Recommendations for injection molding

Envalior
Imagine the Future

Akulon® K223–P2

PA6–I
Impact Modified

Print Date: 2024–03–22

GRADE CODING
Akulon® PA6 non reinforced and non flame retardant injection molding grades.

MATERIAL HANDLING

Storage
In order to prevent moisture pick up and contamination, supplied packaging should be kept closed and undamaged. For the same reason, partial bags should be sealed before re–storage.
Allow the material that has been stored elsewhere to adapt to the temperature in the processing room while keeping the bag closed.

Packaging
Akulon® grades are supplied in airtight, moisture–proof packaging.

Moisture content as delivered
Akulon® grades are packaged at a moisture level ≤ 0.15 w%.

Conditioning before molding
To prevent moisture condensing on granules, bring cold granules up to ambient temperature in the molding shop while keeping the packaging closed.

Moisture content before molding
Akulon® is delivered at molding moisture specification (≤ 0.15 w%). We advise to pre–dry to overcome the fluctuation from package to package (see drying section below). Furthermore, pre–drying is required in case the material is exposed to moisture before molding (prolonged storage or open/damaged packaging).
Moisture content can be checked by water evaporation methods or manometric methods (ISO 15512).

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Drying

Akulon® grades are hygroscopic and absorb moisture from the air relatively quickly. Moisture absorption is fully reversible under the following drying conditions without compromising material quality. Preferred driers are de–humidified driers with dew points maintained between –30 and –40°C / –22 and –40°F. Vacuum driers with N_2 purge can also be used. Hot air ovens or hopper driers are not suitable for pre–drying Akulon® grades; the use of such driers may result in non–optimum performance.

Moisture content	Time	Temperature	
[%]	[h]	[°C]	*[°F]*
0.1–0.2 and as delivered	2–4	80	*176*
0.2–0.5	4–8	80	*176*

Drier types that are not de–humidified can be operated until 100°C but care has to be taken with natural/light colors for which a color change might be observed upon drying depending on time/temperature exposure.

Regrind

Regrind can be used taking into account that this regrind must be clean/low dust content/not thermally degraded/dry, of same composition and similar particle size as the original material. The acceptable level of regrind depends on the application requirements (e.g. UL Yellow Card). Be aware that regrind can cause some small color deviations.

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MACHINERY

Akulon® grades can be processed on general injection molding machines.

Screw geometry
Typically 3–zone screw designs with volumetric compression ratios of approximately 2.5 work fine.

Steel type
Abrasive resistant tool steels which are normally used for glass and/or mineral reinforced materials are also to be used for Akulon® polymers in tools, nozzles and screws.

Nozzle temperature control
The use of an open nozzle with good temperature control and an independently–controlled thermocouple nearby the tip and heater bands with sufficient output is recommended.

Hot runner layout
Try to achieve a close contact with your hot runner supplier and DSM as the material supplier, to be sure that the right hot runner system is chosen.
When processing Akulon® with hot runners, keep in mind these basic rules:

- Central bushing heated separately
- Only use external heated system
- Manifold heated from both sides
- Tip with thermocouple in front (near gate)
- Very accurate temperature control in the gate area

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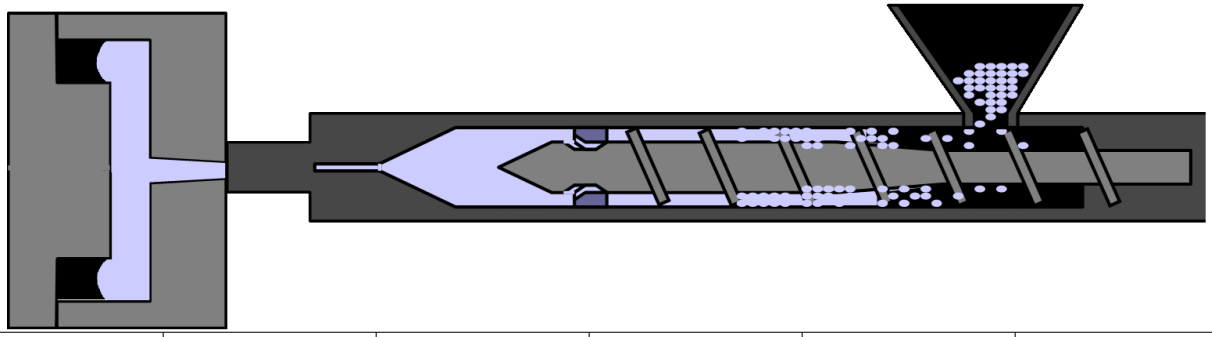
TEMPERATURE SETTINGS

Mold temperature

Akulon® can be used with a wide range of tool temperatures (50 – 80°C / 122 – 176°F). However, we recommend a low mold temperature for parts with thick walls and a high mold temperature for good dimensional stability, flow properties and surface aesthetics.
Furthermore, for impact modified grades (P in the grade coding) a low mold temperature can prevent mold sticking, resulting in a better surface appearance.

Barrel temperature

Optimal settings are governed by barrel size, residence time and melt viscosity. Be aware that melt viscosity is related to the barrel temperature settings.
Due to the high melting point of Akulon® this temperature should be set high enough to provide a homogeneous melt without getting too near to the degradation temperature of 300°C / 572°F. A flat or rising temperature profile is recommended.



Mold/Tool	Measured melt	Nozzle	Front	Center	Rear	
50 – 80°C *122 – 176°F*	240–275°C *464–527°F*	240–270°C *464–518°F*	240–260°C *464–500°F*	235–250°C *455–482°F*	230–235°C *446–455°F*	

Melt temperature

To generate a good and homogeneous melt, the melt temperature should always be above 240°C / 464°F. Optimal mechanical properties will be achieved at melt temperatures between 240–275°C / 464–527°F.
We advise to frequently measure the melt temperature by pouring the melt in a Teflon cup and inserting a thermo probe into the melt.

Hot runner temperature

A hot runner temperature set to the same level as the nozzle temperature should work fine and not lead to excessive overheat of the Akulon® grade. When starting up, an increased tip temperature may be necessary to overcome a frozen nozzle.

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GENERAL PROCESSING SETTINGS

Screw rotation speed
To realize a good and homogeneous melt, it is advised to set a screw rotation speed resulting in a plasticizing time that is just within the cooling time.
The rotational speed of the screw should not exceed 6500 / D RPM (where D is the screw diameter in mm).

Back pressure
Back pressure should be between 30–100 bars effective. Keep it low in order to prevent nozzle–drooling, excessive shear heating and long plasticizing times.

Decompression:
In order to prevent nozzle drool after plasticizing and retracting the nozzle from the mold, a short decompression stroke can be used. However, to prevent oxidation of the melt, which may result in surface defects on the parts, it is recommended to keep this as short as possible.

Injection speed
Moderate to high injection speeds are required in order to prevent premature crystallization in the mold during injection phase and to obtain a better surface finish. Adequate mold venting is required to avoid burning at the end of the flow path (due to diesel effect).

Injection pressure
The real injection pressure is the result of the flowability of the material (crystallization rate, flow length, wall thickness, filling speed). The set injection pressure should be high enough to maintain the set injection speed (use set injection pressure higher than the peak pressure if possible). Tooling air vents must be effective to allow optimum filling pressure and prevent burn marks.

Holding time
Effective holding time is determined by part thickness and gate size. Holding time should be maintained until a constant product weight is achieved.

Holding pressure
The most adequate holding pressure is the level whereby no sinkmarks or flash are visible. A too high holding pressure can lead to stresses in the part.

Cooling Time
Actual cooling time will depend on part geometry and dimensional quality requirements as well as the tool design (gate size).

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MELT RESIDENCE TIME

The optimal Melt Residence Time (MRT) for Akulon® K223–P2 is ≤ 6 minutes with preferably at least 50% of the maximal shot volume used. The MRT should not exceed 10 minutes.
A formula to estimate the MRT is described below:

$$MRT = \frac{\pi D^3 \rho}{m} * \frac{t}{60}$$

Whereas:

MRT	= Melt Residence Time	[minutes]
D	= Screw Diameter	[cm]
ρ	= Melt Density	[g/cm³]
m	= Shot Weight	[g]
t	= Cycle Time	[s]

Please note: In the calculation above, the hotrunner volume has not been taken into account. When a hotrunner is part of the setup, please add the hotrunner volume to the calculation. A full self–service MRT calculation can be done using the following link.

SAFETY

For the safety properties of the material, we refer to our SDS which can be ordered at our sales offices. During practical operation we advise to wear personal safety protections for hand/eye/body.

STARTUP/SHUT DOWN/CLEANING

Production has to be started and stopped with a clean machine. Cleaning can be done with Akulon® K223–P2, applicable cleaning agents or HDPE. Hot runners can also be cleaned and put out of production cleaning them with Akulon® K223–P2.

PRODUCTION BREAKS

During production breaks longer than a few minutes, we advise emptying the barrel. The temperature of the barrel and the hot runner [if applicable] should be reduced to a level far enough below the melting point of the compound in order to stop decomposition of the compound.
When the hot runner, nozzle, or even the screw is blocked, be aware that under these conditions a sudden outburst of molten material can take place. Always wear personal safety protections for hand/eye/body.

TROUBLESHOOTING

See our trouble shooting guidelines on the internet.

Contact Envalior in case more information is required from the aspect of material or processing.

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