

## Polyester Sealant and Potting Formulations from Poly BD<sup>®</sup> and MA grafted polybutadiene



### These resins react to form cured polyesters with:

- Superior electrical insulating capabilities
- Excellent low-temperature properties
- Stability in hot, humid environments

### Introduction

Poly BD<sup>®</sup> resins are hydroxyl-terminated polybutadiene polyols commonly used in urethane sealant, adhesive or electrical potting formulations, where they impart excellent hydrophobicity, thermal cycling properties, low glass transition temperature and embedment stress properties. MA grafted polybutadiene are maleinized polybutadienes which are used in sealant and epoxy formulations, where they enhance moisture resistance, toughness and electrical insulation properties. Poly BD<sup>®</sup> and MA grafted polybutadiene react to give cured, polyester products, which exhibit a combination of the properties characteristic of each resin. With a combination of ease of handling, superior electrical insulating capabilities, minimal curing exotherm, excellent low-temperature properties, and stability in hot, humid environments, Poly BD<sup>®</sup>/MA grafted polybutadiene systems outperform other materials in targeted applications.

### Formulations

Both resins are liquids, so they can be mixed and used immediately, or they can be formulated as a stable two-part system. Curing occurs between the two polymeric resins; no curative, such as a urethane, is used in these formulations. In addition, no byproducts are produced during the reaction. The crosslinking esterification reaction between the hydroxyl groups of Poly BD<sup>®</sup> resin and the anhydride groups of MA grafted polybutadiene resin can occur at an elevated temperature without any catalyst. At lower temperatures, a catalyst, such as Polycat<sup>®</sup> 41 (Air Products and Chemicals, Inc.) or 4-N-pyrrolidinopyridine can be used to lower the gel time. Poly BD<sup>®</sup>/MA grafted polybutadiene can be diluted with process oils, plasticizers or particulate fillers to lower cost and adjust properties such as hardness.

# TECHNICAL UPDATE

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## Typical two-part formulation

Ingredient	Part A	Part B	Manufacturer
Ricon 131MA10	67.5		Cray Valley
Drakeol 9	32.4	18.9	Penreco
Poly BD® R45 HTLO		74.2	Resin Solutions
Irganox 1010	0.09		Ciba Specialty Chemicals
Tinuvin 770	0.01		Ciba Specialty Chemicals
Sovermol V P650NS		3.95	Cognis Corporation
DAMA 1010		2.95	Albemarle

### Mixing Instructions

Part A: Charge materials into mixing vessel; mix at 25-40 °C for 2 hours. Part B:

Charge materials into mixing vessel; warm to 60 °C, stir for 1 hour. Reaction

Ratio: Part A/Part B are mixed in a ratio of 1/1 wt./wt.

Typical gel time is 20 minutes at 50 °C.

## Properties

Property	Values
Hardness Shore A	24
Tensile Strength, psi	68
Glass Transition Temperature, Tg (°C)	-90
Water Absorption at 25 °C after 96 hrs., wt. %	0.1
Dielectric Constant	2.6
Dissipation Factor	0.01
Volume Resistivity, ohms	$6.9 \times 10^{11}$
Surface Resistivity, ohms	$1.4 \times 10^{14}$

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## Thermal & Electrical Performance

Poly BD®/MA grafted polybutadiene can give improved heat stability and electrical insulating properties compared to commonly used polyurethane potting compositions.

### Thermal Stability

The ester-acid linkage (half-ester) generated by reacting an anhydride group with a hydroxyl group is known to be thermally stable when a high molecular weight alcohol is used. This thermal stability is an advantage when compared to polyurethane gel products, which are thermally reversible at elevated temperatures (see table below).

Product	Hours at specified temperature	Wt. Change, % at 150 °C	Wt. Change, % at 175 °C
Polyurethane	500	-1.8	-3.4
	1000	-2.7	-4.6
Polyester from Poly BD®/MA grafted from polybutadiene	500	-0.8	-1.3
	1000	-0.8	-1.6

### Dielectric Constant

The dielectric constant, or insulating capacity, of the MA grafted Poly BD® product at 1000Hz is superior to that of the polyurethane potting composition, both initially and after aging (see table below).

Product	Hours at specified temperature	Dielectric constant (1000 Hz) at 150 °C	Dielectric constant (1000 Hz) at 175 °C
Polyurethane	Initial	5.86	5.86
	500	5.3	4.93
	1000	5.01	4.81
Polyester from Poly BD®/MA grafted from polybutadiene	Initial	3.53	3.53
	500	3.77	3.96
	1000	4.18	3.38

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### **Resin Solutions**

665 Stockton Drive, Suite 100  
Exton, PA 19341  
1-484-284-8998

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