



# MAKROLON® 6457

## Polycarbonate Resin

Flame-Retardant, UV-Stabilized Grade

### Description

Makrolon 6457 polycarbonate resin is a linear, low viscosity, high-performance thermoplastic. It is flame-retardant with UL94 Flammability Rating\* of V-2 at a thickness of 1.5-mm (0.059-in) and V-0 at a thickness of 3.0 mm (0.118in). Makrolon 6457 resin contains an internal mold release additive and is UV (ultraviolet) stabilized. It is produced in pellet form for processing by injection molding. Makrolon 6457 resin is available in clear tints, transparent and opaque colors, and with special visual effects.

### Applications

Makrolon 6457 resin is designed for applications requiring a good balance of flame retardance, toughness, stiffness and heat deflection temperature. Typical applications include business equipment housings, appliances, electrical connectors and connector blocks, telecommunication devices and other applications in the business machine and electrical/electronic industries where good surface quality and colorfastness are required. As with any product, use of Makrolon 6457 resin in a given application must be tested (including but not limited to field testing) in advance by the user to determine suitability.

### Drying

All polycarbonate resins are hygroscopic and must be thoroughly dried prior to processing. A desiccant dehumidifying hopper dryer is recommended. To achieve a moisture content of less than 0.02%, hopper inlet air temperature should be 250° F (121°C) and inlet air dew point should be -20°F (-29°C) or lower. The hopper capacity should be sufficient to provide a minimum residence time of 4 hours. Additional information on drying procedures is available in the Bayer brochure *General Drying Guide*.

### Processing

Makrolon 6457 resin may be easily processed on commercially available equipment suitable for injection molding of polycarbonate. Typical processing parameters are noted below. Actual processing conditions will depend on machine size, mold design, material residence time, shot size, etc.

#### Typical Injection Molding Conditions

##### Barrel Temperatures:

|                          |                              |
|--------------------------|------------------------------|
| Rear .....               | 480°–520°F (249°–271°C)      |
| Middle .....             | 520°–560°F (271°–293°C)      |
| Front .....              | 545°–585°F (285°–307°C)      |
| Nozzle .....             | 515°–585°F (268°–307°C)      |
| Melt Temperature .....   | 550°–580°F (288°–304°C)      |
| Mold Temperature .....   | 150°–220°F (66°–104°C)       |
| Injection Pressure ..... | 10,000–20,000 psi            |
| Hold Pressure .....      | 50–70% of Injection Pressure |
| Back Press.....          | 50–100 psi                   |
| Screw Speed.....         | 50–75 rpm                    |
| Injection Speed.....     | Moderate to Fast             |
| Cushion .....            | 1/8–1/4 in                   |
| Clamp.....               | 3–5 ton/in <sup>2</sup>      |

Additional information on processing may be obtained by consulting the Bayer publication *Makrolon Polycarbonate – A Processing Guide for Injection Molding* and by contacting a Bayer MaterialScience technical service representative.

\* Flammability results are based on small-scale laboratory tests for purposes of relative comparison and are not intended to reflect the hazards presented by this or any other material under actual fire conditions.

#### Regrind Information

Where end-use requirements permit, up to 20% Makrolon resin regrind may be used with virgin material during injection molding, provided that the material is kept free of contamination and is properly dried (see section on Drying). Any regrind used must be generated from properly molded parts, sprues, and/or runners. All regrind used must be clean, uncontaminated, and thoroughly blended with virgin resin prior to drying and processing. Under no circumstances is degraded, discolored, or contaminated material used for regrind. Materials of this type should be properly discarded.

Improperly mixed and/or dried regrind may diminish the desired properties of Makrolon resin. It is critical that you test finished parts produced with any amount of regrind to ensure that end-use performance requirements are fully met. Regulatory or testing organizations (e.g., UL) may have specific requirements limiting the allowable amount of regrind. Because third party regrind generally does not have a traceable heat history or offer any assurance that proper temperatures, conditions, and/or materials were used in processing, extreme caution must be exercised in buying and using regrind from third parties.

***The use of regrind material should be avoided entirely in those applications where resin properties equivalent to virgin material are required, including but not limited to color quality, impact strength, resin purity, and/or load-bearing performance.***

#### General Characteristics of Polycarbonate

**Hydrolytic Stability;** Parts molded from polycarbonate absorb only 0.15 % to 0.19% water at room temperature and 50% relative humidity. Dimensional stability and mechanical properties remain virtually unaffected. Even with immersion in water, dimensional changes measure only about 0.5%. Although frequent, intermittent contact with hot water does not harm the polycarbonate, continuous exposure to humidity or water at high temperatures (>140°F/60°C) is not recommended due to hydrolytic degradation, which reduces impact strength and tensile properties.

**Gas Permeability;** Steam permeability, measured on 100- $\mu$ m thick film, is 15 g/m<sup>2</sup>•24 h (0.97 g/100-in<sup>2</sup>•24 h). Significant permeability also exists for other gases, such as hydrogen, carbon dioxide, sulfur dioxide, helium, ethylene oxide, and oxygen.

**Chemical Resistance;** Polycarbonate is resistant to mineral acids (even in high concentrations), a large number of organic acids, many oxidizing and reducing agents, neutral and acidic saline solutions, some greases and oils, saturated aliphatic and cycloaliphatic hydrocarbons and most alcohols. It is important to note that polycarbonate is degraded by alkaline solutions, ammonia gas and its solutions, and amines. Polycarbonate dissolves in a number of organic solvents, such as halogenated hydrocarbons and some aromatic hydrocarbons. Other organic compounds cause polycarbonate to swell or stress-crack, e.g., acetone and methyl ethyl ketone. Since chemical resistance to various media is dependent on variables, such as concentration, time, temperature, part design, and residual stresses, the above information should serve only as a guideline. It is imperative that production parts be evaluated under actual application conditions prior to commercial use.

#### Health and Safety Information

Appropriate literature has been assembled which provides information concerning the health and safety precautions that must be observed when handling Makrolon 6457 resin. Before working with this product, you must read and become familiar with the available information on its hazards, proper use, and handling. This cannot be overemphasized. Information is available in several forms, e.g., material safety data sheets and product labels. Consult your Bayer MaterialScience representative or contact Bayer's Product Safety and Regulatory Affairs Department in Pittsburgh, Pa.

| Typical Properties*<br>for Natural Resin                                        | ASTM<br>Test Method<br>(Other) | Makrolon® 6457<br>Resin             |                         |
|---------------------------------------------------------------------------------|--------------------------------|-------------------------------------|-------------------------|
|                                                                                 |                                | U.S. Conventional                   | SI Metric               |
| <b>General</b>                                                                  |                                |                                     |                         |
| Specific Gravity                                                                | D 792                          | 1.20                                | 1.20 g/cm <sup>3</sup>  |
| Density                                                                         | D 792                          | 0.043 lb/in <sup>3</sup>            | 0.83 cm <sup>3</sup> /g |
| Specific Volume                                                                 | D 792                          | 23.1 in <sup>3</sup> /lb            | 0.006–0.008 mm/mm       |
| Mold Shrinkage                                                                  | D 955                          | 0.006–0.008 in/in                   | 0.006–0.008 mm/mm       |
| Water Absorption, Immersion at 73°F (23°C):                                     | D 570                          |                                     |                         |
| 24 Hours                                                                        |                                | 0.12%                               |                         |
| Equilibrium                                                                     |                                | 0.30%                               |                         |
| Melt Flow Rate <sup>a</sup> at 300°C/1.2-kg Load                                | D 1238                         | 13 g/10 min                         |                         |
| <b>Optical</b>                                                                  |                                |                                     |                         |
| Transmittance at 0.125-in (3.2-mm) Thickness                                    | D 1003                         | 87%                                 |                         |
| Refractive Index                                                                | D 542                          | 1.586                               |                         |
| <b>Mechanical</b>                                                               |                                |                                     |                         |
| Tensile Stress at Yield                                                         | D 638                          | 9,400 lb/in <sup>2</sup>            | 65 MPa                  |
| Tensile Stress at Break                                                         | D 638                          | 9,400 lb/in <sup>2</sup>            | 65 MPa                  |
| Tensile Elongation at Yield                                                     | D 638                          | 6%                                  |                         |
| Tensile Elongation at Break                                                     | D 638                          | 110%                                |                         |
| Tensile Modulus (1mm/min)                                                       | D 638                          | 350,000 lb/in <sup>2</sup>          | 2.4 GPa                 |
| Flexural Stress at 5% Strain                                                    | D 790                          | 13,200 lb/in <sup>2</sup>           | 91 MPa                  |
| Flexural Modulus                                                                | D 790                          | 340,000 lb/in <sup>2</sup>          | 2.4 GPa                 |
| Compressive Stress at Yield                                                     | D 695                          | 11,000 lb/in <sup>2</sup>           | 76 MPa                  |
| Impact Strength, Notched Izod at 73°F (23°C):                                   | D 256                          |                                     |                         |
| 0.125-in (3.2-mm) Thickness                                                     |                                | 15 ft•lb/in                         | 800 J/m                 |
| Tensile Impact Strength (“S” Specimen):                                         | D 1822                         |                                     |                         |
| 0.125-in (3.2-mm) Thickness                                                     |                                | 275 ft•lb/in <sup>2</sup>           | 575 kJ/m <sup>2</sup>   |
| Rockwell Hardness, M Scale                                                      | D 785                          | 75                                  |                         |
| Rockwell Hardness, R Scale                                                      | D 785                          | 120                                 |                         |
| <b>Thermal</b>                                                                  |                                |                                     |                         |
| Deflection Temperature, Unannealed:                                             | D 648                          |                                     |                         |
| 264-psi (1.82-MPa) Load, 0.250-in (6.4-mm) Thickness                            |                                | 264°F                               | 129°C                   |
| 66-psi (0.46-MPa) Load, 0.250-in (6.4-mm) Thickness                             |                                | 277°F                               | 136°C                   |
| Coefficient of Linear Thermal Expansion                                         | D 696                          | 3.34 E-05 in/in/°F                  | 6.0 E-05 mm/mm/°C       |
| Thermal Conductivity                                                            | C 177                          | 1.39 Btu•in/(h•ft <sup>2</sup> •°F) | 0.20 W/(m•K)            |
| Specific Heat                                                                   | D 2766                         | 0.28 Btu/lb•°F                      | 1,172 J/(kg•K)          |
| Relative Temperature Index at 0.059 in(1.5mm):                                  | (UL746B)                       |                                     |                         |
| Electrical                                                                      |                                | 125°C                               |                         |
| Mechanical with Impact                                                          |                                | 115°C                               |                         |
| Mechanical without Impact                                                       |                                | 125°C                               |                         |
| Vicat Softening Temperature, 50N; 50K/h                                         | D 1525                         | 291°F                               | 144°C                   |
| <b>Flammability**</b>                                                           |                                |                                     |                         |
| Oxygen Index                                                                    | D 2863                         | 37%                                 |                         |
| UL94 Flame Class:                                                               | (UL94)                         | V-2 Rating                          |                         |
| 1.5-mm (0.059-in) Thickness                                                     |                                | V-0, RP50 Rating                    |                         |
| 3.0-mm (0.118-in) Thickness                                                     |                                | V-0 Rating                          |                         |
| 6.0-mm (0.236-in) Thickness                                                     |                                |                                     |                         |
| <b>Weatherability</b>                                                           |                                |                                     |                         |
| UV Light Exposure and Hot Water Immersion Tests                                 | (UL746C)                       | f2 Rating                           |                         |
| <b>Electrical</b>                                                               |                                |                                     |                         |
| Volume Resistivity (Tinfoil Electrodes)                                         | D 257                          | 1.0 E+16 ohm•cm                     |                         |
| Surface Resistivity                                                             | D 257                          | 1.0 E+16 ohm                        |                         |
| Dielectric Strength (Short Time under Oil at 0.062-in [1.6-mm] and 73°F [23°C]) | D 149                          | 810 V/mil                           | 32 kV/mm                |
| Dielectric Constant (Tinfoil Electrodes): 60 Hz                                 | D 150                          | 3.0                                 |                         |
| 1MHz                                                                            |                                | 2.9                                 |                         |
| Dissipation Factor (Tinfoil Electrodes): 60 Hz                                  | D 150                          | 0.0009                              |                         |
| 1 MHz                                                                           |                                | 0.01                                |                         |
| Arc Resistance (Tungsten Electrodes)                                            | D 495                          | 115s                                |                         |

\* These items are provided as general information only. They are approximate values and are not part of the product specifications.

\*\*Flammability results are based on small-scale laboratory tests for purposes of relative comparison and are not intended to reflect the hazards presented by this or any other material under actual fire conditions.

<sup>a</sup> For information on using melt flow as a quality control procedure, see the Bayer publication Makrolon Polycarbonate — A Processing Guide for Injection Molding.