



# Processing Information for Makrolon®

## TC Polycarbonate Grades Offering High Thermal Conductivity

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### Material

Makrolon TC (thermally conductive) polycarbonate grades are designed for applications requiring thermal management, such as electronics or LED luminaries. Compared to many traditional materials, Makrolon TC grades offer better corrosion resistance, weight savings and greater design freedom. In addition, Makrolon TC materials can be more cost-effective, primarily through part and assembly consolidation.

Select Makrolon TC grades offer higher thermal conductivity ( $\geq 8$  W/mK) and are relevant to applications where electrical insulation is not a constraint. This brochure provides processing guidelines for these Makrolon TC grades with higher thermal conductivity.

### Wall Thickness

Wall thickness is a key factor in molding Makrolon TC grades. 1.5 mm is generally the minimum practical nominal wall thickness but the design's maximum flow length will dictate the thickness needed to ensure filling at an acceptable molding pressure. As shown in Figure 1 longer flow distances may require additional wall thickness to fill the part. Studies show that simply increasing the wall thickness from 1.5 to 2.0 mm can increase in flow length 50%-100%, depending on processing conditions and material grade. To facilitate filling and ejection, a minimum thickness of 1.5 mm and adequate venting at the apex of draft angle are generally recommended for ribs and other features.

### Melt Temperature

Makrolon TC materials are thermally conductive and cool quickly. This means that like wall thickness, melt temperature is a key factor in filling the mold. Higher melt temperatures will improve flow length however excessively high melt temperature can cause localized heating of the mold creating sticking and difficulty with ejection. The optimum melt temperature is a balance between excessive heat and filling the part.

The suggested range for Makrolon TC629 is: 300-350°C (572-662°F) with ideal temperatures between 310-330 °C (590-630°F)

### Mold Temperature

Mold temperature has little effect on the flow length of TC materials but is still critical in processing. Excessive mold temperatures can result in slight delamination of the material causing sticking and residue in the mold. The suggested mold temperature range is 65-100°C (150-212°F) although values of 65-82°C (150-180°F) will help avoid sticking. High conductivity mold materials such as beryllium copper are suggested for areas where sticking is likely such as ribs or deep cores. Varying the mold temperature on the stationary and moving halves of the mold can help parts remain on the desired side of the mold.

### Screw Speed / Back Pressure

In general, back pressure of 5.5 – 7 MPa (800-1000 psi) plastic pressure and a screw speed of 70 – 100 rpm are suitable for Makrolon® TC grades. Insufficient back pressure may reduce recovery and overall cycle time however it will also reduce valuable shear heating of the material in the barrel. Although critical for proper mixing and heating, data shows back pressure and screw speed have little effect on the thermal performance of the final part.

### Residence Time

Covestro recommends a linear shot length of 2-3 times the screw diameter to avoid degradation of the base resin due to excessive heat exposure. Degradation from long residence time can cause buildup of residue on the flights of the screw and check ring. If this happens, the screw may be unable to rotate and the nozzle may clog, resulting in delay as the screw will need to be manually pulled from the machine and cleaned. Figure 2 shows an example of a screw, nozzle, and check ring after material was allowed to remain in the barrel for approximately one hour at molding temperatures.

### Regrind

Studies show that adding regrind (up to 20%) has little or no effect on the thermal conductivity of the material. A benefit to using regrind in proper amounts is a potential reduction in pressure due to reduced viscosity of previously processed material.

### Purging

Normal purging procedures such as purging with a general-purpose polystyrene or commercial purging compound are adequate. Pre-production purging is important because the high viscosity and melt temperatures of Makrolon TC materials may loosen deposits of previously processed material. Post-production purging should follow the same process, provided the material has not been exposed to high temperatures for an extended period of time (see Residence Time). The screw and barrel may need to be cleaned manually if excessive residence time or other factors create persistent contamination problems when changing from Makrolon TC to another material.

### Drying

The same equipment and procedures used to dry general Makrolon grades should also be used when drying Makrolon TC resins. The material should be dried to a moisture content of less than 0.02% before molding. It is recommended to use a desiccant dehumidifying dryer with an inlet air temperature of 121°C (250°F) and dew point of -29°C (-20°F). Drying time should be a minimum of 4 hours. Makrolon TC grades may produce more dust and/or fines than general Makrolon resins. If this is the case, more frequent dryer maintenance may be needed, such as cleaning or changing of filters.

**Figure 2: Check ring, nozzle tip, and screw**



Covestro LLC  
1 Covestro Circle  
Pittsburgh, PA 15206 USA  
412-413-2000

[www.plastics.covestro.com](http://www.plastics.covestro.com)  
[plastics@covestro.com](mailto:plastics@covestro.com)

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