizer 141<br>Santicizer B-16                                                           | Aroclor<br>Santicizer 141                                             | Santicizer 9<br>Santicizer 160                                             | Diphenyl Phthalate<br>Dicyclohexyl Phthalate<br>Santicizer 160           | Santicizer 141<br>Diphenyl Phthalate                                               |
| Santicizer 141<br>Santicizer B-16<br>Diocetyl Phthalate*<br>Diisooctyl Phthalate*           | Aroclor<br>Diocetyl Phthalate<br>Tricresyl Phosphate                  | Santicizer 160<br>Tricresyl Phosphate<br>Santicizer 409                    | Diisodecyl Phthalate<br>Santicizer 409<br>Diocetyl Phthalate             | Santicizer 409<br>Diisodecyl Phthalate<br>Tricresyl Phosphate<br>Santicizer 140    |
| Santicizer B-16<br>Santicizer 141                                                           | Tricresyl Phosphate<br>Santicizer 160                                 | Tricresyl Phosphate<br>Santicizer 140<br>Santicizer B-16<br>Santicizer 141 | Santicizer 141<br>Santicizer 160<br>Tricresyl Phosphate                  | Tricresyl Phosphate<br>Santicizer 141<br>Santicizer 140<br>Santicizer 160          |
| Diethyl Phthalate<br>Santicizer B-16<br>Santicizer E-15<br>Santicizer 141<br>Santicizer 160 | Aroclor<br>Tricresyl Phosphate<br>Diethyl Phthalate<br>Santicizer 160 | Santicizer 8<br>Santicizer M-17<br>Triphenyl Phosphate<br>Santicizer 160   | Santicizer 8<br>Santicizer B-16<br>Triphenyl Phosphate<br>Santicizer 160 | Tricresyl Phosphate<br>Santicizer 141<br>Diphenyl Phthalate<br>Triphenyl Phosphate |
| Santicizer E-15                                                                             | Santicizer E-15                                                       | Santicizer 8<br>Santicizer M-17                                            | Santicizer 8<br>Santicizer M-17                                          | Santicizer B-16<br>Triphenyl Phosphate<br>Tricresyl Phosphate                      |
| Diethyl Phthalate<br>Santicizer E-15<br>Santicizer B-16<br>Santicizer 141                   | Aroclor<br>Santicizer 141                                             | Santicizer M-17<br>Santicizer E-15<br>Santicizer 141                       | Aroclor<br>Santicizer 141                                                | Tricresyl Phosphate<br>Santicizer 141<br>Santicizer B-16                           |
| Santicizer B-16<br>Santicizer E-15                                                          | Mod-Epoxy<br>Aroclor                                                  | Tricresyl Phosphate<br>Santicizer E-15<br>Mod-Epoxy                        | Mod-Epoxy<br>Aroclor                                                     | Mod-Epoxy<br>Aroclor<br>Santicizer 8                                               |
| Santicizer 141<br>Santicizer B-16                                                           | Aroclor<br>Tricresyl Phosphate<br>Santicizer 141                      | Aroclor<br>Santicizer M-17<br>Tricresyl Phosphate<br>Santicizer 141        | Tricresyl Phosphate<br>Santicizer 140<br>Aroclor<br>Santicizer 141       | Aroclor<br>Tricresyl Phosphate<br>Santicizer 140<br>Santicizer 141                 |
| Santicizer B-16<br>Santicizer 141                                                           | Aroclor<br>Tricresyl Phosphate                                        | Santicizer M-17<br>Santicizer 140<br>Aroclor                               | Tricresyl Phosphate<br>Santicizer 141<br>Santicizer B-16                 | Tricresyl Phosphate<br>Santicizer 140<br>Santicizer 141<br>Aroclor                 |
|                                                                                             | Santicizer 8                                                          | Santicizer 8                                                               | Santicizer 8<br>Santicizer 9                                             | Santicizer 8<br>Santicizer 9                                                       |

0476093



Diethyl Phthalate imparts quick tack to polyvinyl acetate—emulsion adhesives, including nontoxic ones.

**POLYAMIDES**

Santicizer 8 imparts additional flexibility; compositions containing it maintain high tensile strength, good abrasion and oil resistance. Santicizer 1H, Santicizer 9 and Santolite HHP also impart a plasticizing action with specific values for compositions in particular applications.

**MELAMINE -  
FORMALDEHYDE**

Santicizer 9 improves solution and color stability, flow, and adhesion.

**PHENOL -  
FORMALDEHYDE**

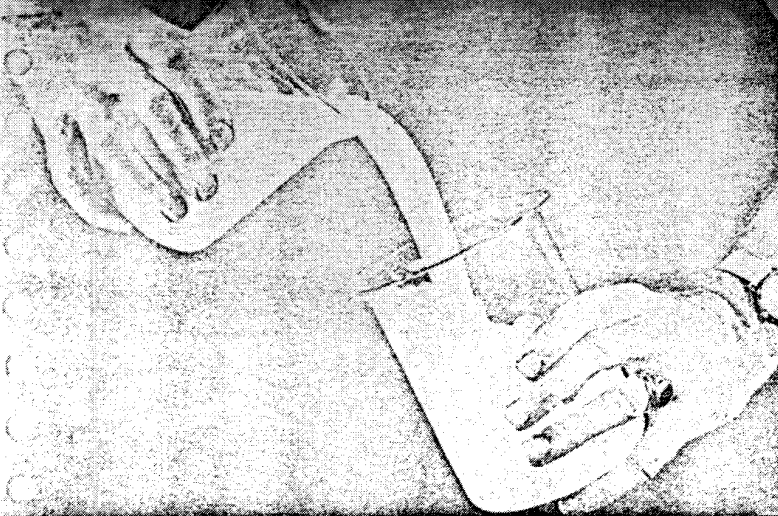
Santicizer 8 and Santicizer 9 improve flow characteristics.

**UREA -  
FORMALDEHYDE**

Santicizer 9 improves flow and acts as a hardening agent.

12

047609A



## **PLASTICIZER PERFORMANCE IN PLASTISOL FORMULATIONS (65 PHR)**

In formulating plastisols for various kinds of coatings, slush molding, rotational casting—the selection of the plasticizer system is critical. Storage life, speed of cure, the hardness and tensile strength of the cured compound can all be developed to the optimum values through selection of the right plasticizer or plasticizer blend.

The following chart shows, for quick comparison purposes, the characteristics of a "standard" 65 PHR plastisol formulated with the various Monsanto plasticizers, using Opalon® 410 resin without stabilizer. These values can be used as a guide to the performance of a particular-type plasticizer. However, closer values to the particular property most important to you may be obtainable by a blended plasticizer system...which can be recommended to you by Monsanto's Plasticizer Council.

0476095

Viscosity, centipoises  
Brookfield HAT #6 Spindle  
50 RPM

23°C  
Initial  
7 Days  
28 Days

7,700  
10,700  
13,000

9,600  
12,700  
12,000

8,200  
11,700  
10,900

3,600  
5,400  
6,000

14,000  
17,000  
26,500

2,400  
4,400  
5,100

3,500  
7,700  
8,900

6,200  
9,900  
8,500

13,000(4):  
16,000(4):  
18,000(5):

164,000(7):  
198,000(7):  
292,000(7):

40°C  
Initial  
7 Days  
28 Days

5,000  
11,800  
13,300

6,200  
9,300  
9,600

6,000  
10,900  
14,100

3,200  
6,200  
7,800

10,400  
170,900  
Gel

1,900  
7,800  
13,000

3,400  
17,600  
37,800

4,000  
6,200  
6,600

7,400(4):  
17,500(4):  
20,600(5):

36,000(6):  
62,000(6):  
84,000(6):

50°C  
Initial  
7 Days  
28 Days

4,500  
20,600  
32,300

5,500  
11,300  
11,700

6,200  
20,400  
33,100

2,800  
12,500  
15,400

20,000  
Gel  
—

2,200  
17,300  
Gel

9,100  
Gel  
—

3,700  
7,000  
7,500

7,700(4):  
74,000(6):  
258,000(7):

22,000(6):  
69,000(6):  
111,000(7):

Seve's, centipoises  
10 psi  
50 psi  
100 psi

9,200  
7,600  
5,900

10,500  
8,000  
6,300

8,800  
8,000  
6,000

3,300  
3,100  
2,400

20,900  
31,400  
29,000

4,800  
4,900  
4,000

5,500  
6,300  
5,200

8,200  
6,800  
5,100

22,000  
22,700  
16,600

304,000  
249,000  
145,000

\*Flow Index

1.0  
0.8  
1.0  
0.9  
2.2  
2.0  
1.8  
1.1  
1.7  
1.5

Yield Value, dynes/cm<sup>2</sup>

64  
465  
370  
100  
32  
40  
16  
255  
95  
9

Fusion Point, °C

127  
138  
127  
—  
89  
119  
105  
146  
90  
122

\*\*\*Air-Release Time, minutes

9  
11  
10  
—  
30  
20  
14  
7  
—  
—

\*\*\*Resilience, inches rebound  
(Standard steel ball dropped 40"  
onto 0.5" thick specimen @ 23°C)

4.5  
5.4  
4.6  
—  
2.8  
5.1  
4.4  
6.4  
—  
—

\*\*\*Ball Resilience, inches rebound  
(4" vinyl ball dropped 90"  
to constant-hardness surface)

18  
18  
—  
—  
15  
—  
—  
20  
—  
—

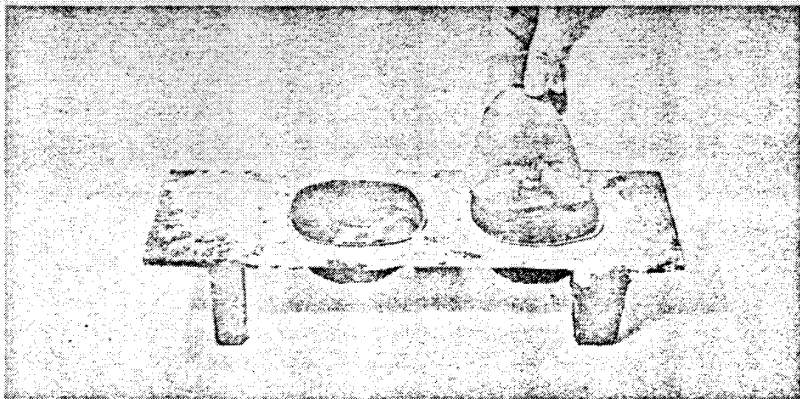
0476096

TOWOLDMON0033066

|                           |                           |                           |                           |                           |                             |                              |                           |                          |                         |                            |                            |                            |                             |
|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|-----------------------------|------------------------------|---------------------------|--------------------------|-------------------------|----------------------------|----------------------------|----------------------------|-----------------------------|
| 8,200<br>12,500<br>11,400 | 6,100<br>9,100<br>10,100  | 9,100<br>10,600<br>12,300 | 9,000<br>10,900<br>12,000 | 3,440<br>4,480<br>4,400   | 24,000<br>27,500<br>33,600  | 30,800<br>38,600<br>42,900   | 5,600<br>11,200<br>15,400 | 4,400<br>5,200<br>6,400  | 5,000<br>5,600<br>5,600 | 2,300<br>3,000<br>3,400    | 10,300<br>16,300<br>23,000 | 97,000<br>93,000<br>92,600 | 84,600<br>73,000<br>63,400  |
| 5,800<br>9,600<br>10,900  | 4,700<br>11,100<br>14,500 | 6,400<br>11,400<br>13,300 | 6,400<br>11,300<br>13,800 | 3,080<br>4,600<br>6,000   | 15,000<br>54,400<br>103,200 | 19,200<br>78,600<br>Gel      | 7,100<br>250,900<br>Gel   | 3,800<br>6,000<br>6,600  | 4,000<br>4,000<br>4,200 | 2,100<br>4,000<br>4,600    | 9,600<br>159,200<br>Gel    | 42,400<br>41,000<br>40,000 | 33,000<br>30,400<br>32,200  |
| 5,200<br>14,100<br>17,300 | 5,200<br>32,600<br>69,400 | 6,100<br>21,400<br>39,200 | 6,100<br>26,600<br>44,000 | 3,160<br>10,120<br>18,800 | 20,200<br>Gel<br>—          | 25,600<br>Gel<br>—           | 15,900<br>Gel<br>—        | 4,200<br>8,100<br>12,000 | 3,300<br>5,200<br>5,600 | 2,700<br>5,200<br>6,200    | 26,100<br>Gel<br>—         | 35,200<br>32,000<br>39,800 | 31,200<br>17,200<br>27,600  |
| 11,400<br>9,500<br>7,600  | 7,500<br>6,300<br>5,100   | 11,100<br>9,300<br>6,400  | 9,700<br>8,100<br>6,200   | 6,130<br>6,280<br>4,630   | 40,000<br>72,700<br>73,600  | 53,300<br>119,100<br>139,900 | 5,800<br>6,400<br>5,800   | 1,000<br>900<br>700      | 2,500<br>2,000<br>1,500 | 15,100<br>14,000<br>11,700 | 16,500<br>21,400<br>18,200 | 98,500<br>85,000<br>80,500 | 105,000<br>77,000<br>72,500 |
| 1.2                       | 1.0                       | 1.0                       | 0.9                       | 1.8                       | 3.0                         | 3.9                          | 1.1                       | 0.2                      | 0.4                     | 6.1                        | 2.1                        | 0.9                        | 0.9                         |
| 240                       | 80                        | 320                       | 464                       | 90                        | 224                         | 440                          | 72                        | 705                      | 640                     | 240                        | 48                         | 160                        | 320                         |
| 132                       | 129                       | 132                       | 130                       | 132                       | 92                          | 100                          | 105                       | 139                      | 156                     | 148                        | 100                        | —                          | —                           |
| 10                        | 18                        | 6                         | 6                         | 10                        | 25                          | 24                           | 15                        | 7                        | 7                       | 7                          | —                          | —                          | —                           |
| 5                         | 5.1                       | 4.5                       | 4.5                       | 4.9                       | 1.7                         | 2.7                          | 5.8                       | 10.9                     | 10.4                    | 9.2                        | —                          | —                          | —                           |
| —                         | —                         | —                         | —                         | —                         | —                           | —                            | 27                        | 34                       | 26                      | —                          | —                          | —                          | —                           |

|        |        |         |        |         |         |        |         |         |        |          |          |          |  |
|--------|--------|---------|--------|---------|---------|--------|---------|---------|--------|----------|----------|----------|--|
| 10,300 | 97,000 | 84,600  | 31,400 | 113,600 | 9,900   | 22,900 | 113,600 | 185,000 | 6,000  | 3,500    | 7,500    | 12,000   |  |
| 16,300 | 93,000 | 73,000  | 20,200 | 99,400  | 11,900  | 28,800 | 117,600 | 178,000 | 11,400 | 4,500    | 10,000   | 20,000   |  |
| 23,000 | 92,600 | 63,400  | 24,600 | 82,400  | 11,800  | 29,600 | 136,000 | 216,000 | 14,500 | 4,700    | 20,000   | 35,000   |  |
| 9,600  | 42,400 | 33,000  | 15,200 | 32,800  | 5,200   | 12,800 | 44,000  | 90,800  | 6,600  | 3,000    | 6,000    | 8,000    |  |
| 59,200 | 41,000 | 30,400  | 21,200 | 27,200  | 12,600  | 17,100 | 54,000  | 67,200  | 13,200 | 4,900    | 12,000   | 16,000   |  |
| Gel    | 40,000 | 32,200  | 15,100 | 20,800  | 10,800  | 20,200 | 48,000  | 72,900  | 14,200 | 6,000    | 35,000   | 42,000   |  |
| 26,100 | 35,200 | 31,200  | 11,000 | 27,000  | 4,600   | 11,200 | 313,600 | 44,600  | 6,400  | 2,900    | 10,000   | 20,000   |  |
| Gel    | 32,000 | 17,200  | 13,800 | 23,000  | 112,100 | 17,800 | 37,200  | 45,500  | 17,800 | 30,000   | >100,000 | >100,000 |  |
| —      | 39,800 | 27,600  | 11,800 | 27,800  | 10,100  | 21,000 | 36,900  | 54,600  | 21,400 | >100,000 | Gel      | Gel      |  |
| 16,500 | 98,500 | 105,000 | 31,110 | 114,000 | 38,800  | —      | —       | —       | —      | 6,300    | —        | —        |  |
| 21,400 | 85,000 | 77,000  | 29,460 | 85,000  | 49,400  | —      | —       | —       | —      | 6,750    | —        | —        |  |
| 18,200 | 80,500 | 72,500  | 27,300 | 74,000  | 40,800  | —      | —       | —       | —      | 4,800    | —        | —        |  |
| 2.1    | 0.9    | 0.9     | 0.8    | 0.7     | 1.5     | —      | —       | —       | —      | 2.3      | —        | —        |  |
| 48     | 160    | 320     | 160    | 640     | 40      | 120    | 0       | 0       | 80     | 60       | —        | —        |  |
| 100    | —      | —       | 148    | —       | —       | —      | —       | —       | —      | 135      | —        | —        |  |
| —      | —      | —       | 60     | —       | —       | —      | —       | —       | —      | 6        | 4        | —        |  |
| —      | —      | —       | 3.1    | —       | —       | —      | —       | —       | —      | 4.5      | 4.5      | —        |  |
| —      | —      | —       | —      | —       | —       | —      | —       | —       | —      | —        | —        | —        |  |

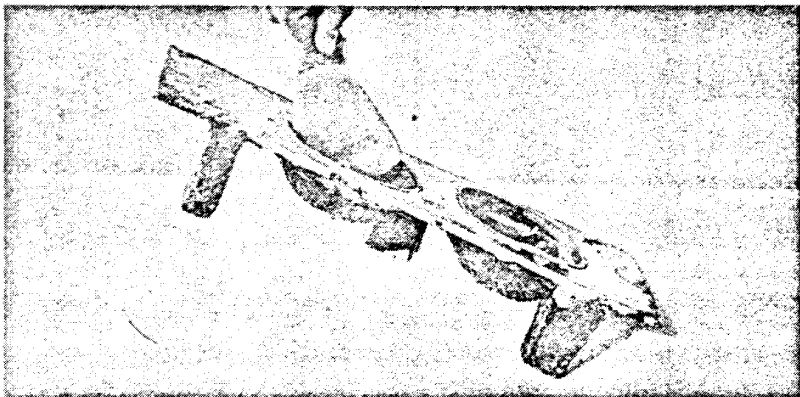
0476098



**With Santicizer 213**

Inclusion of Santicizer 213 greatly improves  
mold release of vinyl plastisols.

**With Dioctyl Phthalate**



13  
0476099

# Plasticizer Performance in Other Resins

## PLASTICIZER PERFORMANCE IN ETHYL CELLULOSE FILM

(48 - 49.5% Ethoxy Content)

15 PHR

| Plasticizer              | Yield Point<br>(p.s.i.) | Tensile Strength<br>(p.s.i.) | Elongation<br>(%) | Hardness<br>Index* | Resistance to<br>Volatilization<br>Loss | Flexibility<br>Retention<br>on Light<br>Exposure |
|--------------------------|-------------------------|------------------------------|-------------------|--------------------|-----------------------------------------|--------------------------------------------------|
| Control (no plasticizer) | 6755                    | 8960                         | 30                | 100                | E                                       | E                                                |
| Dibutyl Phthalate        | 3625                    | 5120                         | 38                | 55                 | G                                       | E                                                |
| Diphenyl Phthalate       | 5405                    | 7680                         | 38                | 80                 | E                                       | G                                                |
| Tricresyl Phosphate      | 4550                    | 7470                         | 48                | 70                 | E                                       | E                                                |
| Santicizer 140           | 5405                    | 8535                         | 38                | 80                 | E                                       | E                                                |
| Triphenyl Phosphate      | 4550                    | 6685                         | 30                | 70                 | E                                       | E                                                |
| Santicizer E-15          | 4265                    | 6685                         | 40                | 65                 | G                                       | E                                                |
| Santicizer B-16          | 3485                    | 4905                         | 36                | 50                 | G                                       | E                                                |
| Santicizer M-17          | 4125                    | 7965                         | 38                | 60                 | G                                       | E                                                |
| Santicizer I-H           | 5475                    | 7750                         | 32                | 80                 | E                                       | E                                                |
| Santicizer 8             | 4625                    | 6900                         | 34                | 70                 | G                                       | E                                                |
| Santicizer 9             | 4625                    | 7325                         | 40                | 70                 | G                                       | E                                                |
| Aroclor 1242             | 4905                    | 7395                         | 36                | 75                 | P                                       | G                                                |
| Aroclor 1248             | 5475                    | 7540                         | 30                | 80                 | P                                       | G                                                |
| Aroclor 1254             | 6185                    | 7825                         | 28                | 90                 | G                                       | G                                                |
| Aroclor 1262             | 7110                    | 8035                         | 22                | 105                | E                                       | G                                                |
| Aroclor 4465             | 8535                    | 9030                         | 22                | 125                | G                                       | P                                                |

\*Yield Point Plasticized Film  
Yield Point Unplasticized Film x 100

E = Excellent  
G = Good  
P = Poor

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TOWOLDMON0033070

## PLASTICIZER PERFORMANCE IN NITROCELLULOSE FILM (12 MIL)

| Plasticizer              | Schopper<br>Fold Cycles |        | Tensile, p.s.i. |        | Elongation<br>(%) |        | Moisture<br>Permeability<br>(%) |        |
|--------------------------|-------------------------|--------|-----------------|--------|-------------------|--------|---------------------------------|--------|
|                          | 25 PHR                  | 50 PHR | 25 PHR          | 50 PHR | 25 PHR            | 50 PHR | 25 PHR                          | 50 PHR |
| Control (no plasticizer) | 20                      | 20     | 8533            | 8533   | 6                 | 6      | 100                             | 100    |
| Santicizer 1-H           | 26                      | 10     | —               | 3270   | —                 | 7      | 45                              | 41     |
| Santicizer 8             | 22                      | 16     | —               | 2275   | —                 | 11     | 31                              | 63     |
| Santicizer 9             | 27                      | —      | —               | —      | —                 | —      | 60                              | —      |
| Santicizer 160           | 11                      | 14     | —               | 3555   | —                 | 10     | 10                              | 19     |
| Dibutyl Phthalate        | 25                      | 10     | —               | 2700   | —                 | 4      | 36                              | 65     |
| Triphenyl Phosphate      | 29                      | 24     | —               | 4410   | —                 | 8      | 52                              | 56     |
| Tricresyl Phosphate      | 20                      | —      | —               | 1210   | —                 | 24     | 16                              | 28     |
| Camphor                  | —                       | —      | —               | 5405   | —                 | 6      | —                               | —      |

PLASTICIZER PERFORMANCE IN CELLULOSE ACETATE (LOW ACETYL)  
MOLDING COMPOSITIONS (52.5-53.5%)

• (51.5 PHR unless otherwise specified)

| Plasticizer                    | Solution<br>Temp., °C | Hardness at 70° C.<br>Rockwell "M" Scale | Flexural<br>Strength<br>(p.s.i.) | Per Cent<br>Water<br>Absorbed<br>48 hrs. |
|--------------------------------|-----------------------|------------------------------------------|----------------------------------|------------------------------------------|
| Dimethyl phthalate             | 120                   | 32                                       | 5840                             | 1.14                                     |
| Diethyl phthalate              | 140                   | 15                                       | 5680                             | 1.20                                     |
| Santicizer M-17                | 148                   | 65                                       | 7110                             | 0.77                                     |
| Santicizer E-15                | 148                   | 50                                       | 6930                             | 0.97                                     |
| Santicizer 8                   | 133                   | 75                                       | 6860                             | 0.94                                     |
| Santicizer 9                   | 153                   | 90                                       | 9160                             | 0.85                                     |
| Triphenyl phosphate (42.5 PHR) | 180                   | 81                                       | 9020                             | 1.17                                     |

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# PLASTICIZER PERFORMANCE IN CELLULOSE ACETATE-BUTYRATE FILM

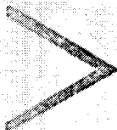
(37% Butyrate, 13% Acetate)

(50 PHR)

| Plasticizer            | Sward Hardness | Tensile Strength<br>(p.s.i.) | Elongation<br>(%) |
|------------------------|----------------|------------------------------|-------------------|
| Dimethyl Phthalate     | 46             | 4200                         | 14                |
| Dibutyl Phthalate      | 38             | 1800                         | 12                |
| Santicizer 160         | 42             | 2700                         | 9                 |
| Diocetyl Phthalate     | 44             | 2900                         | 19                |
| Dicyclohexyl Phthalate | 30             | 3900                         | 31                |
| Diphenyl Phthalate     | 42             | 3800                         | 28                |
| Santicizer E-15        | 34             | 2000                         | 14                |
| Santicizer B-16        | 40             | 1800                         | 15                |
| Santicizer M-17        | 52             | 1800                         | 18                |
| Santicizer 140         | 42             | 2700                         | 13                |
| Santicizer 141         | 44             | 2300                         | 15                |
| Tricresyl Phosphate    | 54             | 3000                         | 20                |
| Triphenyl Phosphate    | 40             | 2500                         | 10                |
| Diocetyl Adipate       | 28             | 2100                         | 12                |
| Santicizer 1-H         | 46             | 3900                         | 46                |
| Santicizer 3           | 34             | 1800                         | 27                |

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TOWOLDMON0033072



## PLASTICIZER PERFORMANCE

## PLASTICIZER

## COMPATIBILITY

VISCOSITY  
Brookfield LVF #4 spindle  
60 rpm (unless otherwise specified)

|                            | Liquid | Room Temperature Cure | 100° C. for 1/2 Hour Cure | Before Adding Curing Agent | After Adding Curing Agent |
|----------------------------|--------|-----------------------|---------------------------|----------------------------|---------------------------|
| Control                    | C      | C                     | C                         | 12,800<br>(30 rpm)         | 7,900                     |
| Dibutyl phthalate          | C      | C                     | C                         | 1,550                      | 1,300                     |
| Di-2-ethyl hexyl phthalate | C      | CI/P.S.               | SICI                      | 2,650                      | 2,700                     |
| Diisodecyl phthalate       | C      | CI/P.S.               | SICI                      | 3,250                      | 2,450                     |
| Diisodecyl adipate         | C      | CI                    | W                         | 1,200                      | 1,100                     |
| Santicizer E-15            | C      | C                     | C                         | 3,050                      | 2,100                     |
| Santicizer M-17            | C      | C                     | C                         | 3,150                      | 2,450                     |
| Santicizer B-16            | C      | C                     | C                         | 2,300                      | 2,000                     |
| Tricresyl phosphate        | C      | C                     | C                         | 3,750                      | 3,000                     |
| Santicizer 140             | C      | C                     | C                         | 2,850                      | 2,200                     |
| Santicizer 141             | C      | C                     | C                         | 1,500                      | 1,400                     |
| HB-40                      | C      | SICI                  | SICI                      | 3,900                      | 2,300                     |
| Aroclor 1248               | C      | C                     | C                         | 7,700                      | 4,300                     |
| Aroclor 1221               | C      | C                     | C                         | 1,650                      | 1,200                     |
| Mod-Epox                   | C      | C                     | C                         | 1,650                      | 1,250                     |

C = Compatible  
 CI = Cloudy  
 CI/P.S. = Cloudy, Phase Separation  
 SICI = Slightly Cloudy  
 W = White

15  
0476103

# IN EPOXY RESINS (EV, = 200)

PHYSICAL PROPERTIES  
Samples cured 30 min. @ 100° C.  
with 8 phr tetraethylene pentamine

PHYSICAL PROPERTIES  
Aged 24 hours @ 65° C.  
in activated carbon

| Izod Impact<br>Resistance | Clarity<br>% Light<br>Reflected | Shore D<br>Hardness<br>(10 Sec.) | Shore D<br>Hardness<br>(10 Sec.) | % Weight<br>Change |
|---------------------------|---------------------------------|----------------------------------|----------------------------------|--------------------|
| 0.2                       | 3.0                             | 78                               | 86                               | -0.012             |
| —                         | 3.5                             | 10                               | 78                               | -0.734             |
| 0.5-1.9                   | 8.0                             | 31                               | 82                               | -0.368             |
| 0.5-0.8                   | 7.0                             | 48                               | 83                               | -0.168             |
| 0.5-0.8                   | 94.0                            | 56                               | 82                               | -0.181             |
| —                         | 2.5                             | 10                               | 80                               | +0.119             |
| —                         | 3.0                             | 6                                | 85                               | -0.131             |
| —                         | 4.5                             | 7                                | 85                               | -0.013             |
| —                         | 3.5                             | 15                               | 86                               | -0.222             |
| —                         | 3.5                             | 22                               | 79                               | -0.284             |
| —                         | 4.0                             | 5                                | 82                               | -0.425             |
| 0.5-0.6                   | 4.0                             | 27                               | 84                               | -0.648             |
| 0.6                       | 3.0                             | 40                               | 88                               | -0.682             |
| —                         | 3.0                             | 8                                | 81                               | -2.118             |
| 0.8-0.9                   | 4.0                             | 84                               | 88                               | +0.134             |

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## Performance in Other Resins (continued)

## PLASTICIZER PERFORMANCE IN POLYVINYL ACETATE-EMULSION ADHESIVES

11 parts plasticizer in 100 parts Gelva S-55 (polyvinyl acetate) emulsion. Film thickness 0.040 inch

| Plasticizer         | Volatility<br>24 hours at 87° C.<br>(Activated Carbon)<br>(per cent) | Low-Temp.<br>Flexibility<br>(Modified Clash<br>& Berg Test)<br>(° C.) | Oil Extraction—Weight Loss After 24 Hours<br>at Room Temperature (per cent) |            |                 |
|---------------------|----------------------------------------------------------------------|-----------------------------------------------------------------------|-----------------------------------------------------------------------------|------------|-----------------|
|                     |                                                                      |                                                                       | Kerosene                                                                    | Peanut Oil | Cotton-Seed Oil |
| Aroclor 1221        | 5.2                                                                  | —5.0                                                                  | 0.63                                                                        | —          | —               |
| Aroclor 1232        | 4.8                                                                  | 4.0                                                                   | 0.54                                                                        | —          | —               |
| Aroclor 1242        | 4.4                                                                  | 5.3                                                                   | 0.57                                                                        | —          | —               |
| Triphenyl Phosphate | 2.0                                                                  | 5.7                                                                   | 0.02                                                                        | 0.37       | 0.38            |
| Tricresyl Phosphate | 0.75                                                                 | 3.6                                                                   | 0.16                                                                        | 0.38       | 0.46            |
| Dimethyl Phthalate  | 5.6                                                                  | —1.6                                                                  | 0.92                                                                        | 0.75       | 0.93            |
| Diethyl Phthalate   | 4.8                                                                  | —5.0                                                                  | 0.85                                                                        | 0.63       | 0.82            |
| Dibutyl Phthalate   | 4.4                                                                  | —6.1                                                                  | 0.59                                                                        | 0.51       | 0.59            |
| Diphenyl Phthalate  | 5.9                                                                  | —                                                                     | 1.31                                                                        | 0.90       | 0.98            |
| Santicizer B-16     | 2.2                                                                  | —3.9                                                                  | 0.08                                                                        | 0.46       | 0.36            |
| Santicizer M-17     | 3.6                                                                  | 1.5                                                                   | 0.19                                                                        | 0.50       | 0.48            |
| Santicizer 1-H      | 1.5                                                                  | —                                                                     | 0.96                                                                        | 0.36       | 0.53            |
| Santicizer 8        | 3.6                                                                  | 6.4                                                                   | 0.43                                                                        | 0.60       | 0.64            |
| Santicizer 9        | 3.1                                                                  | —                                                                     | 1.13                                                                        | 0.57       | 0.63            |
| Santicizer 140      | 1.2                                                                  | 5.0                                                                   | 0.15                                                                        | 0.34       | 0.36            |
| Santicizer 141      | 1.8                                                                  | —3.3                                                                  | 0.17                                                                        | 0.42       | 0.31            |
| Santicizer 160      | 2.1                                                                  | 1.9                                                                   | 0.20                                                                        | 0.39       | 0.34            |

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TOWOLDMON0033075

# TECHNICAL LITERATURE ABOUT MONSANTO PLASTICIZERS

The following technical bulletins and brochures give complete technical information about the properties and applications of the Monsanto plasticizers that are mentioned in this catalog. Monsanto technical literature is continuously revised to contain the most recent and reliable information possible. Your request for any literature will be promptly and cheerfully filled — without obligation, of course.

## Title

## Technical Bulletin No.

### *Phthalate Plasticizers*

|                                          |          |
|------------------------------------------|----------|
| Dibutyl Phthalate                        | PL-302   |
| Dicyclohexyl Phthalate                   | PL-312   |
| Diethyl Phthalate and Dimethyl Phthalate | PL-303   |
| Diisodecyl Phthalate                     | PL-300   |
| Di-(2 ethylhexyl) Phthalate (DOP)        | PL-318   |
| Diphenyl Phthalate                       | PL-319   |
| Di-tridecyl Phthalate                    | PL-329   |
| Di(n-octyl,n-decyl) Phthalate            | PL-330   |
| Santicizer 160 (butyl benzyl) Phthalate  | PL-160   |
| Santicizer 165                           | PL-165   |
| Santicizer 213 and Santicizer 214        | O/PL-213 |
| Santicizer 215                           | PL-215   |
| Santicizer 218                           | PL-218   |
| Santicizer 262                           | PL-262   |
| Santicizer 602 and Santicizer 636        | PL-602   |
| Santicizer 603                           | PL-603   |
| Santicizer 630 and Santicizer 631        | PL-630   |
| Santicizer 632 and Santicizer 683        | PL-632   |
| Santicizer 681                           | PL-681   |

### *Adipate Plasticizers*

|                             |        |
|-----------------------------|--------|
| Diisodecyl Adipate          | PL-308 |
| Di(n-octyl,n-decyl) Adipate | PL-316 |
| Di-octyl Adipate            | PL-304 |

### *Phosphate Plasticizers*

|                     |          |
|---------------------|----------|
| Tricresyl Phosphate | PL-305   |
| Triphenyl Phosphate | PL-301   |
| Santicizer 140      | PL-140   |
| Santicizer 141      | O/PL-141 |

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(continued)

TOWOLDMON0033076

## Title

## Technical Bulletin No.

**Phthalyl Glycollate Plasticizers**

|                                                     |       |
|-----------------------------------------------------|-------|
| Santicizer E-15 (Ethyl phthalate ethyl glycollate)  | PL-15 |
| Santicizer B-16 (Butyl Phthalyl butyl glycollate)   | PL-16 |
| Santicizer M-17 (Methyl phthalate ethyl glycollate) | PL-17 |

**Sulfonamide Plasticizers**

|                                    |          |
|------------------------------------|----------|
| Santicizer 1-H                     | O/PL-1-H |
| Santicizer 3                       | PL-3     |
| Santicizer 8                       | O/PL-339 |
| Santicizer 9                       | O/PL-9   |
| Santolite MHP and Santolite MS-80% | O/PL-320 |

**Permanent Plasticizers**

|                                |          |
|--------------------------------|----------|
| Santicizer 405                 | PL-405   |
| Santicizer 406                 | PL-406   |
| Santicizer 409                 | PL-409   |
| Santicizer 411                 | PL-411   |
| Santicizer 462                 | PL-462D  |
| Permanent Plasticizer Selector | O/PL-344 |

**Other Plasticizers**

|                                          |          |
|------------------------------------------|----------|
| Aroclor Plasticizers                     | O/PL-306 |
| HB-40 (partially hydrogenated terphenyl) | PL-40    |
| Modaflow                                 | O/PL-338 |
| Mod-Epoxy (epoxy-resin modifier)         | PL-313   |
| Montar Compounds                         | PL-328   |
| Phosgard C-22-R                          | O/PL-22  |
| Triphenyl Phosphite                      | PL-317   |

**General**

|                                                             |          |
|-------------------------------------------------------------|----------|
| Monsanto Solid Plasticizers                                 | O/PL-345 |
| Monsanto Plasticizers in Synthetic-Resin Adhesives          | PL-307   |
| Monsanto Plasticizers in Protective Coatings                | PL-327   |
| Bulk Receiving of Plasticizers                              | PL-314   |
| Monsanto Modifiers for Thiokol® Polysulfide Liquid Polymers | PL-331   |
| Monsanto Plasticizers for Food Packaging Applications       | PL-500   |
| Monsanto Plasticizers for Hard-to-Plasticize Resins         | PL-332   |
| Chemical Resistance of Plasticizers in Plastics             | PL-333   |

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