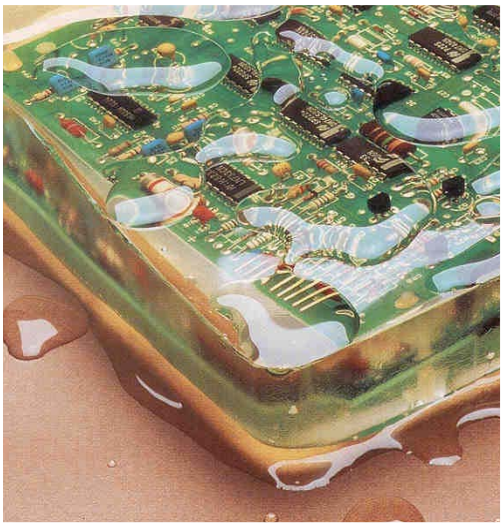
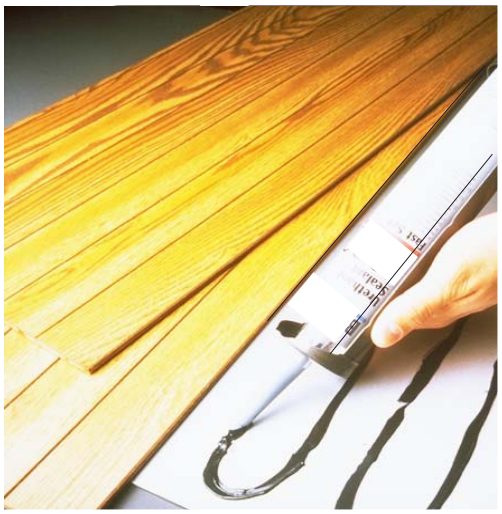
CRAY VALLEY
Resins par excellence

Product Bulletin


Hydroxyl Terminated Polybutadiene Resins and Derivatives - Poly bd® and Krasol®

TOTAL

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INTRODUCTION

Poly bd® and Krasol® resins are low molecular weight, hydroxyl-terminated homopolymers of butadiene. These hydroxyl-terminated polybutadiene (HTPB) resins are characterized by low volatiles content, low glass transition temperatures, excellent hydrophobicity and a high level of reactive functionality.

The facile reaction of Poly bd® and Krasol® polyols with curing agents such as di- and polyisocyanates provides an attractive route to the preparation of general-purpose polyurethane elastomers. The unique structure of the Poly bd® and Krasol® polyols provide properties which surpass typical polyether and polyester polyol based urethane systems, as well as conventional, general-purpose rubbers. Most grades of Poly bd® and Krasol® resins contain unsaturated double bonds (except Krasol® HLBH-P 2000 and Krasol® HLBH-P 3000) that can be cured or crosslinked. Several grades of Poly bd® resin, such as Poly bd® 600E and Poly bd® 605E contain epoxy functionality in the backbone. Krasol® LBH2040 contains additional hydroxyl functions in the backbone.

Some of the outstanding performance characteristics Poly bd® and Krasol® resins provide to polyurethanes include:

Adhesion to a variety of substrates
Hydrolytic stability
Resistance to strong aqueous acid and bases
Low temperature flexibility
Low moisture vapor transmission rates (MVTR)
Low embedment stress
Thermal cycling stability
Electrical insulation properties
High elongation with good elastic recovery

Poly bd® and Krasol® hydroxyl-terminated polybutadienes comply with title 21 (Food and Drugs) of the Code of Federal Regulations, paragraph 175.300, Resinous and Polymeric Coatings.

Cray Valley Company is also supplying non-hydroxyl terminated derivatives of the Poly bd® and Krasol® resins. These include isocyanate (MDI or TDI) terminated prepolymers (Krasol® NN and Krasol® LBD), acrylate-terminated and carboxyl-terminated resins. These products provide the same general properties as the hydroxyl-terminated resins but with more curing and crosslinking options.

Poly bd® and Krasol® resins are used in various industries including construction, automotive, electronics and rubber. They are incorporated in castable elastomers, caulks, sealants, waterproof membranes, foams, adhesives, coatings, binders for composites, potting and encapsulation compounds as well as other rubber-fabricated materials.

Functionalized Polybutadiene Resins Currently Offered by Cray Valley Company

The tables below summarize the functionalized polybutadiene and polyolefin resins currently offer by Cray Valley Company. The various grades and their applications are described in more detail in the following pages.

Hydroxyl Terminated Polybutadiene and Polyolefin Resins

Trade Name	Product	Hydroxyl Functionality	1,2-Vinyl %	Mol. Wt. Mn (g/mol)	OH Value (meq/g)	Viscosity Pa.s @ 30°C	Comments
Poly bd	R-45HTLO	2.5	20	2800	0.84	5	standard product
Poly bd	R-20LM	2.5	20	1350	1.7	1.4	low visc version of R-45HTLO
Poly bd	LF1	2.35	31	2291	0.87	5	lower fn; low vinyl
Poly bd	LF2	2.2	42	2029	0.89	5.3	lower fn; medium vinyl
Poly bd	LF3	2.05	53	2474	0.9	5.8	lower fn; high vinyl
Poly bd	600E	2.5	20	1350	1.7	7	epoxidized; epoxy eq.wt 460
Poly bd	605E	2.5	20	1450	1.74	22	epoxidized; epoxy eq.wt. 300
Krasol	LBH 2000	1.9	65	2100	0.91	9	secondary OH groups
Krasol	LBH-P 2000	1.9	65	2100	0.91	9	primary OH groups
Krasol	LBH 3000	1.9	65	3000	0.64	13	secondary OH groups
Krasol	LBH-P 3000	1.9	65	3000	0.64	13	primary OH groups
Krasol	LBH 5000	1.9	65	5000	0.38	19	secondary OH groups
Krasol	LBH 10000	1.9	65	10000	0.19	35 @50 °C	Primary OH groups
Krasol	LBH-P 5000	1.9	65	5000	0.38	19	primary OH groups
Krasol	LBH-P 10000	1.9	65	10000	0.19	35 @50 °C	secondary OH groups
Krasol	HLBH-P 2000	1.9	-	2100	0.89	37.4 @25 °C	hydrogenated
Krasol	HLBH-P 3000	1.9	-	3100	0.56	62.6 @25 °C 40 @30 °C	hydrogenated
Krasol	LBH 2040	~4	65	2249	1.8	37.2	highest OH functionality (fn)

Isocyanate Terminated Polybutadiene

Trade Name	Product	Isocyanate type	NCO Functionality	1,2-Vinyl %	NCO Content %	Viscosity Pa.s @ 25°C	Comments
Krasol	NN22	MDI	1.9	65	8.8	17	Standard grade
Krasol	NN23	MDI	1.9	65	4.5	1.7	Contains 50% mineral oil
Krasol	NN25	MDI	1.9	65	11.5	1.2	Contains 20% mineral oil
Krasol	LBD2000	TDI	1.9	65	3.4	95	1.1% free TDI
Krasol	LBD3000	TDI	1.9	65	3	120	1.1% free TDI

Diacrylate Terminated Polybutadiene

Trade Name	Product	Functionality	Viscosity Pa.s @25°C	Viscosity Pa.s @60°C
CN	307	2	8000	750

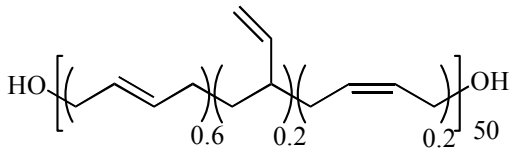
Developmental grades available upon demand

Carboxylic Acid Terminated Polybutadiene

Trade Name	Product	Functionality	1,2-Vinyl %	Mol. Wt.	Acid Value meq/g	Viscosity Pa.s @ 60°C
Poly bd	45CT	2-3	20%	3050	0.77	4.3
Poly bd	2000CT	2	65%	2300	0.86	4.3
Poly bd	3000CT	2	65%	3300	0.60	5.0

Poly bd® R-45HTLO Resin

HYDROXYL TERMINATED POLYBUTADIENE RESIN



DESCRIPTION

Poly bd® R-45HTLO resin is a liquid hydroxyl terminated polymer of butadiene with a number average molecular weight of approximately 2800. Poly bd® resins have primary, allylic alcohol groups that exhibit high reactivity in either condensation polymerization reactions or the preparation of derivatives. The degree of polymerization is approximately 50 for the R-45HTLO. Hydroxyl functionality is typically in the 2.4 – 2.6 range for R-45HTLO. Poly bd® R-45HTLO is regulated by the United States Department of Commerce and may not be exported without a license from that organization.

PRODUCT HIGHLIGHTS

Hydrophobicity
Reactive hydroxyl groups
Low glass transition temperature
Miscibility with asphalt
Low color, high clarity

PERFORMANCE PROPERTIES

Hydrolytic stabiltiy
Low temperature flexibility
Low moisture permeability
Resistance to aqueous acids and bases
Excellent adhesion to a variety of substrates
Electrical insulation properties

SUGGESTED APPLICATIONS

Potting and encapsulation
Adhesives
Sealants
Binders
Waterproof coatings and membranes

Poly bd® R-45HTLO TYPICAL PHYSICAL AND CHEMICAL PROPERTIES

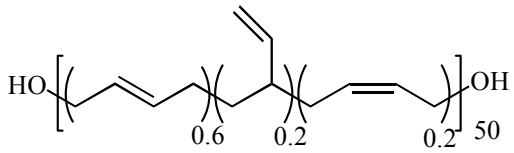
Nonvolatile material, wt%	99.9
Viscosity, mPa·s @ 23°C	8000
Viscosity, mPa·s @ 30°C	5000
Hydroxyl number, mg KOH/g	47.1
Hydroxyl value, meq/g	0.84
Hydroxyl functionality	2.4-2.6
Molecular weight, M_n	2800
Polydispersity, M_w/M_n	2.5
Water, wt%	0.02
Specific gravity @ 23°C	0.901
Iodine number, g/100g	400
Glass transition temp. (Tg), °C	-75
Solubility, g/100 ml of solvent @ 25°C	
Mineral Spirits	>50
Toluene	>50
Chloroform	>50
Methyl ethyl ketone	>50
Ethyl acetate	>50
Acetone	<10[(1)]
Hexane	>50
Aromatic 100	>50
Isopropanol	<10[(1)]

[(1)] Cloudy: 5% solution also cloudy

Regulatory Notice
Poly bd® R-45HTLO is regulated by the United States Department of Commerce and may not be exported without license from that organization.

Poly bd® R-45M

HYDROXYL TERMINATED POLYBUTADIENE RESIN



DESCRIPTION

Poly bd® R-45M is a liquid, hydroxyl terminated polymer of butadiene with a number average molecular weight of approximately 2800. Poly bd® resins have primary, allylic alcohol groups that exhibit high reactivity in either condensation polymerization reactions or the preparation of derivatives. The degree of polymerization is approximately 50 for R-45M. Hydroxyl functionality is typically in the range of 2.2 to 2.4 for R-45M.

PRODUCT HIGHLIGHTS

Low glass transition temperature
Hydrophobicity
High solids loading
Low color, high clarity

PERFORMANCE PROPERTIES

Low temperature flexibility
Excellent adhesion to metal
Excellent dispersion of fillers

SUGGESTED APPLICATIONS

Binders for military applications.

Poly bd® R-45M
TYPICAL PHYSICAL AND CHEMICAL PROPERTIES

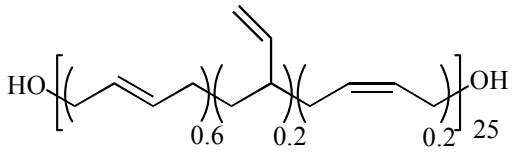
Nonvolatile material, wt%	99.9
Viscosity, mPa·s @23°C	7000
Viscosity, mPa·s @30°C	4400
Hydroxyl number, mg KOH/g	40.4
Hydroxyl value, meq/g	0.72
Hydroxyl functionality	2.2-2.4
Molecular weight, M_n	2800
Polydispersity, M_w/M_n	2.2
Water, wt%	0.02
Specific gravity @23°C	0.899
Iodine number, g/100g	400
Glass transition temp. (Tg), °C	-76
Solubility	
Mineral sprits	>50
Toluene	>50
Chloroform	>50
Methyl ethyl ketone	>50
Ethyl acetate	>50
Acetone	<10[(1)]
Hexane	>50
Aromatic 100	>50
Isopropanol	<10[(1)]

[(1)] Cloudy: 5% solution also cloudy.

Regulatory Notice
Poly bd® R-45M is regulated by the United States Department of Commerce and may not be exported without license from that organization.

Poly bd® R-20LM Resin

LOW MOLECULAR WEIGHT HYDROXYL TERMINATED POLYBUTADIENE RESIN



DESCRIPTION

Poly bd® R-20LM Resin is a low viscosity, low molecular weight liquid, hydroxyl terminated polymer of butadiene. Poly bd® resins have primary, allylic alcohol groups that exhibit high reactivity in either condensation polymerization reactions or the preparation of derivatives. The degree of polymerization is approximately 25 for the Poly bd® R-20LM and the molecular weight is 1200.

PRODUCT HIGHLIGHTS

Reactive hydroxyl groups
Hydrophobicity
Low glass transition temperature
High solids loading
Low color, high clarity

PERFORMANCE PROPERTIES

Hydrolytic stability
Low moisture permeability
Resistance to aqueous acids and bases
Low temperature flexibility
Electrical insulation properties

SUGGESTED APPLICATIONS

Potting and encapsulation
Adhesives
Sealants
Waterproof coatings and membranes

Poly bd® R-20LM
TYPICAL PHYSICAL AND CHEMICAL PROPERTIES

Nonvolatile material, wt%	99.9
Viscosity, mPa.s @ 30°C	1400
Hydroxyl number, mg KOH/g	101.0
Hydroxyl value, meq/g	1.8
Hydroxyl functionality	2.4-2.6
Molecular weight, M_n	1200
Polydispersity, M_w/M_n	2.0
Water, wt%	0.05
Specific gravity @23°C	0.913
Iodine number, g/100g	420
Glass transition temp. (Tg),°C	-70
Solubility	
Mineral spirits	>50
Toluene	>50
Chloroform	>50
Methyl ethyl ketone	>50
Ethyl acetate	>50
Acetone	<10[(1)]
Hexane	<50
Aromatic 100	>50
Isopropanol	<10[(1)]

(1) Cloudy: 5% solution also cloudy.

Regulatory Notice
Poly bd® R-20LM is regulated by the United States Department of Commerce and may not be exported without license from that organization.

Poly bd® LF-1

HYDROXYL TERMINATED 1,3-BUTADIENE HOMOPOLYMER

DESCRIPTION

Poly bd® LF-1 is a liquid polybutadiene with hydroxyl end groups. Due to a high concentration of olefinic double bonds and low molecular weight, Poly bd® LF-1 is a liquid at room temperature. The product is immiscible in water and alcohols; however, it is miscible in relatively non-polar organic liquids, oils, and bitumens. Poly bd® LF-1 reacts through the double bonds along the chain and through the terminal hydroxyl groups. It is particularly useful as the polyol component in polyurethane and polyester systems.

PRODUCT HIGHLIGHTS

Excellent aqueous acid/base resistance
Good electrical characteristics
Good low temperature properties
Hydrolytic resistance
Hydroxyl functionality

SUGGESTED APPLICATIONS

Adhesives
Binding agent for composites
Castable urethane elastomers
Coatings
Electronics, potting compounds
Encapsulants
Hydrolytic stability enhancer for polyurethanes
Polymer modification
Polyurethane foams
Sealing and putty compounds

Poly bd® LF-1 Resin
TYPICAL PHYSICAL AND CHEMICAL PROPERTIES

M_n, g/mol.	2291
Polydispersity	2.9
Microstructure	
1,4-cis, %	15
1,4-trans, %	46
1,2-vinyl, %	39
Hydroxyl functionality	2.33 (calculated)
OH value, meq/g	0.87
Viscosity, mPa.s.	5000 @30°C
Density, g/cm^3	0.9 @20°C
Water, wt.%	0.04

Regulatory Notice
Poly bd® LF-1 is regulated by the United States Department of Commerce and may not be exported without license from that organization.

Poly bd® LF-2

HYDROXYL TERMINATED 1,3-BUTADIENE HOMOPOLYMER

DESCRIPTION

Poly bd® LF-2 is a liquid polybutadiene with hydroxyl end groups. Due to a high concentration of olefinic double bonds and low molecular weight, Poly bd® LF-2 is a liquid at room temperature. The product is immiscible in water and alcohols; however, it is miscible in relatively non-polar organic liquids, oils, and bitumens. Poly bd® LF-2 reacts through the double bonds along the chain and through the terminal hydroxyl groups. It is particularly useful as the polyol component in polyurethane and polyester systems.

PRODUCT HIGHLIGHTS

Excellent aqueous acid/base resistance
Good electrical characteristics
Good low temperature properties
Hydrolytic resistance
Hydroxyl functionality

SUGGESTED APPLICATIONS

Adhesives
Binding agent for composites
Castable urethane elastomers
Coatings
Electronics, potting compounds
Encapsulants
Hydrolytic stability enhancer for polyurethanes
Polymer modification
Polyurethane foams
Sealing and putty compounds

Poly bd® LF-2 Resin
TYPICAL PHYSICAL AND CHEMICAL PROPERTIES

M_n, g/mol.	2029
Polydispersity	2.67
Microstructure	
1,4-cis, %	12
1,4-trans, %	35
1,2-vinyl, %	53
Hydroxyl functionality	2.15 (calculated)
OH value, meq/g	0.89
Viscosity, mPa.s.	5250 @30°C
Density, g/cm^3	0.9 @20°C
Water, wt.%	0.04

Regulatory Notice
Poly bd® LF-2 is regulated by the United States Department of Commerce and may not be exported without license from that organization.

Poly bd® LF-3

HYDROXYL TERMINATED 1,3-BUTADIENE HOMOPOLYMER

DESCRIPTION

Poly bd® LF-3 is a liquid polybutadiene with hydroxyl end groups. Due to a high concentration of olefinic double bonds and low molecular weight, Poly bd® LF-3 is a liquid at room temperature. The product is immiscible in water and alcohols; however, it is miscible in relatively non-polar organic liquids, oils, and bitumens. Poly bd LF-3® reacts through the double bonds along the chain and through the terminal hydroxyl groups. It is particularly useful as the polyol component in polyurethane and polyester systems.

PRODUCT HIGHLIGHTS

Excellent aqueous acid/base resistance
Good electrical characteristics
Good low temperature properties
Hydrolytic resistance
Hydroxyl functionality

SUGGESTED APPLICATIONS

Adhesives
Binding agent for composites
Castable urethane elastomers
Coatings
Electronics, potting compounds
Encapsulants
Hydrolytic stability enhancer for polyurethanes
Polymer modification
Polyurethane foams
Sealing and putty compounds

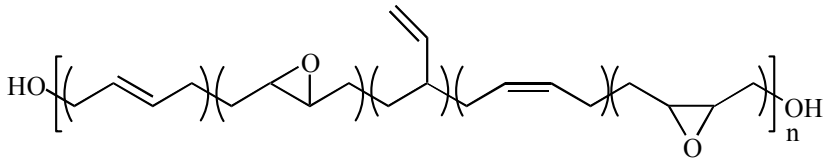
Poly bd® LF-3Resin
TYPICAL PHYSICAL AND CHEMICAL PROPERTIES

M_n, g/mol.	2474
Polydispersity	1.7
Microstructure	
1,4-cis, %	9
1,4-trans, %	27
1,2-vinyl, %	64
Hydroxyl functionality	1.98 (calculated)
OH value, meq/g	0.9
Viscosity, mPa.s.	5750 @30°C
Density, g/cm^3	0.9 @20°C
Water, wt.%	0.04

Regulatory Notice
Poly bd® LF-3 is regulated by the United States Department of Commerce and may not be exported without license from that organization.

Poly bd® 600E

EPOXIDIZED, HYDROXYL TERMINATED POLYBUTADIENE RESIN



DESCRIPTION

Poly bd® 600E is an epoxidized polybutadiene resin offering the compounder a variety of functionalities for formulating finished products. The 600E resin is hydroxyl terminated and brings hydrophobicity, flexibility and water resistance to urethane applications. In addition, oxirane groups on the polymer backbone allow it to be used as the sole resin in epoxy formulations or in combination with bisphenol A or cycloaliphatic epoxy resin formulations, where 600E resin improves the flexibility and impact resistance. These epoxy groups will cure with Lewis acids or anhydrides. Primary and secondary amines are not recommended as curing agents. This product is regulated by the United States Department of Commerce and may not be exported without a license from that organization.

PRODUCT HIGHLIGHTS

Multiple functionality
Compatibility with other epoxy resins

PERFORMANCE PROPERTIES

Flexible epoxy systems
Hydrophobicity
Aqueous acid and base resistance.
Adhesion to a variety of substrates
Excellent water resistance

SUGGESTED APPLICATIONS

Adhesives
Electronic coatings
Flexibilization of epoxy systems

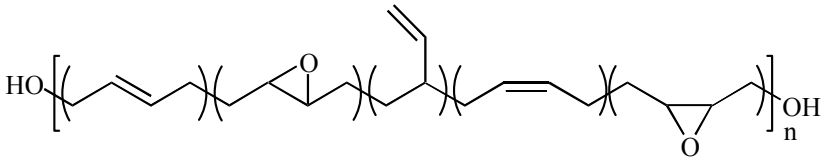
Poly bd® 600E
TYPICAL PHYSICAL AND CHEMICAL PROPERTIES

Oxirane oxygen, %	3.5
Epoxy value, meq/g	2.2
Specific gravity	1.01
Viscosity, mPa.s @ 30°C, max	7000
Epoxy equivalent weight	460
Water, wt%	0.05
Hydroxyl functionality	2.4-2.6
Hydroxyl value, meq/g	1.7
Molecular weight, Mn	~1300

Regulatory Notice
Poly bd® 600E is regulated by the United States Department of Commerce and may not be exported without license from that organization.

Poly bd® 605E

EPOXIDIZED, HYDROXYL TERMINATED POLYBUTADIENE RESIN



DESCRIPTION

Poly bd® 605E is an, epoxidized polybutadiene resin offering the compounder a variety of functionalities for formulating finished products. The 605E resin is hydroxyl terminated and brings hydrophobicity, flexibility and water resistance to urethane applications. In addition, oxirane groups on the polymer backbone allow it to be used as the sole resin in epoxy formulations or in combination with Bisphenol A or cycloaliphatic epoxy resin formulations, where 605E resin improves the flexibility and impact resistance. These epoxy groups will cure with Lewis acids or anhydrides. Primary and secondary amines are not recommended as curing agents. Poly bd® 605E resin may be used as a reactive oligomeric additive in cationically cured coatings to impart high flexibility. This product is regulated by the United States Department of Commerce and may not be exported without a license from that organization.

PRODUCT HIGHLIGHTS

Most highly epoxidized Poly bd® resin
Multiple functionality
Low viscosity
Compatibility with other epoxy resins
UV cationic cure

PERFORMANCE PROPERTIES

Flexible epoxy systems
Hydrophobicity
Aqueous acid and base resistance
Adhesion to a variety of substrates
Excellent water resistance

SUGGESTED APPLICATIONS

Adhesives
Electronic coatings
Flexibilization of epoxy systems

Poly bd® 605E
TYPICAL PHYSICAL AND CHEMICAL PROPERTIES

Oxirane oxygen, %	6.5
Epoxy value, meq/g	3.5
Specific gravity	1.01
Viscosity, mPa.s @ 30°C	22,000
Epoxy equivalent weight	300
Hydroxyl functionality	2.4-2.6
Water, wt%	0.05
Hydroxyl value, meq/g	1.74
Molecular weight, Mn	1300

Regulatory Notice
Poly bd® 605E is regulated by the United States Department of Commerce and may not be exported without license from that organization.

Poly bd® 2035TPU

POLYBUTADIENE THERMOPLASTIC URETHANE

DESCRIPTION

Poly bd® 2035TPU is designed to enhance the performance of films, adhesives, sealants, coatings, and thermoplastic elastomers (TPEs). The polybutadiene backbone provides exceptional hydrolytic stability, and low moisture vapor transmission rates. Poly bd® 2035 is far superior to polyether and polyester-based TPEs in resistance to aqueous solutions of strong mineral acids.

PRODUCT HIGHLIGHTS

Excellent chemical resistance
Good low temperature properties
Hydrolysis resistance
Low moisture vapor transmission rate
Outstanding electrical properties

PERFORMANCE PROPERTIES

Acid and base resistance
Asphalt miscibility
Electrical insulative properties
High urethane strength
Low temperature flexibility

SUGGESTED APPLICATIONS

Adhesives
Coatings
Film and sheet
Footwear
Hoses
Pipe
Polymer modification
Sealants
Wire and cable insulation

Poly bd® 2035TPU
TYPICAL PHYSICAL AND CHEMICAL PROPERTIES

Elongation, %	550
Hardness, Shore A	80
Modulus, psi	812
Softening point, R&B, C	90
Specific gravity @25°C	0.96
Tensile strength, psi.	2030
Tg, °C	-35

Regulatory Notice
Poly bd® 2035TPU is regulated by the United States Department of Commerce and may not be exported without license from that organization.

Poly bd® 3027TPU

POLYBUTADIENE THERMOPLASTIC URETHANE

DESCRIPTION

Poly bd® 3027TPU is designed to enhance the performance of films, adhesives, sealants, coatings, and thermoplastic elastomers (TPEs). The polybutadiene backbone provides exceptional hydrolytic stability, and low moisture vapor transmission rates.

PRODUCT HIGHLIGHTS

Excellent chemical resistance
Good low temperature properties
Hydrolytic resistance
Low moisture vapor transmission rate
Outstanding electrical properties

PERFORMANCE PROPERTIES

Acid and base resistance
Asphalt miscibility
Electrical insulative properties
High urethane strength
Low temperature flexibility
Viscosity reduction

SUGGESTED APPLICATIONS

Adhesives
Coatings
Film and sheet
Footwear
Hoses
Pipe
Polymer modification
Sealants
Wire and cable insulation

Poly bd® 3027TPU
TYPICAL PHYSICAL AND CHEMICAL PROPERTIES

Elongation, %	560
Hardness, Shore A	63
Modulus, psi	370
Softening point, °C	75
Specific gravity @25°C	0.96
Tensile strength, psi.	975
Tg, °C	-35
Die C Tear strength, pli	176

Regulatory Notice
Poly bd® 3027TPU is regulated by the United States Department of Commerce and may not be exported without license from that organization.

KRASOL® LBH 2000

KRASOL® HYDROXYL TERMINATED POLYBUTADIENE

DESCRIPTION

Krasol®LBH2000 is a linear polybutadiene polymer with hydroxyl end groups. Due to a high concentration of olefinic double bonds and low molecular weight, Krasol®LBH2000 is a liquid at ambient temperature. The product is immiscible in water and alcohols; however, it is miscible in non-polar organic liquids, oils, and bitumens. Krasol®LBH2000 reacts through the double bonds along the polymer chain and through the terminal hydroxyl groups. It is particularly useful as the polyol component in polyurethane systems.

PRODUCT HIGHLIGHTS

Excellent chemical resistance
Good electrical characteristics
Good low temperature properties
Hydroxyl functionality
Narrow molecular weight distribution
Resists hydrolysis

SUGGESTED APPLICATIONS

Adhesives
Coatings
Composites, binding agent for
Elastomers, castable urethane
Elastomers, thermoplastic
Electronics, potting compounds
Encapsulants
Hydrolytic stability enhancer for polyurethanes
Polymer modification
Polyurethane foams
Sealing and putty compounds

Krasol® LBH 2000
TYPICAL PHYSICAL AND CHEMICAL PROPERTIES

Microstructure:	
1,2-vinyl, %	65
1,4-cis, %	12.5
1,4-trans, %	22.5
Density, g/cm^3	0.9 @20°C
Hydroxyl value, meq/g	0.91
M_n, g/mol.	2100
Non-volatile material %	99.5
Polydispersity	1.35
Viscosity, @ 25°C, Pa.s.	13
Water, wt.%	0.04
Hydroxyl functionality	1.9-2.0

Regulatory Notice
Krasol® LBH 2000 is regulated by the United States Department of Commerce and may not be exported without license from that organization.

KRASOL® LBH 2040

KRASOL® HYDROXYL TERMINATED POLYBUTADIENE

DESCRIPTION

Krasol® LBH 2040 has four hydroxyl groups per chain. The viscosity of the polymer at room temperature is relatively high, but it drops quickly with increasing temperature. In the preparation of polyurethane elastomers, increasing hydroxyl functionality accelerates the crosslinking reaction, increases elastomer hardness, decreases elongation at break, improves compression-set characteristics and increases softening temperature. The differences can be attributed to an increase in the crosslink density of polyurethane networks.

PRODUCT HIGHLIGHTS

Excellent aqueous acid/base resistance
Good electrical characteristics
Good low temperature properties

PERFORMANCE PROPERTIES

Acid and Base Resistance
Adhesion
Asphalt Miscibility
Electrical Insulative Properties
High Urethane Strength
Low Tempature Flexibility
Water Resistance

SUGGESTED APPLICATIONS

Adhesives; sealants
Binding agent for composites
Castable urethane elastomers
Elastomers
Electronics, potting compounds
Polyurethane foams

Krasol® LBH 2040
TYPICAL PHYSICAL AND CHEMICAL PROPERTIES

Avg. OH functionality	4.0
Mn, g/mol.	2249
Mw/Mn	1.2
OH content, meq/g	1.791
Tg, °C	-33
Viscosity, Pa.s @25 °C	62

Regulatory Notice
Krasol® LBH 2040 is regulated by the United States Department of Commerce and may not be exported without license from that organization.

KRASOL® LBH 3000

KRASOL® HYDROXYL TERMINATED POLYBUTADIENE

DESCRIPTION

Krasol®LBH3000 is a linear polybutadiene polymer with hydroxyl end groups. Due to a high concentration of olefinic double bonds and low molecular weight, Krasol®LBH3000 is a liquid at ambient temperature. The product is immiscible in water and alcohols; however, it is miscible in non-polar organic liquids, oils, and bitumens. Krasol®LBH3000 reacts through the double bonds along the polymer chain and through the terminal hydroxyl groups. It is particularly useful as the polyol component in polyurethane systems.

PRODUCT HIGHLIGHTS

Excellent chemical resistance
Good electrical characteristics
Good low temperature properties
Hydroxyl functionality
Narrow molecular weight distribution
Resists hydrolysis

SUGGESTED APPLICATIONS

Adhesives
Coatings
Composites, binding agent for
Elastomers, castable urethane
Elastomers, thermoplastic
Electronics, potting compounds
Encapsulants
Hydrolytic stability enhancer for polyurethanes
Polymer modification
Polyurethane foams
Sealing and putty compounds

Krasol® LBH 3000
TYPICAL PHYSICAL AND CHEMICAL PROPERTIES

Microstructure:	
1,2-vinyl, %	65
1,4-cis, %	12.5
1,4-trans, %	22.5
Density, g/cm^3	0.9 @20°C
Hydroxyl value, meq/g	0.64
M_n, g/mol.	3000
Non-volatile material %	99.5
Polydispersity	1.35
Viscosity, @ 25°C, Pa.s.	20
Water, wt.%	0.04
Hdroxyl functionality	1.9-2.0

Regulatory Notice
Krasol® LBH 3000 is regulated by the United States Department of Commerce and may not be exported without license from that organization.

KRASOL® LBH 5000

KRASOL® HYDROXYL TERMINATED POLYBUTADIENE

DESCRIPTION

Krasol®LBH5000 is a linear polybutadiene polymer with hydroxyl end groups. Due to a high concentration of olefinic double bonds and low molecular weight, Krasol®LBH5000 is a liquid at ambient temperature. The product is immiscible in water and alcohols; however, it is miscible in non-polar organic liquids, oils, and bitumens. Krasol®LBH5000 reacts through the double bonds along the polymer chain and through the terminal hydroxyl groups. It is particularly useful as the polyol component in polyurethane systems.

PRODUCT HIGHLIGHTS

Excellent chemical resistance
Good electrical characteristics
Good low temperature properties
Hydroxyl functionality
Narrow molecular weight distribution
Resists hydrolysis

SUGGESTED APPLICATIONS

Adhesives
Coatings
Composites, binding agent for
Elastomers, castable urethane
Elastomers, thermoplastic
Electronics, potting compounds
Encapsulants
Hydrolytic stability enhancer for polyurethanes
Polymer modification
Polyurethane foams
Sealing and putty compounds

Krasol® LBH 5000
TYPICAL PHYSICAL AND CHEMICAL PROPERTIES

Microstructure:	
1,2-vinyl, %	65
1,4-cis, %	12.5
1,4-trans, %	22.5
Density, g/cm3	0.9@20C
Hydroxyl functionality	1.9-2.0
Hydroxyl value, meq/g	0.38
Mn, g/mol.	5000
Non-volatile material %	99.5
Polydispersity	1.35
Viscosity @25C, Pa.s	29
Viscosity @30C, Pa.s	19
Water, wt.%	0.04

Regulatory Notice
Krasol® LBH 5000 is regulated by the United States Department of Commerce and may not be exported without license from that organization.

KRASOL® LBH 10000

KRASOL® HYDROXYL TERMINATED POLYBUTADIENE

DESCRIPTION

Krasol® LBH10000 is a linear polybutadiene polymer with hydroxyl end groups. Due to a high concentration of olefinic double bonds and low molecular weight, Krasol® LBH 10000 is a liquid at ambient temperature. The product is immiscible in water and alcohols; however, it is miscible in non-polar organic liquids, oils, and bitumens. Krasol® LBH 10000 reacts through the double bonds along the polymer chain and through the terminal hydroxyl groups. It is particularly useful as the polyol component in polyurethane systems.

PRODUCT HIGHLIGHTS

Excellent chemical resistance
Good electrical characteristics
Good low temperature properties
Hydroxyl functionality
Narrow molecular weight distribution
Resists hydrolysis

SUGGESTED APPLICATIONS

Adhesives
Coatings
Composites, binding agent for
Elastomers, castable urethane
Elastomers, thermoplastic
Electronics, potting compounds
Encapsulants
Hydrolytic stability enhancer for polyurethanes
Polymer modification
Polyurethane foams
Sealing and putty compounds

Krasol® LBH 10000
TYPICAL PHYSICAL AND CHEMICAL PROPERTIES

Microstructure:	
1,2-vinyl, %	65
1,4-cis, %	18
1,4-trans, %	17
Density, g/cm^3	0.9 @20°C
Hydroxyl value, meq/g	0.19
M_n, g/mol.	10000
Non-volatile material, %	99.5
Polydispersity	1.1
Viscosity, @ 50°C, Pa.s.	35
Water, wt.%	0.04

Regulatory Notice
Krasol® LBH 10000 is regulated by the United States Department of Commerce and may not be exported without license from that organization.

KRASOL® LBH-P 2000

KRASOL® HYDROXYL TERMINATED POLYBUTADIENE

DESCRIPTION

Krasol®LBH-P2000 is a linear polybutadiene polymer with primary hydroxyl end groups. Due to a high concentration of olefinic double bonds and low molecular weight, Krasol®LBH-P2000 is a liquid at ambient temperature. The product is immiscible in water and alcohols; however, it is miscible in non-polar organic liquids, oils, and bitumens. Krasol®LBH-P2000 reacts through the double bonds along the polymer chain and through the terminal hydroxyl groups. It is particularly useful as the polyol component in polyurethane systems.

PRODUCT HIGHLIGHTS

Excellent chemical resistance
Good electrical characteristics
Good low temperature properties
Hydrolysis resistance
Hydroxyl functionality
Narrow molecular weight distribution

SUGGESTED APPLICATIONS

Adhesives
Biners
Cast polymers
Coatings
Electronics, potting compounds
Encapsulants
Polymer modification
Sealants

Krasol® LBH-P 2000
TYPICAL PHYSICAL AND CHEMICAL PROPERTIES

Microstructure:	
1,2-vinyl, %	65
1,4-cis, %	12.5
1,4-trans, %	22.5
Density, g/cm^3	0.9 @20°C
Hydroxyl value, meq/g	0.91
M_n, g/mol.	2000
Non-volatile material %	99.5
Polydispersity	1.35
Viscosity, @ 25°C, Pa.s.	20
Water, wt.%	0.04
Hydroxyl functionality	1.9-2.0

Regulatory Notice
Krasol® LBH-P 2000 is regulated by the United States Department of Commerce and may not be exported without license from that organization.

KRASOL® LBH-P 3000

KRASOL® HYDROXYL TERMINATED POLYBUTADIENE

DESCRIPTION

Krasol®LBH-P3000 is a linear polybutadiene polymer with primary hydroxyl end groups. Due to a high concentration of olefinic double bonds and low molecular weight, Krasol®LBH-P3000 is a liquid at ambient temperature. The product is immiscible in water and alcohols; however, it is miscible in non-polar organic liquids, oils, and bitumens. Krasol®LBH-P3000 reacts through the double bonds along the polymer chain and through the terminal hydroxyl groups. It is particularly useful as the polyol component in polyurethane systems.

PRODUCT HIGHLIGHTS

Excellent chemical resistance
Good electrical characteristics
Good low temperature properties
Hydrolysis resistance
Hydroxyl functionality
Narrow molecular weight distribution

SUGGESTED APPLICATIONS

Adhesives
Biners
Cast polymers
Coatings
Electronics, potting compounds
Encapsulants
Polymer modification
Sealants

Krasol® LBH-P 3000
TYPICAL PHYSICAL AND CHEMICAL PROPERTIES

Microstructure:	
1,2-vinyl, %	65
1,4-cis, %	12.5
1,4-trans, %	22.5
Density, g/cm^3	0.9 @20°C
Hydroxyl value, meq/g	0.64
M_n, g/mol.	3200
Non-volatile material %	99.5
Polydispersity	1.35
Viscosity, @ 25°C, Pa.s.	20
Water, wt.%	0.04
Hydroxyl functionality	1.9-2.0

Regulatory Notice
Krasol® LBH-P 3000 is regulated by the United States Department of Commerce and may not be exported without license from that organization.

KRASOL® LBH-P 5000

KRASOL® HYDROXYL TERMINATED POLYBUTADIENE

DESCRIPTION

Krasol®LBH-P5000 is a linear polybutadiene polymer with primary hydroxyl end groups. Due to a high concentration of olefinic double bonds and low molecular weight, Krasol® LBH-P5000 is a liquid at ambient temperature. The product is immiscible in water and alcohols; however, it is miscible in non-polar organic liquids, oils, and bitumens. Krasol®LBH-P5000 reacts through the double bonds along the polymer chain and through the terminal hydroxyl groups. It is particularly useful as the polyol component in polyurethane systems.

PRODUCT HIGHLIGHTS

Excellent chemical resistance
Good electrical characteristics
Good low temperature properties
Hydrolysis resistance
Hydroxyl functionality
Narrow molecular weight distribution

SUGGESTED APPLICATIONS

Adhesives
Biners
Cast polymers
Coatings
Electronics, potting compounds
Encapsulants
Polymer modification
Sealants

Krasol® LBH-P 5000
TYPICAL PHYSICAL AND CHEMICAL PROPERTIES

Microstructure:	
1,2-vinyl, %	65
1,4-cis, %	12.5
1,4-trans, %	22.5
Density, g/cm3	0.9@20C
Hydroxyl functionality	1.9-2.0
Hydroxyl value, meq/g	0.38
Mn, g/mol.	5300
Non-volatile material %	99.5
Polydispersity	1.35
Water, wt.%	0.04
Viscosity @25°C, Pa.s	29
Viscosity @30°C, Pa.s	19

Regulatory Notice
Krasol® LBH-P 5000 is regulated by the United States Department of Commerce and may not be exported without license from that organization.

KRASOL® LBH-P 10000

KRASOL® HYDROXYL TERMINATED POLYBUTADIENE

DESCRIPTION

Krasol®LBH-P10000 is a linear polybutadiene polymer with primary hydroxyl end groups. Due to a high concentration of olefinic double bonds and low molecular weight, Krasol® LBH-P10000 is a liquid at ambient temperature. The product is immiscible in water and alcohols; however, it is miscible in non-polar organic liquids, oils, and bitumens. Krasol®LBH-P10000 reacts through the double bonds along the polymer chain and through the terminal hydroxyl groups. It is particularly useful as the polyol component in polyurethane systems.

PRODUCT HIGHLIGHTS

Excellent chemical resistance
Good electrical characteristics
Good low temperature properties
Hydrolysis resistance
Hydroxyl functionality
Narrow molecular weight distribution

SUGGESTED APPLICATIONS

Adhesives
Biners
Cast polymers
Coatings
Electronics, potting compounds
Encapsulants
Polymer modification
Sealants

Krasol® LBH-P 10000
TYPICAL PHYSICAL AND CHEMICAL PROPERTIES

Microstructure:	
1,2-vinyl, %	65
1,4-cis, %	12.5
1,4-trans, %	22.5
Density, g/cm3	0.9@20C
Hydroxyl functionality	1.9-2.0
Hydroxyl value, meq/g	0.19
Mn, g/mol.	10,000
Non-volatile material %	99.5
Polydispersity	1.35
Water, wt.%	0.04
Viscosity, Pa.s (50°C)	35

Regulatory Notice
Krasol® LBH-P 10000 is regulated by the United States Department of Commerce and may not be exported without license from that organization.

KRASOL® HLBH-P 2000

KRASOL® HYDROGENATED HYDROXYL TERMINATED POLYOLEFIN

DESCRIPTION

Krasol® HLBH-P 2000 is a an odorless, water clear, saturated aliphatic liquid polyol. The saturated nature of the resin provides light-and weather-stability, enabling formulators to develop polyurethane coatings that will not yellow or lose their critical mechanical properties, such as flexibility, adhesion, elongation, and strength. In addition, Krasol® HLBH-P 2000 provides improved heat resistance and adhesion to difficult substrates (i.e., polyolefins) compared to standard hydroxyl-terminated polybutadiene resins.

Krasol® HLBH-P 2000
TYPICAL PHYSICAL AND CHEMICAL PROPERTIES

Appearance	Clear liquid
Diol purity, %	>97
Hydrogenation extent, %	>98
Hydroxyl functionality	1.9
Hydroxyl number, mg KOH/g	49.8
Hydroxyl value, meq/g	0.89
M_n, g/mol.	2100
Viscosity, Pa.s @ 25°C	37
Water, wt.%	0.03
Tg, °C	-46

PRODUCT HIGHLIGHTS

Excellent thermal stability
Good weatherability
Hydrophobicity
Low color - high clarity
Low glass transition temperature
Reactive hydroxyl groups

PERFORMANCE PROPERTIES

Acid and base resistance
Adhesion
Asphalt miscibility
Electrical insulation properties
Low temperature flexibility

SUGGESTED APPLICATIONS

Adhesives, coatings & sealants
Electronics, encapsulants
Polymer modification
Prepolymer-two-component
Thermoplastic polyurethane (TPU),

KRASOL® HLBH-P 3000

KRASOL® HYDROGENATED HYDROXYL TERMINATED POLYOLEFIN

DESCRIPTION

Krasol® HLBH-P 3000 is a an odorless, water clear, saturated aliphatic liquid polyol. The saturated nature of the resin provides light-and weather-stability, enabling formulators to develop polyurethane coatings that will not yellow or lose their critical mechanical properties, such as flexibility, adhesion, elongation, and strength. In addition, Krasol® HLBH-P 3000 provides improved heat resistance and adhesion to difficult substrates (i.e., polyolefins) compared to standard hydroxyl-terminated polybutadiene resins.

PRODUCT HIGHLIGHTS

Excellent thermal stability
Good weatherability
Hydrophobicity
Low color - high clarity
Low glass transition temperature
Reactive hydroxyl groups

PERFORMANCE PROPERTIES

Acid and base resistance
Adhesion
Asphalt miscibility
Electrical insulation properties
Low temperature flexibility

SUGGESTED APPLICATIONS

Adhesives, coatings & sealants
Electronics, encapsulants
Polymer modification
Prepolymer-two-component
Thermoplastic polyurethane (TPU),

Krasol® HLBH-P 3000
TYPICAL PHYSICAL AND CHEMICAL PROPERTIES

Appearance	Clear liquid
Diol purity, %	>97
Hydrogenation extent, %	>98
Hydroxyl functionality	1.9
Hydroxyl number, mg KOH/g	31
Hydroxyl value, meq/g	0.56
M_n, g/mol.	3100
Viscosity, Pa.s @ 50°C	7
Viscosity, Pa.s @ 25°C	65
Water, wt.%	0.03
Tg, °C	-46

KRASOL® NN-22

KRASOL® ISOCYANATE-TERMINATED PREPOLYMER

DESCRIPTION

Krasol® NN-22 is an isocyanate-terminated prepolymer prepared from hydroxyl-terminated polybutadiene and a modified diphenylmethane diisocyanate (MDI). The isocyanate groups of Krasol® NN-22 undergo all the reactions common to isocyanate, most notably the reactions used in polyurethane production. The prepolymer can be used in either one-component or two-component systems.

PRODUCT HIGHLIGHTS

Adhesion to non-polar materials
Excellent electrical insulation properties
Good low temperature properties
Hydrolysis resistance
Very low moisture permeability

SUGGESTED APPLICATIONS

Adhesives
Coatings
Composites
Moisture cured formulations
Prepolymer for two-component polyurethanes

Krasol® NN-22
TYPICAL PHYSICAL AND CHEMICAL PROPERTIES

NCO group content, wt.%	8.8
NCO group content, mol/Kg	2.1
Viscosity, Pa.s	17 @25°C
Density, g/cm^3	0.98 @20°C

KRASOL® NN-23

KRASOL® ISOCYANATE-TERMINATED PREPOLYMER

DESCRIPTION

Krasol® NN-23 is an isocyanate-terminated prepolymer prepared from hydroxyl-terminated polybutadiene (Krasol® LBH3000) resin and a modified diphenylmethane diisocyanate (MDI). The isocyanate groups of Krasol® NN-23 undergo all the reactions common to isocyanate, most notably the reactions used in polyurethane production. The prepolymer can be used in either one-component or two-component systems.

PRODUCT HIGHLIGHTS

Adhesion to non-polar materials
Excellent electrical insulation properties
Good low temperature properties
Hydrolysis resistance
Very low moisture permeability

SUGGESTED APPLICATIONS

Adhesives
Coatings
Composites
Moisture cured formulations
Prepolymer for two-component polyurethanes

Krasol® NN-23
TYPICAL PHYSICAL AND CHEMICAL PROPERTIES

NCO group content, wt.%	4.5
NCO group content, mol/Kg	1.07
Viscosity, Pa.s	1.7 @25°C
Density, g/cm^3	0.94 @20°C

KRASOL® NN-25

KRASOL® ISOCYANATE-TERMINATED PREPOLYMER

DESCRIPTION

Krasol® NN-25 is an isocyanate-terminated prepolymer prepared from hydroxyl-terminated polybutadiene (Krasol® LBH3000) resin and a modified diphenylmethane diisocyanate (MDI). The isocyanate groups of Krasol® NN-25 undergo all the reactions common to isocyanate, most notably the reactions used in polyurethane production. The prepolymer can be used in either one-component or two-component systems.

PRODUCT HIGHLIGHTS

Adhesion to non-polar materials
Excellent electrical insulation properties
Good low temperature properties
Hydrolysis resistance
Very low moisture permeability

SUGGESTED APPLICATIONS

Adhesives
Coatings
Composites
Moisture cured formulations
Prepolymer for two-component polyurethanes

Krasol® NN-25
TYPICAL PHYSICAL AND CHEMICAL PROPERTIES

NCO group content, wt.%	11.5
NCO group content, mol/Kg	2.75
Paraffin oil, wt. %	20
Viscosity, Pa.s	1.2 @25°C
Density, g/cm^3	1 @20°C

KRASOL® LBD2000

KRASOL® ISOCYANATE-TERMINATED PREPOLYMER

DESCRIPTION

Krasol® LBD2000 is an isocyanate-terminated pre polymer prepared by the reaction of a hydroxyl-terminated polybutadiene (Krasol® LBH2000) and toluene diisocyanate. The isocyanate groups of Krasol® LBD2000 undergo all the reactions common to isocyanate, most notably the reactions used in polyurethane production. The prepolymer can be used in either one-component or two-component systems.

PRODUCT HIGHLIGHTS

Adhesion to non-polar materials
Excellent electrical insulation properties
Good low temperature properties
Hydrolysis resistance
Very low moisture permeability

SUGGESTED APPLICATIONS

Cast elastomers
Coatings, acid and salt resistance
Conventional polyurethane modification
Sealant, industrial and construction

Krasol® LBD2000
TYPICAL PHYSICAL AND CHEMICAL PROPERTIES

NCO group content, wt.%	3.4
Free TDI, wt. %	1.1
Viscosity, Pa.s	95 @25°C

KRASOL® LBD3000

KRASOL® ISOCYANATE-TERMINATED PREPOLYMER

DESCRIPTION

Krasol® LBD3000 is an isocyanate-terminated prepolymer prepared by the reaction of a hydroxyl-terminated polybutadiene (Krasol® LBH3000) and tolune diisocyanate. The isocyanate groups of Krasol® LBD3000 undergo all the reactions common to isocyanate, most notably the reactions used in polyurethane production. The prepolymer can be used in either one-component or two-component systems.

PRODUCT HIGHLIGHTS

Adhesion to non-polar materials
Excellent electrical insulation properties
Good low temperature properties
Hydrolysis resistance
Very low moisture permeability

SUGGESTED APPLICATIONS

Cast elastomers
Coatings, acid and salt resistance
Conventional polyurethane modification
Sealant, industrial and construction

Krasol® LBD3000
TYPICAL PHYSICAL AND CHEMICAL PROPERTIES

NCO group content, wt.%	3
Free TDI, wt. %	1.1
Viscosity, Pa.s	120 @25°C

CN307

POLYBUTADIENE DIACRYLATE

DESCRIPTION

CN307 is a polybutadiene diacrylate oligomer. CN307 demonstrates excellent flexibility, water resistance and chemical resistance. It is used in UV/EB-cured coatings, adhesives, electronics, and photopolymers.

PRODUCT HIGHLIGHTS

Excellent flexibility
Hydrophobic
Low viscosity

PERFORMANCE PROPERTIES

Adhesion
Chemical resistance
Flexibility
Impact strength
Low shrinkage
Water resistance

SUGGESTED APPLICATIONS

Adhesives
Coatings
Electronics
Sealants

CN307
TYPICAL PHYSICAL AND CHEMICAL PROPERTIES

Appearance	Clear liquid
Color, Gardner	1G
Functionality	2
Refractive index @25°C	1.5034
Specific gravity @25°C	0.9524
Tg, °C	-16.9
Viscosity, Pa.s @60°C	0.75
Viscosity, Pa.s @25°C	8

Poly bd® 45CT

CARBOXYLIC ACID TERMINATED POLYBUTADIENE

DESCRIPTION

Poly bd® 45CT is a branched polybutadiene polymer with carboxylic acid end groups. Due to a high concentration of olefinic double bonds and low molecular weight, Poly bd® 45CT is a liquid at ambient temperature. The product is immiscible in water and alcohols; however, it is miscible in non-polar organic liquids, oils, and bitumens. Poly bd® 45CT reacts through the double bonds along the polymer chain and through the terminal carboxylic acid groups. This material can be crosslinked with polycarbodiimide or aziridine to form gels.

PRODUCT HIGHLIGHTS

Excellent chemical resistance
Good electrical characteristics
Good low temperature properties
Carboxylic acid functionality
Resists hydrolysis

SUGGESTED APPLICATIONS

Slow release gels
Modifier for thermosplastics such as polyamides, PET, PBT...
Modifier for thermosets such as epoxy resins
Adhesives
Coatings
Electronics, potting compounds
Encapsulants
Sealing and putty compounds

Poly bd® 45CT
TYPICAL PHYSICAL AND CHEMICAL PROPERTIES

Mn, g/mol	3050
Non-volatile	99.9%
Density, 25°C	0.9
Viscosity @60°C	4300
Acid Value,	0.77 meq/g

Regulatory Notice
Poly bd® 45CT is regulated by the United States Department of Commerce and may not be exported without license from that organization.

Poly bd® 2000CT (PRO 6162)

CARBOXYLIC ACID TERMINATED POLYBUTADIENE

DESCRIPTION

Poly bd® 2000CT is a branched polybutadiene polymer with carboxylic acid end groups. Due to a high concentration of olefinic double bonds and low molecular weight, Poly bd® 2000CT is a liquid at ambient temperature. The product is immiscible in water and alcohols; however, it is miscible in non-polar organic liquids, oils, and bitumens. Poly bd® 2000CT reacts through the double bonds along the polymer chain and through the terminal carboxylic acid groups. This material can be crosslinked with polycarbodiimide or aziridine to form gels.

PRODUCT HIGHLIGHTS

Excellent chemical resistance
Good electrical characteristics
Good low temperature properties
Carboxylic acid functionality
Narrow molecular weight distribution
Resists hydrolysis

SUGGESTED APPLICATIONS

Slow release gels
Modifier for thermosplastics such as polyamides, PET, PBT...
Modifier for thermosets such as epoxy resins
Adhesives
Coatings
Electronics, potting compounds
Encapsulants
Sealing and putty compounds

Poly bd® 2000CT
TYPICAL PHYSICAL AND CHEMICAL PROPERTIES

1,2-vinyl, %	65
1,4-cis, %	18
1,4-trans. %	17
Density, g/cm^3	0.9 @20°C
Mn, g/mol	2300
Non-volatiles	99.5%
Viscosity, cps @60°C	4300
Acid value,	0.86 meq/g

Regulatory Notice
Poly bd® 2000CT is regulated by the United States Department of Commerce and may not be exported without license from that organization.

Poly bd® 3000CT (PRO 6163)

CARBOXYLIC ACID TERMINATED POLYBUTADIENE

DESCRIPTION

Poly bd® 3000CT is a branched polybutadiene polymer with carboxylic acid end groups. Due to a high concentration of olefinic double bonds and low molecular weight, Poly bd® 3000CT is a liquid at ambient temperature. The product is immiscible in water and alcohols; however, it is miscible in non-polar organic liquids, oils, and bitumens. Poly bd® 3000CT reacts through the double bonds along the polymer chain and through the terminal carboxylic acid groups. This material can be crosslinked with polycarbodiimide or aziridine to form gels.

PRODUCT HIGHLIGHTS

Excellent chemical resistance
Good electrical characteristics
Good low temperature properties
Carboxylic acid functionality
Resists hydrolysis

SUGGESTED APPLICATIONS

Slow release gels
Modifier for thermosplastics such as polyamides, PET, PBT...
Modifier for thermosets such as epoxy resins
Adhesives
Binding agent for composits
Coatings
Electronics, potting compounds
Encapsulants
Sealing and putty compounds

Poly bd® 3000CT
TYPICAL PHYSICAL AND CHEMICAL PROPERTIES

1,2-vinyl, %	65
1,4-cis, %	18
1,4-trans. %	17
Density, g/cm^3	0.9 @20°C
Mn, g/mol	3300
Non-volatiles	99.5%
Viscosity, cps @ 60°C	5000
Acid value,	0.60 meq/g

Regulatory Notice
Poly bd® 3000CT is regulated by the United States Department of Commerce and may not be exported without license from that organization.

Reactions with Poly bd® and Krasol® Polyols and Their Derivatives

Reactions At the Hydroxyl Groups
The hydroxyl functionality in Poly bd® and Krasol® resins can be utilized in both polymerization and derivatization reactions as indicated in the diagram on page36 in section a).

Polyurethanes
Poly bd® and Krasol® resins are readily chain extended with di and polyisocyanates to produce polyurethanes with a wide range of mechanical properties. Typical one-shot and prepolymer techniques can be employed. The end products have excellent hydrolytic stability, low temperature flexibility, and can be extended with a wide range of organic and inorganic materials including hydrocarbon oils and inorganic fillers.

Poly bd® resins have predomantly primary and allylic hydroxyl functionality. Krasol® products come with primary (LBH-P grades) and secondary (LBH grades) hydroxyl functionality. The number of hydroxyl functionalities per molecule in the Poly bd® and Krasol® product lines ranges from 1.9 to 4.

Prepolymers and Thermoplastic Urethane
The chemical nature of Krasol® resins makes them suitable for the preparation of isocyanate terminated prepolymers and thermoplastic polyurethanes (TPU). Sartomer offers Krasol® polyols and also isocyanate terminated derivatives (prepolymers) of the polyols. The Krasol® NN grades are MDI terminated and the Krasol® LBD are TDI terminated. These products are cured with polyols, amines or moisture. They are typically used as adhesives, sealants, cast elastomers and binders (see brochure "Krasol® Prepolymers").

Ester Derivatives
Ester derivatives can be prepared by reaction of Poly bd® and Krasol® resins with the appropriate carboxylic acids, acid chlorides, anhydrides or by transesterification.

Reactions at the Alkene Groups
The carbon - carbon bond unsaturation in Poly bd® Krasol® resins, which is predominantly internal, can be utilized in both polymerization and derivatization reactions, as illustrated in section b. on page 36.

Oxidative Crosslinking – Poly bd® Krasol® resins are reactive under oxidative conditions to yield internally cross linked, film forming materials. Coatings derived from such processes can range from flexible to brittle compositions.

Epoxidation — Oxirane derivatives can be prepared with various epoxide contents. The resulting products can be cured by the reaction of the epoxide groups (UV cationic) and/or the hydroxyl groups. These materials can also be used in combination with other epoxy resins to produce a variety of products.

Addition to Double Bonds
Other reactions common to olefinic unsaturation, in theory, are applicable to Poly bd® Krasol® resins. For example addition of thiols to the double bond gives unique functional derivatives.

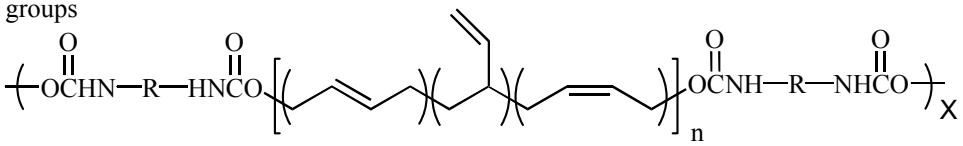
Saturated hydroxyl terminated polybutadiene
Krasol® HLBH-P3000 is a hydroxyl terminated polyolefin. This product can be used where weathering and heat stability properties are critical and when specific adhesion properties are required.

Isocyanate terminated prepolymers
Acrylate terminated resins include a commercial grade CN307 and some developmental grades such as PRO6611 (diacrylated aliphatic polyolefin) and PRO 6229, diacrylated polybutadiene. These products can be cured by UV light, electron beam and peroxides.

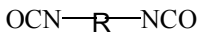
Carboxyl terminated
These products can be crosslinked with epoxies or used in the modification of polymers.

Reactions Of Poly bd Resins

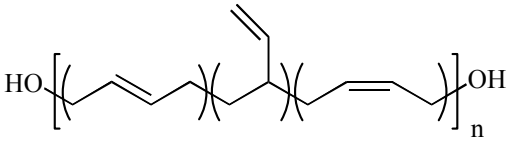
a.) At the hydroxyl groups



Poly bd - based polyurethane

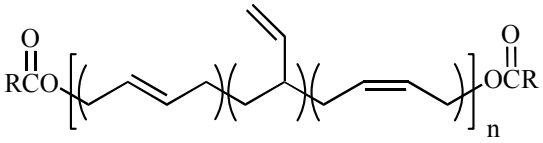


Diisocyanate



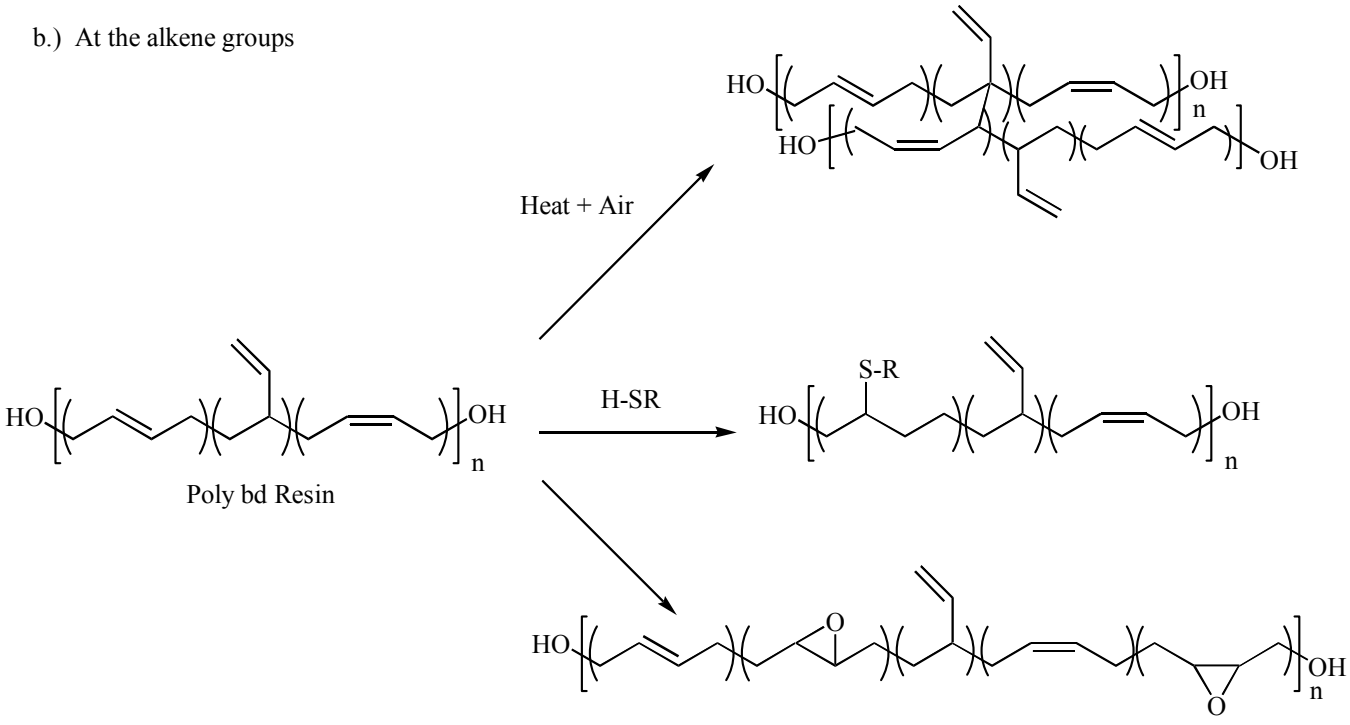
Poly bd Resin

Carboxylic Acid,
Acid Chloride Or Anhydride



Poly bd - based Ester

b.) At the alkene groups



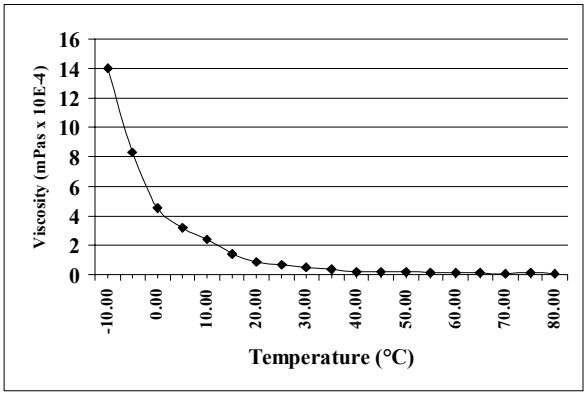
Poly bd Resin

Poly bd 600E and 605E

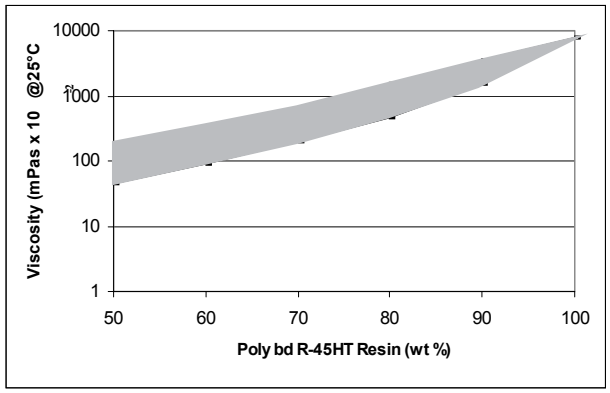
Typical Viscosity Properties of Poly bd® and Krasol® Resins

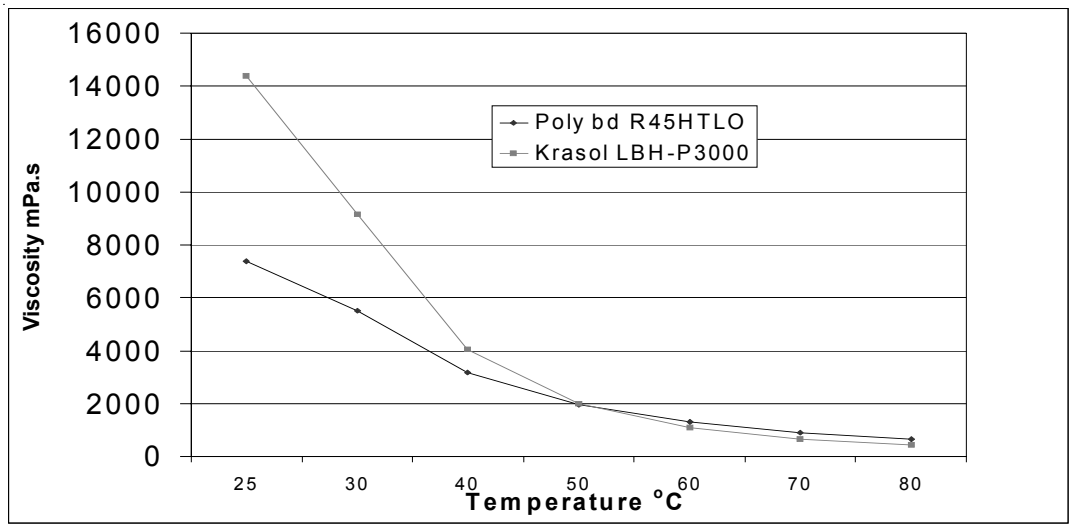
Poly bd® and Krasol® resins are viscous liquids at room temperature. To facilitate transfer of these products, the viscosity can be reduced by heating the neat resin as in the figure below or by cutting with solvent.

Poly bd® R-45HTLO Resins Viscosity as a Function of Temperature



Poly bd® R-45HTLO Resins-Solutions Viscosity Envelope





I. General

Poly bd® resins are liquid, hydroxyl-terminated homopolymers of butadiene. These resins are only slightly combustible with flash points greater than 400°F (205°C). They exhibit excellent stability if properly handled and stored.

Drum Storage

Poly bd® resins are supplied in 55-gallon non-returnable, open-head steel drums having an epoxy phenolic lining. Krasol® resins are supplied in 200 Kg. drums. Storage of the drums out of direct sunlight at temperatures between 50°F (10°C) and 90°F (32°C) is recommended. Due to the viscosity of the products heating may be required to facilitate removal from the drums. Exposure of the drum or contents to temperature in excess of 150°F (66°C) should be avoided. As a result, the use of band or bayonet heaters should be avoided due to the possibility of localized overheating and the resultant oxidative crosslinking and viscosity increase. Suggested methods of heating include the use of hot boxes or water baths. After opening and removal of a portion of the contents it is recommended that the vapor space in the drum be flushed with an inert gas, such as dry nitrogen, prior to reclosure.

Poly bd® resins should be stored in nitrogen padded vessels to prevent moisture contamination and oxygen degradation. Elevated temperatures can result in thermal degradation. The storage vessel should be constructed of 300 series stainless steel or epoxy-lined carbon steel.

Since the polymers are viscous, lines must be sized carefully and positive displacement pumps are necessary. Lines should be electrically traced and insulated. Suction heaters are often used to assure good supply to the pump. Traced piping and heater skin temperatures should not exceed 150°F (66°C).

II. Bulk Storage– Detail

Poly bd® resins are best stored in low pressure cone roof tanks under slightly positive nitrogen pressure. The material should be stored at ambient temperature (50 to 90°F for 10 to 32°C) so insulation is often advantageous. The tank should be located in a sheltered area to help minimize heat gain and heat loss.

Level indicators should be provided as well as a high level alarm to warn of over-filling the tank.

The bottom of the tank should be sloped to the pump suction and sump. The section nozzle should be at such an elevation that normal piping layout will put the center line of the nozzle at the center line of the pump. A recirculation line with a back pressure control valve will allow safe operation without requiring pump shut-down.

Pumping out the heel, when service or inspection of the tank is required, should be by use of the scavenger line if the suction line is located above the bottom of the tank.

Lines should be sized carefully, allowing for the viscosity of the product.

The use of a suction heater between the tank and pump is recommended to assure good pump operation. The maximum temperature of the product should not exceed 150°F (66°C). Therefore, the use of live steam is not recommended. Hot condensate may be used without overheating the exchanger tube walls. Another possibility is the use of electric heaters which can control the sheath (heating surface) temperature. Where condensate or hot water is used for heating, precautions must be taken to prevent water contact with the product.

Before the pump is shut-down, the suction heater should be shut-off and product pumped through to remove the residual heat before the circulation is stopped. This procedure will prevent loss of quality due to "heat-soaking" the product which can result in product crosslinking and viscosity increase.

No internal coils, bayonets or other heating devices should be installed.

III. Materials of Construction

A. Tanks

Storage vessels may be made of stainless steel, or epoxy lined carbon steel.

Small vessels are usually fabricated from stainless steel while large storage tanks are more economically fabricated in epoxy-lined carbon steel.

Tanks should be insulated to minimize heat loss and heat gain.

B. Pumps

In general, 300 series stainless steel positive displacement pumps such as Sier-Bath brand double screw pumps or Viking brand gear pumps are recommended. These units are equipped with external bearings which give good service life and are easily in spected and repaired.

C. Heat Exchanger

Product-wetted parts of heaters should be constructed of 300 series stainless steel.

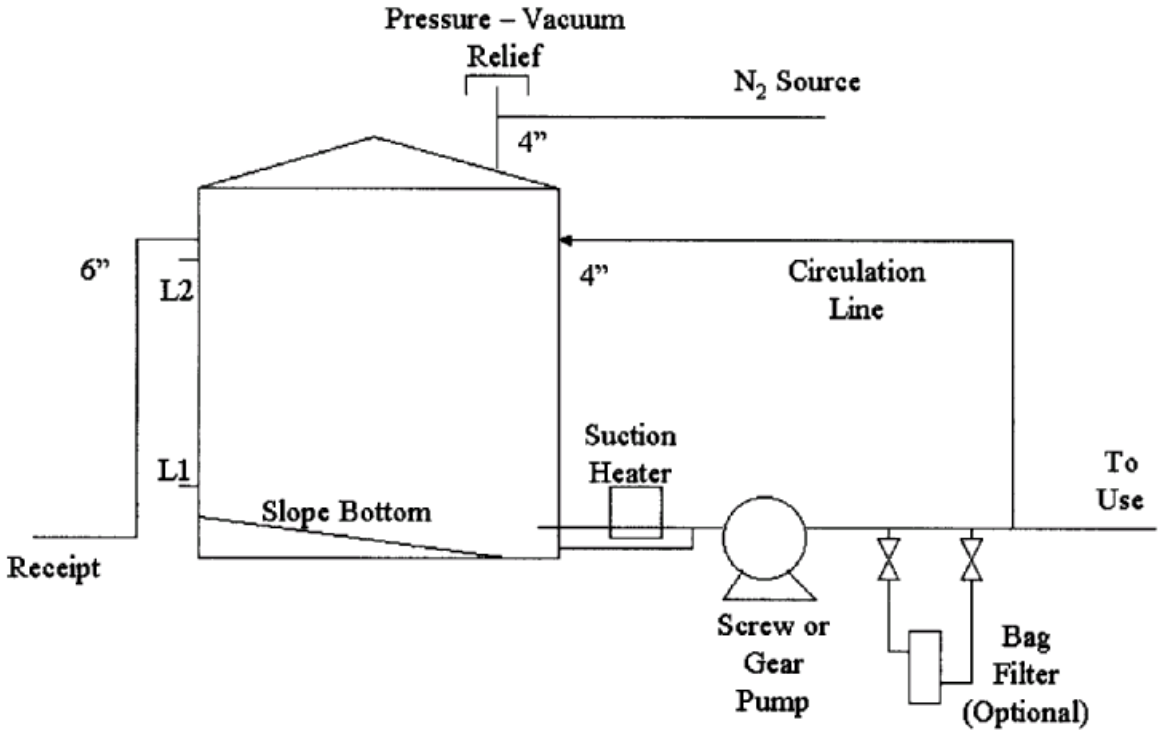
D. Piping

Lines should be adequately sized considering the viscosity of the material being handled. Electrical tracing and insulation should be provided where lines are exposed to low temperatures. Piping should be 300 series stainless steel.

IV. Tank Truck Shipments

Clean, dry, insulated stainless steel trailers, preferably equipped for rear or center off-loading (subject to availability), should be specified. Product is loaded at 140-150°F (60-66°C). Depending on the outside temperature, the product temperature will decrease approximately 5-10°F (3-6°C) per day. Since a minimum off-loading temperature of 120°F-(49°C) is recommended, in-transit heating will usually be required during cold weather. Clean and dry pumps and hoses should be used for product discharge. Positive displacement, double screw or gear pumps and 3 inch hoses and connections are recommended. A minimum 60 gpm pump size is suggested. Off-loading may be assisted by the application of dry nitrogen pressure to the truck

Poly bd® Typical Tank Arrangement



Poly bd® and Krasol® FDA Status

The firm of Keller and Heckman (Washington, D.C.) advises that hydroxyl terminated polybutadiene resins (HTPB) may be used by adhesives formulators in food-contact articles.

According to the firm's opinion, the HTPB resins, which include Cray Valley's Krasol® resins, as well as Poly bd® R 45HTLO and Poly bd® R 20LM resins, may be used "as components of adhesives used in food-contact articles, including polyurethane adhesives, and that such use may properly be said to comply fully with the Federal Food, Drug, and Cosmetic Act and all applicable food additive regulations, including 21 C.F.R. § 175.105 ('Adhesives')". One such use includes the laminating adhesives commonly found in food packaging applications.

In addition, Cray Valley's Krasol® and Poly bd® HTPB resins, including the internally epoxidized Poly bd® 600E and Poly bd® 605E products, may be used in compliance with FDA 21 C.F.R § 175.300 ("Resinous and polymeric coatings"); for example, as part of an oxidatively crosslinked or a UV cationically cured coating.

Supplemental Poly bd® and Krasol® Literature

Technical literature including starting formulations, technical papers, product bulletins, and material safety data sheets are available to optimize the use of Cray Valley's products.

Literature can be obtained through Cray Valley's cusotmer service group (1-877-871-2729) or our web site (www.crayvalleyus.com).

Cray Valley offers these additional documents discussing our Poly bd® resins to aid in formulating.

Prepolymers General Bulletin

Polyurethane Elastomers Derived from Krasols® and Hydrogenated Krasols® and their Weathering and Thermal Aging Properties. The Poly bd® Resin in Urethane Elastomers

The Poly bd® Resin in Urethane Elastomers

Poly bd® Resins Starting Formulations

Poly bd® Resins in Electrical Applications

Poly bd® Resins in Adhesives

Poly bd® Resins in Foam Applications

Polyurethane Gels from Poly bd® Resins

Poly bd® 600E and 605E - Epoxidized Polybutadienes

Novel Polybutadiene Diols For Thermoplastic Polyurethane

Krasol Prepolymers

Grafting of Hydroxyl Terminated Polybutadiene with 2-Mercaptoethanol

Polyurethane Binders for the Production of Composites Materials

Poly bd® Resins in the Coatings Industry

Poly bd® Resins in Insulated Glass Window Sealants

Poly bd® Resins With Low Hydroxyl Functionality

Polybd® Resins in Construction Applications

Thermal and light Stabilization of Poly bd® Resin Formulations

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http://www.crayvalley.com

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