Makrolon® for LED Lighting
# Introducing Makrolon® Polycarbonate

A Building Block for Innovation

A thermoplastic with truly diverse applications, Makrolon® polycarbonate enables efficient design and manufacturing of optical parts for LED powered luminaires. The tailored portfolio of Makrolon® from Covestro for general lighting applications include transparent, translucent, reflective white, thermal conductive and flame retardant grades, which can be used for injection molding and extrusion. Stronger and lighter than glass, polycarbonate also provides energy and CO₂ emission savings. All of which explains why Makrolon® has been trusted for decades and continues to pave the way for tomorrow’s lighting innovations.

## Product List

### Makrolon® Transparent Polycarbonate
- LED5102: Low viscosity
- LED5202: Medium viscosity
- LED5302: High viscosity

### Makrolon® Diffusion Quality
- DQ5122: Low diffusion
- DQ5142: Medium diffusion
- DQ5162: High diffusion

### Makrolon® Flame Retardant
- LED5902 FR: High transmission

### Makrolon® Reflective White
- RW2407 012363: High reflection
- RW2407 012612: Light blocking
- RW6267X 012363: High reflection Flame retardant

### Makrolon® Thermal Conductive
- TC611: Excellent thermal conductivity
- TC110: Electrically insulating
- TP0822: Electrically insulating Flame retardant
**Makrolon® LED**

**Transparent**

- High light transmission across the visual spectrum
- Good life time performance
- High mechanical stability

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**Form Your Future**

The modern design possibilities for luminaries powered by LEDs are endless. Makrolon® LED5102 provides good flowability, allowing you to injection mold complex geometrics while maintaining high mechanical stability. In case you need additional mechanical performance, Makrolon® LED5302 has you covered.
Shine Brighter

The incredible transparent properties of Makrolon® LEDs102, Makrolon® LEDs202 and Makrolon® LEDs302 let your light shine brighter through both quality and longevity.

<table>
<thead>
<tr>
<th>Material Properties</th>
<th>Makrolon® LEDs102</th>
<th>Makrolon® LEDs202</th>
<th>Makrolon® LEDs302</th>
</tr>
</thead>
<tbody>
<tr>
<td>MVR [cm³/10 min]</td>
<td>34</td>
<td>19</td>
<td>13</td>
</tr>
<tr>
<td>Transmission @ 2 mm</td>
<td>90%</td>
<td>90%</td>
<td>90%</td>
</tr>
<tr>
<td>UV stabilized</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Yellowness Index @ 2 mm</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Haze @ 2 mm</td>
<td>&lt;0.5%</td>
<td>&lt;0.5%</td>
<td>&lt;0.5%</td>
</tr>
<tr>
<td>Izod notched impact 23 °C [kJ/m²]</td>
<td>55</td>
<td>69</td>
<td>72</td>
</tr>
</tbody>
</table>
Makrolon® DQ
Diffusion Quality

For luminaires with superior lumen output
Customized levels of hiding power

Transmission is our Vision

With up to 10% more light transmission, Makrolon® DQ improves your luminaire efficacy, allowing you to make more powerful luminaires with the same ability to diffuse light.
### Makrolon® DQ Diffusion Quality

#### Material Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Makrolon® DQ5122</th>
<th>Makrolon® DQ5142</th>
<th>Makrolon® DQ5162</th>
</tr>
</thead>
<tbody>
<tr>
<td>HPA* @ 2 mm</td>
<td>19°</td>
<td>43°</td>
<td>56°</td>
</tr>
<tr>
<td>Transmission @ 2 mm</td>
<td>85%</td>
<td>65%</td>
<td>57%</td>
</tr>
<tr>
<td>UV stabilized</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>RTI listed</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>125 °C/115 °C/125 °C</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>f1 listed</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>UL94 Classification</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>V-2 0.75-2.0 mm</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>MVR [cm³/10 min]</td>
<td>34</td>
<td>34</td>
<td>34</td>
</tr>
</tbody>
</table>

* Half power angle

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**Three Grades – Tailored Power**

Makrolon® DQ comprises three products with tailored half power angles, offering you the right hiding power for your luminaries. Optimized by data science, we can push light transmission to be best in class.
Makrolon® FR

Flame Retardant

Excellent optical performance

Available in transparent

Strong flame retardance V0 / 5VA

“Hot” Topic in LED

Trends in LED powered luminaries like miniaturization and functional integration drive the need for flame retardant optics that fulfil demanding flame classifications. Makrolon® LED5902 FR help you to meet these requirement without making compromises in optical performance.
Makrolon® FR
Flame Retardant

Don’t Learn Safety by Accident.

Being both temperature resistant and capable of high impact strength, Flame Retardant Makrolon® is a perfect option for light and safety in enclosed spaces with strict safety regulations.

<table>
<thead>
<tr>
<th>Material Properties</th>
<th>Makrolon® LED5902 FR</th>
</tr>
</thead>
<tbody>
<tr>
<td>UL94 Classification</td>
<td>V-0 1.0 mm</td>
</tr>
<tr>
<td>MVR [cm/V10 min]</td>
<td>6</td>
</tr>
<tr>
<td>Transmission @ 2 mm</td>
<td>89%</td>
</tr>
<tr>
<td>UV stabilized</td>
<td>✓</td>
</tr>
<tr>
<td>Yellowness Index</td>
<td>1.2</td>
</tr>
<tr>
<td>Haze @ 2 mm</td>
<td>&lt;1%</td>
</tr>
</tbody>
</table>
Makrolon® RW
Reflective White

Human Centric Lighting

Makrolon® RW provides an ideal reflective surface in an aesthetic white appearance, spreading light homogeneously in all directions. Making the light easy for the eyes, without glare.

- High light reflection
- Exceptional mechanical performance
- Optimized processability
Makrolon® RW
Reflective White

Wide Variety for Specific Needs

Makrolon® RW grades are optimized to achieve excellent optical performance without compromise in processability, flame retardance and mechanical performance. The effect of light leakage in reflectors with thin wall thicknesses can be managed by dedicated light blocking products.

<table>
<thead>
<tr>
<th>Material Properties</th>
<th>Makrolon® RW2407 013612</th>
<th>Makrolon® RW2407X 012363</th>
<th>Makrolon® RW2407 013612</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Light Reflection @ 2 mm</td>
<td>96%</td>
<td>96%</td>
<td>86%</td>
</tr>
<tr>
<td>UL94 Classification</td>
<td>V-2 1.5 mm</td>
<td>V-0 1.5 mm</td>
<td>V-2 1.5 mm</td>
</tr>
<tr>
<td>MVR [cm³/10 min]</td>
<td>19</td>
<td>19</td>
<td>19</td>
</tr>
<tr>
<td>UV stabilized</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Light blocking Transmission @ 1 mm &lt;0.01%</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
Makrolon® TC
Thermal Conductive

- Reduces weight
- Strong heat transferring capability
- High level of design freedom

Innovative Freedom

The Makrolon® TC grades provide you the opportunity to replace metals in heat sink applications, opening up incredible design opportunities while still keeping high dimensional stability.
Thermally Conductive

Makrolon® TC helps you achieve weight savings while meeting service life requirements and high efficiency. Improve time, ergonomics and costs.

<table>
<thead>
<tr>
<th>Material Properties</th>
<th>Makrolon® TC611</th>
<th>Makrolon® TC110</th>
<th>Makrolon® TP0822</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal Conductivity in plane [W/mK]</td>
<td>16</td>
<td>1</td>
<td>0.8</td>
</tr>
<tr>
<td>Electrical properties</td>
<td>Cond.</td>
<td>Insul.</td>
<td>Insul.</td>
</tr>
<tr>
<td>Color appearance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UL94 Classification</td>
<td>V-0 2.0 mm</td>
<td>HB</td>
<td>V-0 1.5 mm SVA 2.0 mm</td>
</tr>
<tr>
<td>Charpy unnotched impact 23 °C [J/m²]</td>
<td>&lt;10</td>
<td>78</td>
<td>90</td>
</tr>
</tbody>
</table>

Lighten Your Experience

Makrolon® TC helps you achieve weight savings while meeting service life requirements and high efficiency. Improve time, ergonomics and costs.
Unlock new designs

Well-defined light distribution

Edge lighting made possible in polycarbonate

New Frontiers

Free formed and microstructured light guides based on Makrolon® LED offer new design possibilities in technical luminaires and ambient lighting applications. Enabling custom illumination geometries with appealing low-glare lighting.
What’s Your Idea?

In collaboration with our industry partners we cover all competencies that are necessary to develop an edge lighting luminaire from the idea phase to serial production. Let’s work on your idea.

Schematic Illustration:
Microstructured polycarbonate light guide
Curious, Courageous and Colorful

Curious
We are open to new ideas and strive for progress. We are constantly looking for improvements. Curiosity drives us to listen closely and offer solutions that are creative and need-based.

Courageous
We see opportunities where others see risks. Where others ask ‘why’ we answer ‘why not?’. With our knowledge and experience we can push boundaries – always with our eyes set on the future.

Colorful
In the often dull corporate world we stand for diversity, optimism and creativity. We know that different views help to solve problems in an innovative way.

You Are Not Just a Number
At Covestro, we feel strongly about being on equal level and on the same page as our customers. We appreciate interpersonal relationships and want to listen to and evolve with you. Your competitiveness is our success.

Reliability is Our Priority
Our global presence makes us a reliable and flexible partner. Together we strive to find the right solutions for you needs.
Covestro

Our Global presence

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Antwerp
Krefeld-Uerdingen Leverkusen
Filago
Greater Noida
Map Ta Phut
Guangzhou
PCS HQ: Shanghai
What’s Next?

The possibilities are endless. You have the ideas, we have the materials.

Go ahead and start your journey with Makrolon® for LED Lighting.
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