# Celazole® PBI U-60
## Typical Properties

| PROPERTIES | ASTM METHOD | ENGLISH VALUE | METRIC VALUE |
|---|---|---|---|
| | | | |
| **MECHANICAL** | | | |
| Tensile Strength | D-638 | 23 kpsi | 160 MPa |
| Modulus | | 850 kpsi | 5900 MPa |
| Elongation | | 3.0% | 3.0% |
| Tensile Fatigue, % of stress to failure at 1,000,000 cycles, 1 Hz | D-638 | 35% (8.1 kpsi) | 35% (56 MPa) |
| Flexural Strength | D-790 | 32 kpsi | 220 MPa |
| Modulus | | 950 kpsi | 6500 MPa |
| Compressive Strength (Yield) | D-695 | 57 kpsi | 390 MPa |
| Compressive Strength (10% Strain) | D-695 | 50 kpsi | 340 MPa |
| Compressive Modulus | D-695 | 850 kpsi | 5900 MPa |
| Hardness – Rockwell M | D-785 | >125 | >125 |
| – Rockwell E | D-785 | 104 | 104 |
| – Shore D | D-2240 | 95 | 95 |
| Izod Impact Strength (notched) | D-256 | .53 ft-lb/in | 30 J/m |
| (unnotched) | | 11 ft-lb/in | 590J/m |
| | | | |
| **THERMAL** | | | |
| Heat Deflection Temp. (264 psi; 1.8 MPa) | D-648 | 815°F | 435°C |
| Glass Transition | DMA | 800°F | 427°C |
| Coefficient of Linear Thermal Expansion | | | |
| 75-300°F (25-150°C) | TMA | 13 X $10^{-6}$ in/in°F | 23 µm/m°C |
| 390-570°F (200-300°C) | TMA | 18 X $10^{-6}$ in/in°F | 33 µm/m°C |
| Limiting Oxygen Index | D-2863 | 58% | 58% |
| Thermal Conductivity 77°F (25°C) | | 2.8 Btu-in/hr-$ft^2$°F | 0.41 W/m°C |
| | | | |
| **ELECTRICAL** | | | |
| Dielectric Strength | D-149 | 580 V/mil | 23 KV/mm |
| Volume Resistivity | D-257 | 2 X $10^{15}$ ohm-cm | 2 X $10^{15}$ ohm-cm |
| Dissipation Factor | | | |
| 1 kHz | D-150 | 0.000 | 0.000 |
| 10 kHz | D-150 | 0.003 | 0.003 |
| 0.1 MHz | D-150 | 0.034 | 0.034 |
| Dielectric Constant | | | |
| 1 kHz | D-150 | 3.4 | 3.4 |
| 10 kHz | D-150 | 3.4 | 3.4 |
| 0.1 MHz | D-150 | 3.3 | 3.3 |
| Arc Resistance | D-495 | 185 sec. | 185 sec. |

PBI Performance Products, Inc.
9800 Southern Pine Blvd Suite D
Charlotte, NC 28273 USA
704.554.3378
www.CelazolePBI.com

# Celazole® PBI U-60
## Typical Properties – Continued

| PROPERTIES | ASTM METHOD | ENGLISH VALUE | METRIC VALUE |
|---|---|---|---|
| | | | |
| **OTHER** | | | |
| Specific Gravity | | 1.3 | 1.3 |
| Coef. of Friction, Static | | | |
| Aluminum | | 0.14 | 0.14 |
| Steel | | 0.15 | 0.15 |
| Brass | | 0.16 | 0.16 |
| Coef. of Friction, Dynamic | | | |
| Aluminum | | 0.16 | 0.16 |
| Steel | | 0.16 | 0.16 |
| Brass | | 0.18 | 0.18 |
| Water Adsorption, 24 hrs at 73F | D-570 | 0.4% | 0.4% |

U-60 grade Celazole® polybenzimidazole (PBI) resin is a unique organic polymer which does not burn in air and has extraordinary high temperature resistance, along with excellent stability to chemicals and hydrolysis.

The data shown here describe an unfilled high-performance part molded of Celazole PBI, with many outstanding properties:

- Highest compressive strength of any unfilled resin
- Excellent tensile and flexural strength
- Good fatigue properties
- Excellent hardness
- Low coefficient of friction
- Outstanding Tg and heat deflection temperature
- Relatively low coefficient of thermal expansion
- High volume resistivity
- Very good plasma resistance

Celazole PBI is ideal for applications where requirements cannot be met by other resins—in extreme high temperatures, in harsh chemical or plasma environments, or in applications where durability and wear resistance are important. Parts molded of Celazole PBI are being used in semiconductor and flat panel display manufacture, electrical insulating parts, heat insulating applications, as well as seals, bearings and wear plates in various industrial applications. They are also being evaluated in demanding aerospace applications requiring outstanding strength and short-term high temperature resistance.

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# Celazole® PBI U-60 (Molded)

## Environmental Resistance Ratings

Parts are molded of U-60 grade Celazole® polybenzimidazole (PBI) resin, a unique organic polymer which does not burn in air and has extraordinary high-temperature resistance, along with excellent stability to chemicals and hydrolysis.

In high-temperature exposure to organic chemicals, Celazole® molded parts offer outstanding chemical resistance and property retention, even after extended exposures. In hot caustic, Celazole parts out-perform other high-performance resins. And Celazole U-60 parts have been used successfully in a variety of harsh environments, ranging from oil fields to aerospace applications. In the field, Celazole parts have performed well when exposed to hydraulic and heat-transfer fluids, chlorinated solvents, polyester, nylon, PEEK, and PES molten polymers, and metal-corrosion inhibitors – conditions too severe for most plastics.

Celazole parts are hydrolytically stable after exposure to high pressure steam or boiling water. Moisture absorption of Celazole U-60 resin reaches equilibrium at 10-14% and, through solvation, some strength loss and swelling occur. However, Celazole parts typically regain their original properties after dehydration. When constrained, as in valve assemblies, Celazole U-60 parts have been used successfully in high-temperature, high-pressure steam environments.

### Molded Celazole U-60 Environmental Resistance Ratings

| Chemical | Temp. (°F) | Pressure (psi) | Rating @ Days 1 | 7 | 30 |
|---|---|---|---|---|---|
| **Hydrocarbons** | | | | | |
| Xylene | Reflux | Ambient | -- | A | -- |
| Toluene | Reflux | Ambient | -- | A | -- |
| Kerosene | 200 | Ambient | -- | A | -- |
| Gasoline | 200 | Ambient | -- | A | -- |
| **Ketones/Aldehydes** | | | | | |
| Methyl Ethyl Ketone | Reflux | Ambient | -- | A | -- |
| **Chlorinated Solvents** | | | | | |
| Methylene Chloride | Reflux | Ambient | -- | A | -- |
| **Organic Acids** | | | | | |
| Acetic Acid (Glacial) | 200 | Ambient | -- | A | -- |
| Phenol | 200 | Ambient | A | A | A |
| **Polar Aprotic Solvents** | | | | | |
| Dimethylacetamide | 200 | Ambient | C | D | -- |
| Alcohols | | | | | |
| Methanol | Reflux | Ambient | A | A | B |
| Triethylene glycol | 200 | Ambient | A | A | A |
| Triethylene glycol | 450 | Ambient | A | A | A |
| Strong **Bases** | | | | | |
| Sodium Hydroxide (Caustic (15%)) | 200 | Ambient | A | B | C |
| Weak **Bases** | | | | | |
| Sodium Carbonate (10%) | 200 | Ambient | A | A | A |
| Strong Acids | | | | | |
| Sulfuric Acid (30%) | 200 | Ambient | A | C | D |
| Hydrochloric Acid (10%) | 200 | Ambient | A | C | D |
| Hydrochloric Acid (37%) | 200 | Ambient | B | C | D |
| Nitric Acid (10%) | 200 | Ambient | B | D | D |
| Phosphoric Acid (35%) | 200 | Ambient | A | B | D |

Rating System: A = No Effect, B = Small Effect, C = Large Effect, D = Severe Effect

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# Celazole® PBI U-60 (Molded)

## Environmental Resistance Ratings - Continued

Use of Celazole parts may be less beneficial in exposures to polar, aprotic solvents or in high-temperature exposures to strong, oxidizing, aqueous acids. Although Celazole U-60 parts are affected by powerful oxidizing agents in high concentrations, tests show good resistance to organic acids. Performance in acid envi-ronments should be evaluated vs. application requirements.

In addition, tests have shown no noticeable change in strength or appearance of Celazole U-60 parts after 200 megarad exposure to Cobalt 60 gamma radiation (1.17 and 1.33 MeV). These tests were conducted in air at room temperature.

Celazole U-60 parts have excellent resistance to a range of extreme environments that degrade most plastics. Other high-performance materials, such as polyetherimide, polyimide, polyamideimide, polyetherether-ketone, and polyphenylene sulfide are severely affected by many of these harsh conditions.

### Environmental Resistance Ratings, Continued

| Chemical | Temp. (°F) | Pressure (psi) | Rating @ Days 1 | 7 | 30 |
|---|---|---|---|---|---|
| Weak Acids | | | | | |
| Acetic Acid (10%) | 200 | Ambient | A | B | B |
| Aqueous Oxidants | | | | | |
| 5% Sodium Hypochlorite | 200 | Ambient | A | B | B |
| Water | | | | | |
| Boiling Water | 212 | Ambient | A | B | B |
| Steam | 650 | 2200 | B | B | B |
| End Use Specific | | | | | |
| “Mobile Bay” Sourgas (Hydrogen sulfide, carbon dioxide, methane) | 450 | 2000 | -- | A | -- |
| NACE “A” (amine, water-based) Corrosion Inhibitor | 200 | Ambient | -- | A | -- |
| NACE “B” (amine, oil-based) Corrosion Inhibitor | 200 | Ambient | -- | A | -- |
| Brine (Zn and Ca Bromide) 15-20 lb/gal | 200 | Ambient | -- | A | -- |
| Skydrol B Hydraulic Fluid | 200 | Ambient | A | A | A |
| Monsanto Therminol-66 Heat Transfer Fluid | 520 | Ambient | -- | A | -- |
| Texaco Havoline Supreme 30W Motor Oil | 200 | Ambient | A | A | A |

Rating System: A = No Effect, B = Small Effect, C = Large Effect, D = Severe Effect

Chemical Resistance testing is conducted on tensile and compression test specimens using methodology derived from ASTM D 543. Ratings include tensile and compressive strength retention, weight gain or loss, swelling, and hardness changes.

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