

# CELAZOLE™ PBI

CELAZOLE PBI offers the highest temperature resistance and best mechanical property retention of all unfilled thermoplastics. Thanks to its unique property profile, CELAZOLE PBI might bring the ultimate solution when no other plastics material can. It is a very appealing material to high-tech industries such as semiconductor, aircraft and aerospace industries.

## Physical properties (indicative values<sup>¥</sup>)

PROPERTIES	Test methods ISO/IEC	Units	VALUES
Colour	Ñ	Ñ	black
Density	1183	g/cm <sup>3</sup>	1.30
Water absorption:			
- after 24 h immersion in water of 23; C (1)	62	mg	38
	62	%	0.50
- at saturation in water of 23; C	Ñ	%	14
<b>Thermal Properties</b>			
Melting temperature	Ñ	; C	NA
Glass transition temperature	Ñ	; C	425
Thermal conductivity at 23; C	Ñ	W/(Kám)	0.40
Coefficient of linear thermal expansion:			
- average value between 23 and 100; C	Ñ	m/(máK)	25á10 <sup>-6</sup>
- average value between 23 and 150; C	Ñ	m/(máK)	25á10 <sup>-6</sup>
- average value above 150; C	Ñ	m/(máK)	25á10 <sup>-6</sup>
Temperature of deflection under load:			
- method A: 1.8 MPa	75	; C	425
Max. allowable service temperature in air:			
- for short periods (2)	Ñ	; C	500
- continuously: for min. 20,000h (3)	Ñ	; C	310
Flammability (4):			
- Oxygen index $\bar{O}$	4589	%	58
- according to UL 94 (1.5/3 mm thickness)	Ñ	Ñ	V-0/V-0
<b>Mechanical Properties at 23; C</b>			
Tension test (5):			
- tensile stress at break (6)	527	MPa	140
- tensile strain at break (6)	527	%	3
- tensile modulus of elasticity (7)	527	MPa	5,800
Compression test (8):			
- compressive stress at 1% nominal strain (7)	604	MPa	42
- compressive stress at 2% nominal strain (7)	604	MPa	82
Charpy impact strength - Notched	179/1eA	kJ/m <sup>2</sup>	3.5
Ball indentation hardness (9)	2039-1	N/mm <sup>2</sup>	375
Rockwell hardness (9)	2039-2	Ñ	E 105
<b>Electrical Properties at 23; C</b>			
Electric strength (10)	(60243)	kV/mm	22
Volume resistivity	(60093)	ácm	> 10 <sup>14</sup>
Surface resistivity	(60093)		> 10 <sup>13</sup>
Relative permittivity $\epsilon_r$ :			
- at 100 Hz	(60250)	Ñ	3.3
- at 1 MHz	(60250)	Ñ	3.2
Dielectric dissipation factor tan $\delta$ : - at 100 Hz	(60250)	Ñ	0.001

Note: 1 g/cm<sup>3</sup> = 1,000 kg/m<sup>3</sup>; 1 MPa = 1 N/mm<sup>2</sup>; 1 kV/mm = 1 MV/m

NA: not applicable

### Legend

- (1) According to method 1 of ISO 62 and done on discs  $\bar{}$  50 x 3mm.
- (2) Only for short time exposure (a few hours) in applications where no or only a very low load is applied to the material.
- (3) Temperature resistance over a period of min. 20,000 hours. After this period of time, there is a decrease in tensile strength of about 50% as compared with the original value. The temperature value given here is thus based on the thermal-oxidative degradation which takes place and causes a reduction in properties. Note, however, that the maximum allowable service temperature depends in many cases essentially on the duration and the magnitude of the mechanical stresses to which the material is subjected.
- (4) These mostly estimated ratings, derived from raw material supplier data, are not intended to reflect hazards presented by the materials under actual fire conditions. There is no UL-yellow card available for CELAZOLE PBI stock shapes.
- (5) Test specimens: Type 1 B.
- (6) Test speed: 5 mm/min.
- (7) Test speed: 1 mm/min.
- (8) Test specimens: cylinders  $\bar{}$  12 x 30 mm.
- (9) 10 mm thick test specimens.
- (10) 1 mm thick test specimens.

¥ This table is a valuable help in the choice of a material. The data listed here fall within the normal range of product properties of dry material. However, they are not guaranteed and they should not be used to establish material specification limits nor used alone as the basis of design.

## Availability

Round Rods: 9.53-101.60 mm - Plates: Thicknesses 12.70-38.10 mm - Tubes: QD. 42.86-138.11 mm

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# CELAZOLE\*PBI

- **Highest mechanical properties of any plastic over 400°F (205°C)**
- **Highest heat deflection temperature of any plastic at 800°F (425°C), with a continuous service capability of 750°F (400°C) in inert environments, or 650°F (345°C) in air with short term exposure potential to 1,000°F (540°C)**
- **Lowest coefficient of thermal expansion and highest compressive strength of all unfilled plastics**

**Celazole\* PBI is the highest performance engineering plastic available today.**

It offers the highest heat resistance and mechanical property retention over 400°F (205°C) of any unfilled plastic. It has better wear resistance and load carrying capabilities at extreme temperatures than any other reinforced or unreinforced engineering plastic.

As an unreinforced material, Celazole PBI is very “clean” in terms of ionic impurity and it does not outgas (except water). These characteristics make this material very attractive to semiconductor manufacturers for vacuum chamber applications. Celazole PBI has excellent ultrasonic transparency which makes it an ideal choice for parts such as probe tip lenses in ultrasonic measuring equipment. Celazole PBI is also an excellent thermal insulator. Other plastics in melt do not stick to PBI. These characteristics make it ideal for contact seals and insulator bushings in plastic production and molding equipment.

## Proven Applications

### High heat insulator bushings

Bushings used in hot runner plastic injection molds made of Celazole PBI allow the plastic being molded to remain in melt as the part “freezes” in the cool mold. Bushings last longer and ease clean up since hot molten plastics do not stick to PBI.

*(Prior materials: Vespel\* PI, Ceramic)*

### Electrical connectors

For an extra margin of safety, an aircraft engine manufacturer replaced connectors exposed to temperatures over 400°F (205°C) with Celazole PBI. *(Prior material: Vespel\* PI)*

### Ball valve seats

Seats manufactured from Celazole PBI excel in high temperature fluid handling service. *(Prior material: Metal)*

### Clamp rings

Parts machined from Celazole PBI on gas plasma etching equipment last longer than polyimide parts due to reduced high energy erosion rates. Because they need replacement less often, valuable production “uptime” is gained. *(Prior material: Vespel\* PI)*

### Engineering Notes:

Celazole PBI is extremely hard and can be challenging to fabricate. Polycrystalline diamond tools are recommended when fabricating production quantities. Celazole tends to be notch sensitive. All corners should be radiused (0.040" min.) and edges chamfered to maximize part toughness. High tolerance fabricated components should be stored in sealed containers (usually polybags with desiccant) to avoid dimensional changes due to moisture absorption. Components rapidly exposed to temperatures above 400°F (205°C) should be “dried” prior to use or kept dry to avoid deformation from thermal shock.

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## Celazole PBI (CM), Polybenzimidazole, unfilled, compression molded

Compression Molded	Rod	Disc	Plate	Tubular Bar	Other
Celazole® PBI	.375 -3.75"	3.5"- 8-0"	.500"-1.5" (C,E)	1.625"-15.0" OD, .750"-10.6" ID	-

Key: C = 12" wide x 12" long      E = 12" wide x 24" long

MECHANICAL PROPERTIES	VALUES	ASTM/COMMENTS
Specific Gravity	1.3	D792
Tensile Strength, psi	23000	D638
Tensile Modulus, psi	850000	D638
Elongation, %	3	D638
Flexural Strength, psi	32000	D790
Flexural Modulus, psi	950000	D790
Compressive Strength, psi	50000	D695, 10% Def.
Compressive Modulus, psi	900000	D695
Hardness, Rockwell E	105	D785
Hardness, Rockwell M1	25	D785
Izod Impact (Notched), ft-lb/in	0.5	D256 Type A
Coefficient of Friction, Dynamic	0.24	Dry vs. Steel, PTM55007
Limiting PV, psi-fpm	37500	PTM55010
k (wear) factor, 10-10in3-min/lb-ft-hr	60	PTM55010
<b>THERMAL PROPERTIES</b>		
Coefficient of Thermal Expansion, 10E-4/°F	0.13	E831 (TMA)
Deflection Temperature 264 psi, °F	800	D648
Tg-Glass Transition (Amorphous), °F	750	D3418
Continuous Service in Air (Max), °F	590	Without Load
Thermal Conductivity, BTU-in/hr-ft2-°F	2.8	
<b>ELECTRICAL PROPERTIES</b>		
Dielectric Strength, Short Term, Volts/mil	550	Short Term, ASTM D149(2)
Volume Resistivity, Ohm-cm	1E+13	Lower Limit; ASTM D257
Dielectric Constant, 1 MHz	3.2	1 MHz, ASTM D150(2)
Dissipation Factor, 1 MHz	0.003	1MHz, ASTM D150(2)
<b>CHEMICAL PROPERTIES</b>		
Water Absorption Immersion, 24 hr., %	0.4	24 hour immersion
Water Absorption Immersion Sat, %	5	saturation immersion
Acids, Weak (acetic, dilute HCl)	2	Limited Service
Acids, Strong (conc. HCl or sulfuric)	1	Unacceptable
Alkalies, Weak (dilute NaOH)	2	Limited Service
Alkalies, Strong (conc. NaOH)	1	Unacceptable
Hydrocarbons, Aromatic (toluene)	3	Acceptable Service
Hydrocarbons, Aliphatic (gasoline)	3	Acceptable Service
Ketones, Esters (acetone)	3	Acceptable Service
Ethers (diethyl ether, THF)	3	Acceptable Service
Chlorinated Solvents (methylene chloride)	3	Acceptable Service
Alcohols (methanol, anti-freeze)	3	Acceptable Service
Inorganic Salt Solutions (NaCl, KCl)	3	Acceptable Service
Continuous Sunlight	2	Limited Service
Steam	1	Unacceptable
<b>COMPLIANCE</b>		
Flammability, UL94 (5=V-0; 4=V-1; 3=V-2; 1=HB)	5 (V-0)	V-0 UL94
FDA(1=Yes)	0	Not Compliant
USDA(1=Yes)	0	Not Compliant
NSF (1=Yes)	0	Not Compliant
3A-Dairy (1=Yes)	0	Not Compliant
Canada AG (1=Yes)	0	Not Compliant
USP Class VI (1=Yes)	0	Not Compliant

MATERIAL IDENTIFICATION

PRODUCT NAME: **CELAZOLE**

CHEMICAL NAME: **POLYBENZIMIDAZOLE POLYMER**

CAS NO.: **25928-81-8**

PRODUCT USE: **ENGINEERING POLYMER STOCK SHAPE FOR SUBSEQUENT FABRICATION.**

TSCA INVENTORY STATUS: **ALL REPORTABLE INGREDIENTS ARE LISTED IN THE TSCA CHEMICAL SUBSTANCE INVENTORY.**

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**SECTION 2**

HAZARDOUS INGREDIENTS

**THIS PRODUCT IS NOT REGULATED UNDER THE OSHA HAZARD COMMUNICATION STANDARD, 29 CFR 1910.1200 OR SARA TITLE III.**

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**SECTION 3**

HEALTH HAZARD DATA

ACUTE OR IMMEDIATE EFFECTS: ROUTES OF ENTRY AND SYSTEMS.

INGESTION: **NOT A PROBABLE ROUTE OF EXPOSURE.**

SKIN: **MOLTEN POLYMER CAUSES THERMAL BURNS.**

EYE: **MECHANICAL IRRITATION ONLY.**

INHALATION: **SHAPES NOT RESPIRABLE BUT MACHINING MAY GENERATE A NUISANCE DUST WHICH CAN CAUSE MECHANICAL IRRITATION TO THE EYES, SKIN, NOSE AND THROAT.**

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## SECTION 4

### EMERGENCY FIRST AID

- If exposed to fumes from overheating, move to fresh air. Consult a physician if symptoms persist.
- Wash skin with soap and plenty of water.
- Flush eyes with water. Consult a physician if symptoms persist.
- If molten polymer contacts skin, cool rapidly with cold water. Do not attempt to peel polymer from skin. Obtain medical attention to thermal burn.

CHRONIC EFFECTS: CHRONIC INHALATION OF DUST CAN HARM THE LUNGS.

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY THIS MATERIAL: NONE KNOWN.

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## SECTION 5

### FIRE AND EXPLOSION HAZARD DATA

FLASHPOINT: NOT APPLICABLE.

UNUSUAL FIRE, EXPLOSION HAZARDS: NONE.

HAZARDOUS DECOMBUSTION PRODUCTS: CELAZOLE BEGINS TO DECOMPOSE ABOVE 500°C AND RELEASES GASES AND VAPORS (WITHOUT SMOKE) SUCH AS CARBON MONOXIDE, CARBON DIOXIDE AND TYPICAL COMBUSTION PRODUCTS.

SPECIAL FIRE FIGHTING INSTRUCTIONS: FIRE FIGHTERS AND OTHERS EXPOSED TO PRODUCTS OF COMBUSTION SHOULD WEAR FULL PROTECTIVE CLOTHING INCLUDING SELF-CONTAINED BREATHING APPARATUS. FIRE FIGHTING EQUIPMENT SHOULD BE THOROUGHLY DECONTAMINATED AFTER USE.

EXTINGUISHING MEDIA: CELAZOLE DOESN'T BURN; USE EXTINGUISHING MEDIA APPROPRIATE TO THE SURROUNDING FIRE.

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## SECTION 6

### ACCIDENTAL RELEASES

SPILL OR RELEASE: CLEAN UP BY VACUUMING OR SWEEPING TO PREVENT FALLS.

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## SECTION 7

### STORAGE CONDITIONS

Dry storage. Keep containers closed to prevent contamination.

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## SECTION 8

### PROTECTION INFORMATION

EYE: Safety glasses are recommended to prevent particulate matter from entering eyes while grinding or machining.

SKIN: Protective gloves are required when handling hot polymer. Also, long sleeve cotton shirt and long pants if handling molten polymer.

VENTILATION: Local exhaust at processing equipment to keep particulates below 5 mg/m<sup>3</sup>, the OSHA limit for respirable dusts. Grinding and machining of parts should be reviewed to assure that particulate levels are kept at recommended levels.

RESPIRATOR: If dust is generated and ventilation is inadequate, use NIOSH/MSHA certified respirator which will protect against dust.

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## SECTION 9

### PHYSICAL/CHEMICAL DATA

APPEARANCE: STOCK SHAPE IS BLACK IN COLOR AND MAY BE IN THE FORM OF ROD, PLATE, OR TUBING.

ODOR: ESSENTIALLY ODORLESS.

MELTING POINT: NONE.

SOLUBILITY IN WATER: INSOLUBLE.

VOLATILE CONTENT %: NONE.

SPECIFIC GRAVITY: 1.28 - 1.33

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**SECTION 10**

HAZARDOUS REACTIVITY

STABILITY AT ROOM TEMPERATURE: **STABLE.**

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**SECTION 11**

TOXICOLOGICAL INFORMATION

CARCINOGENICITY: **THIS PRODUCT IS NOT LISTED IN NTP, IARC OR OSHA AS A CARCINOGEN.**

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**SECTION 12**

ECOLOGICAL INFORMATION

AQUATIC TOXICITY: **Toxicity is expected to be low based on insolubility of polymer in water.**

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**SECTION 13**

DISPOSAL

SPILL OR RELEASE: **Clean up by vacuuming or wet sweeping to minimize dust exposure.**

WASTE DISPOSAL: **Landfill or incineration in compliance with federal, state, and local regulations.**

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**SECTION 14**

TRANSPORT INFORMATION

DOT HAZARD CLASS: **NA**  
SHIPPING NAME: **NA**

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**SECTION 15  
REGULATORY INFORMATION**

SECTION 313 SUPPLIER NOTIFICATION:  
(SARA TITLE III-TOXIC CHEMICALS LIST)

This product contains the hazardous chemicals mentioned in SECTION 2 of this MSDS for routine annual "TOXIC CHEMICAL RELEASE REPORTING" of section 313 of the Emergency Planning and Community Right-To-Know Act of 1986 and 40 CFR 372.

STATE RIGHT TO KNOW LAWS

No substances on the state hazardous list, for the states indicated below, are used in the manufacture of products on this Material Safety Data Sheet, with the exceptions indicated. While we do not specifically analyze these products, or the raw materials used in their manufacture, for substances on various state hazardous substances lists, to the best of our knowledge the products on this Material Safety Data Sheet contain no such substances except for those specifically listed below:

PENNSYLVANIA:

SUBSTANCES ON THE PENNSYLVANIA HAZARDOUS SUBSTANCES LIST PRESENT AT A CONCENTRATION OF 1% OR MORE: **NONE KNOWN.**

SUBSTANCES ON THE PENNSYLVANIA SPECIAL HAZARDOUS SUBSTANCES LIST PRESENT AT A CONCENTRATION OF 0.01% OR MORE: **NONE KNOWN.**

CALIFORNIA PROPOSITION 65:

SUBSTANCES KNOWN TO THE STATE OF CALIFORNIA TO CAUSE CANCER: **NONE KNOWN.**

SUBSTANCES KNOWN TO THE STATE OF CALIFORNIA TO CAUSE BIRTH DEFECTS OR OTHER REPRODUCTIVE HARM: **NONE KNOWN.**

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**HMIS RATING**

<b>Health</b>	<b>0</b>
<b>Flammability</b>	<b>1</b>
<b>Reactivity</b>	<b>0</b>
<b>PPE</b>	<b>A</b>
<b>#Acute *Chronic</b>	



## SECTION 16

### MISCELLANEOUS INFORMATION

Prepared by: T.W. Swavely, Product Compliance Coordinator.

**Reviewed August 28, 2001**

Rev. -

Supersedes: None

The information set forth herein has been gathered from standard reference materials and/or supplier test data and is, to the best knowledge and belief of Quadrant EPP, accurate and reliable. Such information is offered solely for your consideration, investigation and verification, and it is not suggested or guaranteed that the hazard precautions or procedures mentioned are the only ones which exist. Quadrant EPP makes no warranties, expressed or implied, with respect to the use of such information or the use of the specific material identified herein in combination with any other material or process, and assumes no responsibility therefor.

NA = Not applicable

NE = Not established.

> = New or revised information in this section when " > " appears in the left margin.

**END OF MSDS**