



MOCOM

❖ Alcom® LD/LD2/LDDC PC Processing Guide Injection Molding

Alcom® LD/LD2/LDDC* PC are translucent, optically diffuse and unfilled compounds based on Polycarbonate (PC).

The special optical properties of Alcom® LD PC require special attention during pretreatment and processing of the materials, especially with regard to adherence to injection molding parameters, as well as cleanliness and purity of the processing environment. The following processing instructions provide guide values for handling the materials. The information on pretreatment and processing on the technical data sheet of the product used must also always be followed.

Processing Environment

As usual when processing thermoplastic molding compounds into optical components, special care must be taken to ensure cleanliness of machines and peripherals. Contamination and dust in drying equipment, pellet feeders, storage containers or other surfaces the pellets come into contact with can lead to defects and impurities in the

finished part. Dust in particular causes cracking and black entrapments in finished parts during subsequent processing. If larger amounts of dust occur during material handling or transport, the use of an additional dust removal system is recommended. Contamination in injection molding units and mold cavities, e.g. due to residues of foreign material, oil or other processing aids, must also be avoided. Before using Alcom® LD PC, purge the injection molding unit with clear polycarbonate until no impurities (e.g. specks, streaks, color haze) are visible in the melt cake.

*Hereinafter referred to as "Alcom® LD PC"

Material Handling

Alcom® LD PC is usually supplied in bags. This helps to avoid contamination of larger granulate quantities during material handling and thus large reject quantities, as would otherwise be possible with octabin, BigBag or silo goods. Store unopened bags dry and protected from light. Opened residual containers must be sealed airtight after opening and checked for increased residual moisture and contamination before processing.

Pretreatment

PC is a hygroscopic polymer and absorbs moisture from the ambient air which can lead to material damage and surface defects during injection molding. Therefore, pre-drying, preferably in a dry air dryer, is necessary until a residual moisture of 0.02% maximum (Karl Fischer titration) is reached. Ensure the drying equipment is clean and free of dust in order to prevent contamination. The material must be processed immediately and continuously after pre-drying as it absorbs moisture from the ambient air again in the material supply of the injection molding machine. After longer production stops it may be necessary to dry the granules again if they have not been stored airtight.

Processing

Alcom® LD PC can be processed on all standard injection molding machines with 3-zone screw. Please follow the recommended process conditions given below, as well as the recommendations on the technical data sheet of the product used. In the following, some points are considered which should be given special attention when processing Alcom® LD PC.

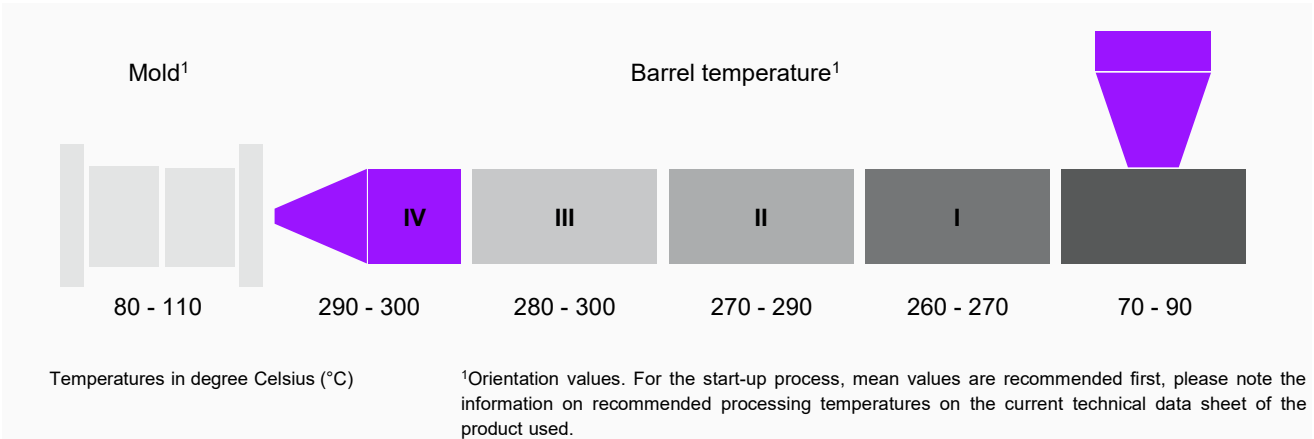
Plasticizing: A screw speed and back pressure set correctly contribute significantly to a homogeneous melt quality. However, both parameters should not be set too high in order to avoid damage to the molding compound due to excessive shear energies. A screw circumferential speed < 0.2 m/s and a specific back pressure between 50-150 bar are recommended.

Nozzle: Open nozzles are preferred. Particularly for easy-flowing materials (MVR >25 cm³/10min), valve gate nozzles are used sometimes. However, due to their design, these nozzles may cause increased shear and possible zones with increased residence time. Both can lead to component defects due to streaks or black specks. Purging during material changes is also more complex with valve gate nozzles.

Residence time: Excessive residence time can lead to material damage and color deviations ("yellowing"). Make sure the size of the plasticizing unit used matches the shot volume of the injection mold used. The recommended dosing volume is 1-3 times the screw diameter (1-3D). Residence times of the material in the plasticizing should be 8 minutes maximum.

Processing temperatures: The processing temperatures recommended on the technical data sheet must be followed. Temperatures too high can lead to significant color deviations and material degradation. Temperatures too low increase the injection pressure. This leads to excessive shear and increased stresses in the component, up to and including component failure. As a guide for initial sampling it is recommended to start with the mean value of the processing temperatures specified on the technical data sheet. In case of production interruptions residual material in the aggregate should be purged and barrel temperatures should be lowered to 160°C - 180°C. Before re-starting production, the plasticizing unit should be purged with material until no more degraded/discolored melt is being extruded and the melt cake is free of streaks and black specks.

Injection speed and holding pressure: The injection speed should ensure component filling with constant flow front speed. The holding pressure should be between 50% to 70% of the maximum injection pressure. Uneven filling and excessive pressures cause internal stresses in the component, which can lead to warpage and damage to the component. At very high injection pressures (> 1500 bar), the gating system should be checked and adjusted if necessary (e.g. by larger gate diameter).



Injection Mold

Temperature control: Uniform mold surface temperature is mandatory for optimum component quality. The best appearance is met by choosing mold temperatures in the upper range. Special attention must be taken to inserts and sliders in complex molds. We recommend checking the temperature control by measuring the mold surface temperature (e.g. with a contact thermometer). Insufficient or uneven mold temperature control can cause component defects, such as increased warpage. PC is susceptible to stress cracking in general which is favored by high internal stresses in the component.

Gating: The gate should be located in an area of highest wall thickness in order to ensure the optimum effect of the holding pressure to reduce sink marks. The position of the gate should support uniform cavity filling with short flow paths. The type of gate chosen must ensure gentle material processing. Point and tunnel gates can be used but minimum diameter of the gate should not be less than 0.5 mm. Excessive shear stress on the molding compound can lead to color changes under certain circumstances.

Hot runner: The use of hot runner systems for processing Alcom® LD PC is possible and has been proven for a long time. Care should be taken to a hot runner design without dead angles and with the smallest possible volume to reduce the residence time. At the same time, the hot runner system should introduce as little shear stress as possible to the molding compound. Torpedo tips should be avoided. Hot runner nozzles with valve gates are possible but extend purging time and cause streaks more frequently. Please follow the maximum processing temperatures of the material used in the hot runner system as well.

Surface: Due to the special formulation of Alcom® LD PC, optimum light diffusion is achieved even on polished surfaces. Structuring is not necessary. In the case of large-area components with (mirror-bright) polished surfaces,

demolding problems may occur due to surface adhesion. These can be counteracted by suitable mold coatings. For further information please contact your technical representative.

Shear during processing

Polycarbonate-based materials are sensitive to high shear during processing. The shear rate, which can be calculated using the processing parameters and geometry of the component, including the sprue system, serves as a reference value. This value is also a basic parameter in the filling simulation during mold design. For opaque colored polycarbonates, a guideline shear rate of $< 40,000 \text{ [1/s]}$ generally applies, but for optical or transparent materials, the limit value of $< 20,000 \text{ [1/s]}$ should be considered. Excessive shear can lead to aesthetic defects or an increased risk of stress cracks due to internal stress in the part.

Use of regrind

Alcom® LD are materials for highest technical and optical requirements with narrow color tolerances. The use of ground production waste (e.g. sprues) is not recommended. Dust, impurities and also the increased thermal load due to re-melting mean that the optical quality of the components cannot be ensured. Please feed production waste into the recycling circuit for polycarbonate instead.

Properties

Polymer	PC
Density (ISO 1183)	1.18 - 1.20 g/cm ³ (see technical datasheet)

Injection Molding Machine

Screw stroke	Dosing stroke between 1 x D and 3 x D (D = screw diameter)
Screw type	Three-zone screw with L/D-ratio 18:1 to 23:1
Nozzle type	Open or needle valve nozzle
Hopper type	Standard

Pretreatment

Storage	Dry, protected from heat and UV radiation	
Dryer	Air circulating dryer	Dry air dryer
Drying time	4 - 12 h	2 - 4 h
Drying temperature	120 °C	120 °C
Max. moisture content	< 0.02 %	< 0.02 %

Processing Conditions

Melt temperature	280 - 310 °C (for type-related values please see technical data sheet)	
Tool temperature	80 - 110 °C	
Coolant	Water	
Coolant throughput	A turbulent flow is to be achieved	
Screw circumferential speed	50 - 200 mm/s	
Back pressure (specific)	50 - 150 bar	
Residence time	< 8 min	
Injection speed	Profile for constant melt flow front	

Shrinkage²

	PC, unfilled
Shrinkage, 24 h (ISO 294-4)	0.5 - 0.9 %

² Shrinkage is not a pure material property, but is influenced by fillers, the component geometry, its wall thickness and the position and size of the gate. Processing parameters, such as mold wall and melt temperature, also play a decisive role. Please also refer to the separate guide on shrinkage.

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