

# Thermal Resistant PBI Coatings S10 & S15 Product Characteristics and Application Recommendations

## Overview

PBI coatings from PBI Performance Products' S10 and S15 PBI solutions provide a low friction surface for protection from mechanical abrasion; thermal and electrical insulation; and protection from chemical attack for a wide range of substrates.

These solutions are designed for thin conformal coatings. PBI coatings provide thermal resistance that rivals or surpasses other coating systems due to PBI's high glass transition temperature. This, in combination with PBI's low coefficient of thermal expansion (similar to aluminum) makes it an ideal candidate for many demanding applications. The aromatic bi-benzimidazole structure provides superior strength, chemical and thermal resistance inherent in the strong intermolecular bonds. (Fig. 1)

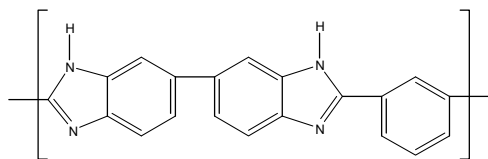


Fig. 1. Chemical structure of PBI polymer.

PBI Performance Products' S10 and S15 polybenzimidazole (PBI) products are ready-to-use solutions suitable for film casting, or coating.

Depending upon the substrate condition and method of application, PBI can be firmly adhered to steel, stainless steel, aluminum, copper, nickel-chromium, glass, ceramics and plastics.

## Bulk PBI Polymer Properties

Table 1. Properties of pure PBI polymer. Actual coating properties may vary.

Property	Value
Tensile strength (MPa)	160
Elongation (%)	3
Modulus (GPa)	5.9
Moisture uptake (% 24h)	0.4
Dielectric constant (1kHz)	3.4
Dissipation factor (10 kHz – 0.1MHz)	.003-.034
Dielectric strength (volts/mil)	580
CTE (ppm, 25-150C)	23
Tg (C)	427

PBI coatings are designed for removal by polar solvents to make re-work easy. Fully cured PBI may be removed by dissolving with polar solvent.

## Typical Properties of S10/ S15 PBI Solution

	S10	S15
Solids (%) w/w	9 +/- 0.5	15 +/- 1.5
Solvent (DMAc) (%) w/w	91	85
Viscosity (cP)	90 +/- 20	750 +/- 150
Stability	26 weeks	4 weeks
Color	red-brown	red-brown

## Remarks

S10 and S15 PBI solutions should be kept sealed and dry at 45F (7C) until use.

Curing requires thermal evaporation of the carrier solvent dimethylacetamide (DMAc) and condensation of the resin.

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While DMAc is the preferred solvent, it is generally regarded as hazardous. Users of the PBI solution should consult the Material Safety Data Sheet and follow appropriate safety precautions.

The preferred coating thickness is dependent upon the application. Thick coatings are possible but are not always preferred. Maximum recommended coating thickness is 50 microns (um).

Avoid sharp edges which will not coat uniformly.

### **Coating Procedure**

#### **1. Solution Preparation**

S10 and S15 PBI solutions are ready to use after bringing up to room temperature. No dilution is necessary for most applications.

#### **2. Substrate Preparation**

Adhesion is best with a very clean and slightly roughened substrate. Surfaces should be cleaned of all oxidation, foreign matter, oils and lubricants. Wash substrate in a heated solution of 5% trisodium phosphate (TSP) in purified water (80 C, 5-10 min.). Triple rinse in purified water. Do not use tap water – particularly on steel. Where the substrate is prone to corrosion (i.e. carbon-steel), use an intermediate dip in a borate-based rust inhibitor followed by another purified water rinse. Rinse in IPA and dry thoroughly.

#### **3. Coating**

Substrate may be coated at ambient temperature. Apply a sufficient amount of S10/ S15 to substrate by slit cast, spin coat, spray or dip to yield a coating that will cure to desired thickness. Ideally, dry layers should be 5 microns, and never exceed 25 microns. The thin, 5 micron layers provide the best adhesion. Thicker PBI coatings may be achieved by heavier applications, use of S15 vs S10 or multiple coatings, but be aware that heavy applications may produce irregular films and will have lower bond strength.

#### **4. Initial Cure**

Initial Cure is in 2 steps (for 5 um thickness):

- a) 110 C for 10 min.
- b) 150 C for 5 min.

For thicker coatings by multilayering, proceed to Step 5. If desired thickness is achieved, move to Step 6.

#### **5. Thicker Coatings by Multilayering**

Cool substrate to 25 C; repeat steps 3 & 4 yielding additional 5 um layers with each repeat.

#### **6. Final Cure**

Once the desired thickness has been obtained, and immediately following the last Initial Cure step (b), proceed to Final Cure:

- c) 250 C for 5 min.

#### **7. Cool**

As with any coated object, stress build-up due to thermal shock should be minimized. The coated item should be cooled slowly to avoid stress cracks.

#### **8. Clean-Up**

PBI may be cleaned from equipment using highly polar solvents such as DMAc and n-methylpyrrolidone (NMP). When cleaning small intricate parts, a heated bath of the solvent may be best. Vessels made of aluminum, stainless steel or glass are compatible with these solvents.