Phosflex® 314, 321 ,327

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Phosflex®
Flame Retardant Plasticizers

Chemical Name:
Phosflex® 314, 321, 327

Overview

Three proprietary FR plasticizers have been developed for flexible PVC applications. Based on aryl phosphate esters, these blends not only offer excellent flame resistance to the vinyl compounds but most also are very good plasticizers with significantly lower color.

Phosflex® Product Selector

	Key applications	Key characteristics
4	• Primary plasticizer for nitrocellulose, chlorinated rubber • Anti-foam agent	• Low viscosity • Low density
31L	• PVC film and sheet compounds • Dispersant for plastisols	• Low color • Blendable with non-FR plasticizers
41L	• PVC film and sheet compounds • Dispersant for plastisols	• Low color • Blendable with non-FR plasticizers
71B	• Flame retardant plasticizer for PVC	• Excellent flame retardant properties • Low volatility
362	• Flame retardant plasticizer for PVC alloys	• Low temperature and low smoke • Excellent vinyl solvating properties • Approved for packaging materials in food contact
390	• Flame retardant plasticizer for PVC sheets and coatings	• Excellent low temperature flexibility • Low smoke, good weathering properties
314, 321, 327	• Blended plasticizer for film and sheet vinyl goods	• High efficiency • High solvating

Key Applications

Phosflex® 314
Phosflex® 314 is a proprietary low color plasticizer blend containing triaryl phosphate esters. This mixture is useful in a number of PVC applications including vinyl wall covering, sheet goods, and laminated products requiring a high degree of flame resistance.

Phosflex® 321
Phosflex® 321 is a proprietary low color plasticizer blend containing flame retardants and triaryl phosphate esters. This mixture is useful in a number of PVC applications including vinyl wall covering, sheet goods (tarpaulins), and laminated products requiring a high degree of flame retardancy and low levels of smoke generation. Also, this plasticizer could be used in wire and cable applications. In addition to improved flame resistance, Phosflex® 321 is an excellent plasticizer with low temperature flexibility characteristics.

Phosflex® 327
This FR plasticizer formulated to deliver a high degree of flame retardancy to vinyl composites. It is a common practice to combine phosphate plasticizers with other non-FR plasticizers to custom tailor composite properties. Phosflex® 327 enables the formulator the flexibility to combine a highly FR efficient plasticizer with other plasticizers to best modify their composite properties.

Typical Properties

	314	321	327
Physical appearance	All clear liquid		
Specific gravity, 20°C/20°C	1.16	1.21	1.25
Phosphorus content, wt. %	6.5	8.1	8.1
Viscosity @ 25°C, mPa.s	70	60	120
Color, APHA	60	50	60
Water content, wt. %	<0.1	<0.1	<0.1

Safety & Handling
Consult the Material Safety Data Sheet for this product.

Shipping Information
Phosflex® 314: available in bulk tank trucks, isocontainers, 2,600 lb totes, and 529 lb drums.
Phosflex® 321: available in bulk tank trucks, isocontainers, 2,700 lb totes, and 540 lb drums.
Phosflex® 327: available in bulk tank trucks, isocontainers, and 550 lb drums.

Performance Properties at a Glance

Phosflex® Product	Plasticizer Efficiency	FR Efficiency	Low Temp. Flexibility	Special Features
314	Good	Excellent	Fair	Low color
321	Good	Excellent	Fair	Low color, low smoke, good overall properties
327	Fair	Excellent	Poor	Excellent FR properties

Flammability

The following table demonstrates the typical flammability characteristics of a suspension PVC (GEON 103EP) plasticized with the new blends. Also shown for comparison are FR values of phthalate ester plasticized composites and compounds containing Phosflex® plasticizers and typical FR synergists. In general Phosflex® 321 is shown to have the best compromise properties between smoke generation and flame resistance. Phosflex® 327 exhibits the most FR efficiency of these blended materials, and Phosflex® 314 exhibits intermediate FR values. All phosphate ester blends however show significantly better flame resistance than the phthalate ester composite.

UL-94 and LOI Flammability

Plasticizer Type (50phr)	**DIDP**	**314**	**321**	**327**	**41L**
Neat (no synergists)					
LOI (% O_2)	23.0	30.0	30.8	30.9	30.7
UL-94 (1.6mm)	Fail	V-0	V-0	V-0	V-0
With ATH (40phr)					
LOI (% O_2)	-	-	34.2	-	-
UL-94 (1.6mm)	-	-	V-0	-	-
With ATH/ZB (40/6phr)					
LOI (% O_2)	25.0	34.8	36.6	35.0	35.5
UL-94 (1.6mm)	Fail	V-0	V-0	V-0	V-0

Typical Mechanical Properties

The following tables demonstrate the effect of Phosflex® blends on mechanical properties in suspension and emulsion grades PVC, alone and in combination with other flame retardant additives. Generally, Phosflex® blends show good plasticizing characteristics. E-Modulus values are an indication of the plasticizing efficiency of each plasticizer (the tensile strain of each composite at 100% elongation; lower value - better plasticizer).

Phosflex® Blends in Suspension Grade PVC (GEON 103EP)

	DIDP 50phr	314 50phr	321 50phr	327 50phr	41L 50phr
Tensile Properties Strength (MPa)	12.2	13.2	13.8	17.7	15.3
E Modulus (MPa)	5.9	7.1	7.7	12.3	7.6
Elongation (%))	428	350	301	383	290
Shore "A" Hardness	88	91	85	97	92

Addition of ATH/ZB (40/6 phr)

	DIDP 50phr	314 50phr	321 50phr	327 50phr	41L 50phr
Tensile Properties Strength (MPa)	11.3	10.1	11.1	12.5	12.9
E Modulus (MPa)	7.2	8.4	7.6	9.0	8.9
Elongation (%))	374	210	260	322	665
Shore "A" Hardness	93	91	95	97	93

Phosflex Blends in Emulsion Grade PVC (GEON 121)

	DIDP 50phr	314 50phr	321 50phr	327 50phr	41L 50phr
Tensile Properties Strength (MPa)	11.5	18.5	17.6	16.4	18.8
E Modulus (MPa)	3.6	4.2	4.5	6.4	4.3
Elongation (%))	711	699	660	503	665
Shore "A" Hardness	83	81	87	89	82

Addition of ATH/ZB (40/6 phr)

	DIDP 50phr	314 50phr	321 50phr	327 50phr	41L 50phr
Tensile Properties Strength (MPa)	10.6	14.5	11.9	13.9	14.4
E Modulus (MPa)	3.8	3.7	4.6	6.3	5.4
Elongation (%))	583	581	503	518	520
Shore "A" Hardness	83	84	89	91	85

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