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Quick Guide to Injection Molding

Ixef® PARA

Equipment

Ixef® polyarylamide (PARA) resins can be processed on conventional injection molding equipment.

- Estimated clamp tonnage of 1T/cm^2 (4 T/in^2) is required.
- Standard (general purpose) screws with a compression ratio between 2 : 1 and 3 : 1 and a L/D ratio between 15 : 1 and 20 : 1 are suggested.
- Use a ring-check valve, not a ball-check valve.
- Use a reverse taper nozzle to minimize drooling or freeze off.
- Use insulation plates between the mold and machine platens.
- Use a mold temperature control unit with either water or oil depending on the processing temperatures required.
- When using oil heaters, ensure that lines, seals, and heat transfer fluids are suitable for the processing temperatures.
- Use a desiccated hopper dryer to ensure that the resin remains dry during processing.
- Select a barrel capacity for a residence time no greater than 6 minutes. An indication of the residence time is given by:

$$\text{Residence Time, Minutes} = 2 \times \frac{\text{Barrel Capacity} \times \text{Cycle Time, Seconds}}{\text{Shot Size} \times 60}$$

- Hot runner systems must be designed for high-temperature crystalline polymers.

Table 1: Drying instructions

Drying Method	Temperature	Hours
Hot air	80 °C (176 °F)	12
Desiccant	120 °C (248 °F)	4 – 5

Drying

Ixef® PARA compounds are delivered in granular form (bulk density around 0.7 g/cm^3) usually in 25-kg bags or 1-ton octabins. Both package types are sealed and water-tight, so it is not necessary to dry the product before processing. Bags opened for 24 hours or more should be dried according to the guidelines in Table 1.

Injection

The settings of the injection phase cannot be carried out until the mold temperature and material temperature are correct and verified above 120 °C (248 °F). An item molded with the mold temperature being too low can suffer from the following defects:

- Increased moisture pick-up
- Risk of post-crystallization
- Poor surface appearance
- Higher tendency to creep
- Lower shrinkage

See Table 2 for starting point molding conditions.

Table 2: Starting point molding conditions

Material temperature (purged)	
Standard grades	280 °C (536 °F)
Flame-retardant and impact-modified grades	< 270 °C (< 518 °F)
Cylinder temperatures	
Feed zone	250 °C to 280 °C (482 °F to 536 °F)
Compression zone	250 °C to 280 °C (482 °F to 536 °F)
Metering zone	250 °C to 280 °C (482 °F to 536 °F)
Nozzle zone	260 °C to 290 °C (500 °F to 554 °F)
Hot runners (when used)	250 °C to 280 °C (482 °F to 536 °F)
Mold temperature	120 °C to 140 °C (248 °F to 284 °F)
Injection speed	High, 0.5 s to 2.5 s
Hold pressure	500 bar to 1,500 bar (specific) (7,250 psi to 21,750 psi)
Back pressure	0 bar to 10 bar (hydraulic) (0 psi to 150 psi)
Screw speed	3 m/min to 10 m/min

Temperature

- **Ixef® PARA compounds require a mold temperature of at least 120 °C (248 °F)**
- Verify the temperature of the mold cavities using a temperature probe.
- Confirm the melt temperature using a temperature probe moved about in a volume of melt, shot onto an insulator (a glove, cardboard, etc.).

Shot Volume

- Set the initial cooling time.
- Set a zero hold time and/or pressure.
- Inject incomplete parts by gradually increasing the shot volume using an average to high injection speed.
- When the mold is almost filled (95 % to 98 %), set the initial hold pressure and gradually increase the hold time. See Table 3 for more specific guidelines.
- In this way, the end of the filling is done under constant pressure and part over-packing is avoided.

Table 3: Hold and cooling

Hold time [seconds]	$3\ s \times w$ [3]
Cooling time [seconds]	$2.5\ s \times w^2$ [4]

[1] *w = wall thickness, mm*
[2] *w = wall thickness, mm, ≥ 2 mm*

Troubleshooting

Table 4 is a troubleshooting guide that contains the solution to many common molding problems. If problems persist, contact your Solvay representative for additional assistance and technical service.

Safety Procedures

Proper safety procedures must be followed at all times:

- All machine guards and covers must be in place. Required personal protection equipment must be worn. Face shields, gloves, and long sleeves are recommended. Purge barriers should be placed against the sprue bushing to protect the tool. Purged materials are very hot and should be handled and disposed of with care.
- Always be alert of the possibility that resin decomposition can occur. Typical signs of resin decomposition include badly discolored resin purge and excessive gas generation. When resin decomposition is suspected, assume that gas at high pressure is present and take appropriate action to prepare for the release of high-pressure gas. Be particularly cautious with plugged nozzles and follow all established safety guidelines.

Table 4: Troubleshooting guide

Problems	Suggested Remedies
Greasy spots on the parts and mold (signs of degradation)	• Reduce material temperature (screw and/or hot runners)
Whitish spots (same phenomenon but with cold mold)	• Increase mold temperature • Reduce material temperature (screw and/or hot runners) • Release agents, lubricants
Bad surface appearance	• Increase mold temperature • Increase injection speed • Verify holding time and pressure
Glass fibers visible on surface	• Increase mold temperature • Increase injection speed • Increase runner dimensions • Increase material temperature
Jetting	• Modify injection point position • Reduce the initial injection speed • Increase the cross-sectional area of the injection point
Burning	• Increase venting • Reduce injection speed at end of filling
Incomplete part	• Increase shot volume • Increase injection pressure and speed • Increase runner dimensions • Increase material temperature • Increase venting
Deformed part	• Increase the temperature of the mold • Modify the part design, avoiding major thickness differences • Increase holding pressure to reduce shrinkage • Modify position and dimension of the injection gate • Increase the cooling time
Part or sprue sticks in the mold	• Reduce holding time • Reduce holding pressure level • Increase the draft angle of the mold cavity
Sink marks	• Increase the holding time and pressure • Change the position and dimension of the injection point

www.solvay.com

SpecialtyPolymers.EMEA@solvay.com | Europe, Middle East and Africa
SpecialtyPolymers.Americas@solvay.com | Americas
SpecialtyPolymers.Asia@solvay.com | Asia Pacific

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