



# Combining the best of two material worlds.

Flame-retardant high CTI polycarbonates

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# Charging ahead with unexpected solutions

Polycarbonates are well known in the electrical industry for offering excellent flame retardance and electrical properties. Today electric vehicles increasingly require these properties together with a Comparative Tracking Index (CTI) of 600V due to component miniaturization and energy density increase. **Now Covestro combined the best of two material worlds:** the CTI of 600V of flame-retardant materials with the well known benefits of amorphous polycarbonates such as the dimensional stability, the predictable shrinkage and low warpage behavior as well as the stable mechanical and electrical properties over a broad temperature range. As these advantages so far have hardly been offered by thermoplastic materials traditionally used in the drive train, new solutions are now possible for Li-Ion batteries, power electronics and electrical components by using **Bayblend® FR3015 CTI** and **Makrolon® FR6019 CTI**.

## At a glance

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- ✓ Excellent electrical properties, including a CTI of 600V according to IEC60112.
- ✓ Low & predictable shrinkage, low warpage, precise injection molding.
- ✓ Stable mechanical and electrical properties over a wide temperature range.
- ✓ Lower density than many glass fiber reinforced (GF) materials or metals.
- ✓ Flame retardant UL94V-0 at 1,5 mm, phosphate-based FR technology.
- ✓ No electrolytical corrosion resulting from FR additives according to IEC 60426:2007, 120V.

# Innovative material properties

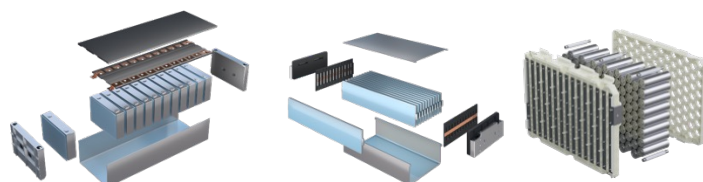


**Bayblend® FR3015 CTI** and **Makrolon® FR6019 CTI**, offer a CTI of 600V measured according to IEC60112 and a UL94V-0 rating at 1.5 mm with UL Yellow Card recognition. In addition to having solid thermomechanical properties without the need for glass-fiber reinforcement, they represent excellent dimensional stability, isotropic behavior and low warpage. Both products use an advanced phosphate-based flame retardant (FR) technology to prevent electrolytical corrosion of the electrical tracks.

This unique combination of properties makes them both highly innovative alternatives to other thermoplastics.

## Potential applications

**Bayblend® FR3015 CTI**, characterized by a high Vicat temperature of 120 °C and an excellent impact resistance, is a suitable grade for applications in Li-ion batteries, such as cell holders, busbar carriers or housings. It is an ideal complement to Covestro's solutions already widely used in battery packaging.



*Figure 1: Battery modules with prismatic, pouch and cylindrical cells, cell holders and busbar carriers are suitable applications for Bayblend® FR3015 CTI. Pictures: © 2024 Covestro AG. All rights reserved.*

**Makrolon® FR6019 CTI** is designed for applications in power electronics and the electrical industry. It is impact resistant with a high Vicat temperature of 131 °C, which offers a ball indentation temperature of 120 °C according to IEC 60695-10-2 (ball pressure test).



*Figure 2: Simplified power electronics device (exemplary representation) potentially using orange Makrolon® FR6019 CTI and black, thermally conductive Makrolon® TC. © 2024 Covestro AG. All rights reserved.*

# Material properties

Properties	Standard	Bayblend® FR3015 CTI	Makrolon® FR6019 CTI
Rheological properties			
<b>Melt volume-flow rate MVR</b>	ISO 1133	23 cm <sup>3</sup> /10 min (260°C / 5kg)	13 cm <sup>3</sup> /10 min (300°C / 1.2kg)
Mechanical properties (23°C / 50% r.h.)			
<b>Tensile modulus</b>	ISO 527-1,-2	2370	2470
<b>Impact strength</b> (notched)	Bayblend®: ISO 180/A Makrolon®: ISO 21305/based on ISO 179/1eA	45 kJ/m <sup>2</sup>	11 kJ/m <sup>2</sup>
<b>Impact strength</b> (unnotched)	Bayblend®: ISO 180/U Makrolon®: ISO 21305/based on ISO 179/1eU	No break 23°C / 50% r.h.	No break 23°C / 50% r.h.
Thermal properties			
<b>Burning behavior</b>	UL94 (several colors)	V-0 at 1.5 mm	V-0 at 1.5 mm
<b>Vicat temperature</b>	ISO 306 / B120	120 °C	131 °C
<b>HDT A</b>	ISO 75-1,-2, 1.8 MPa	101 °C	112 °C
<b>Resistance to heat (ball pressure test)</b>	IEC 60695-10-2	110 °C	120 °C
<b>GWFI</b>	IEC 60695-2-12 1.5 mm / 3.0 mm	960°C / 960°C	960°C / 960°C
<b>GWIT</b>	IEC 60695-2-13 1.5 mm / 3.0 mm	775°C / 775°C	825°C / 825°C
Electrical properties (23°C / 50% r.h.)			
<b>Comparative Tracking Index CTI</b>	IEC60112 Solution A	600V	600V
<b>Electrical strength</b>	b.o. IEC 60243-1	36 kV/mm	31 kV/mm
<b>Volume resistivity</b>	IEC 60093	4·10 <sup>16</sup> Ωm	4·10 <sup>17</sup> Ωm

## CTI according to IEC60112

The CTI test is used to evaluate the electrical tracking resistance of insulating materials (test setup as shown in Figure 3). The CTI value is the highest voltage at which no specimen fails during testing of five samples, each after the application of 50 drops of a defined test solution. Recommended starting point is 350V, increased in 25V steps.

## Colors and UL yellow cards

The color of each thermoplastic material is part of the material recipe and can have an impact on the CTI rating. Therefore, only these colors of **Bayblend® FR3015 CTI** and **Makrolon® FR6019 CTI** that can achieve a CTI of 600V according to IEC60112 are UL Yellow Card-recognized. For other colors, Covestro offers technical support. Positive results thereof will be continuously added to the UL Yellow Card.

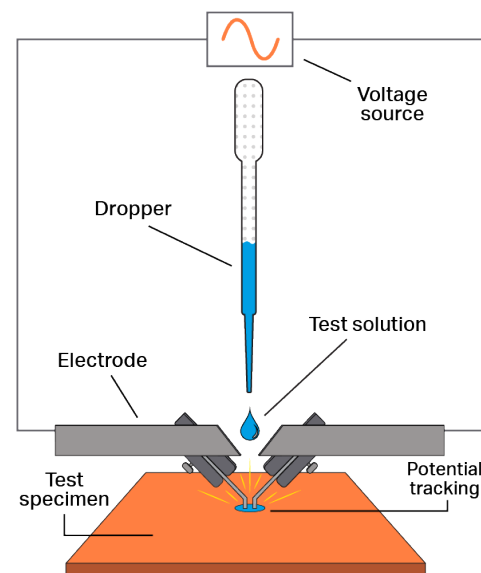


Figure 3: Simplified CTI test setup according to IEC60112.

# Technical data sheets Covestro Solution Center

[Bayblend® FR3015 CTI](#)  
[Makrolon® FR6019 CTI](#)

## Contact an expert

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