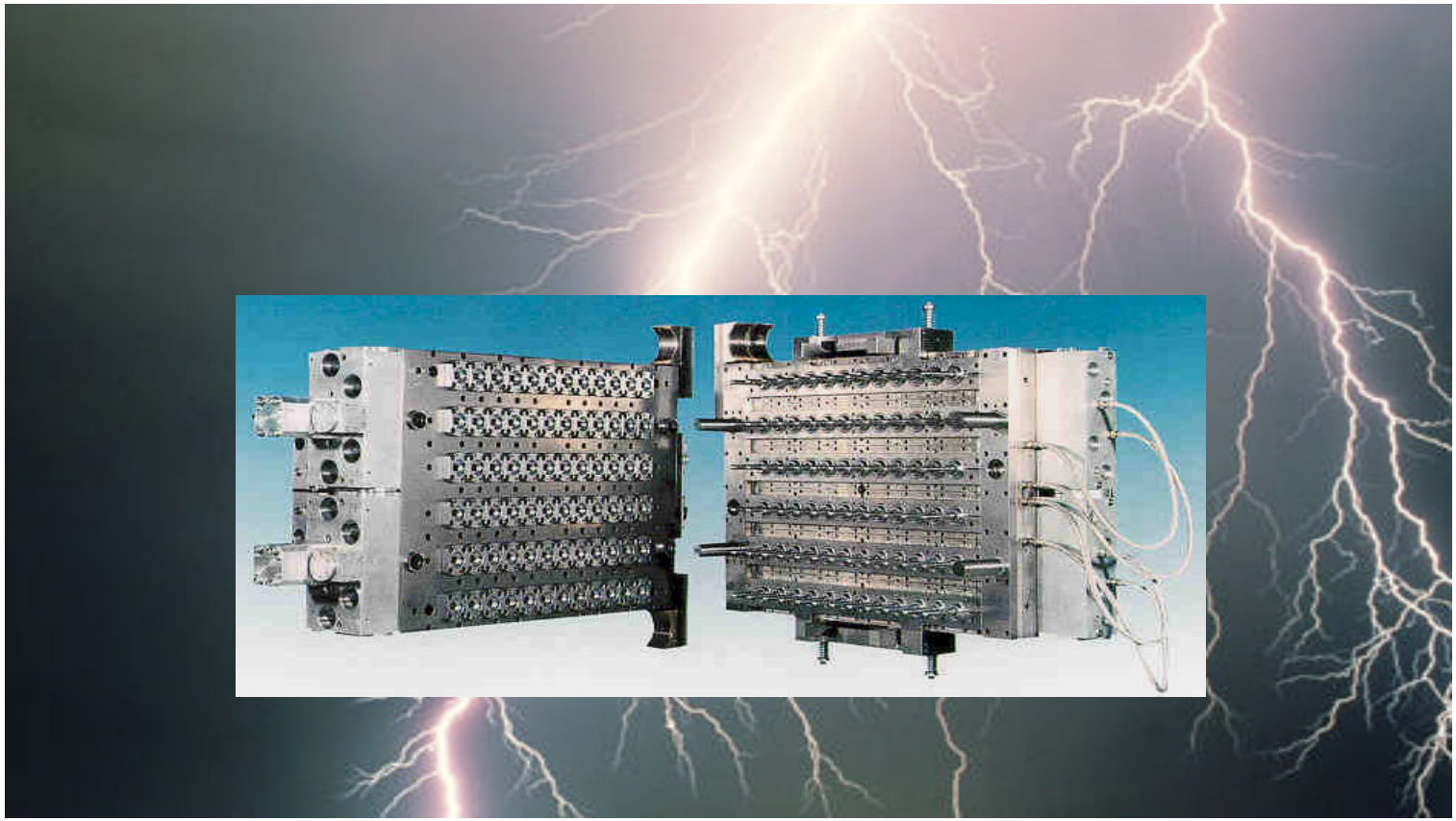
Grivory HT-PPA

Guidelines for Injection Moulding

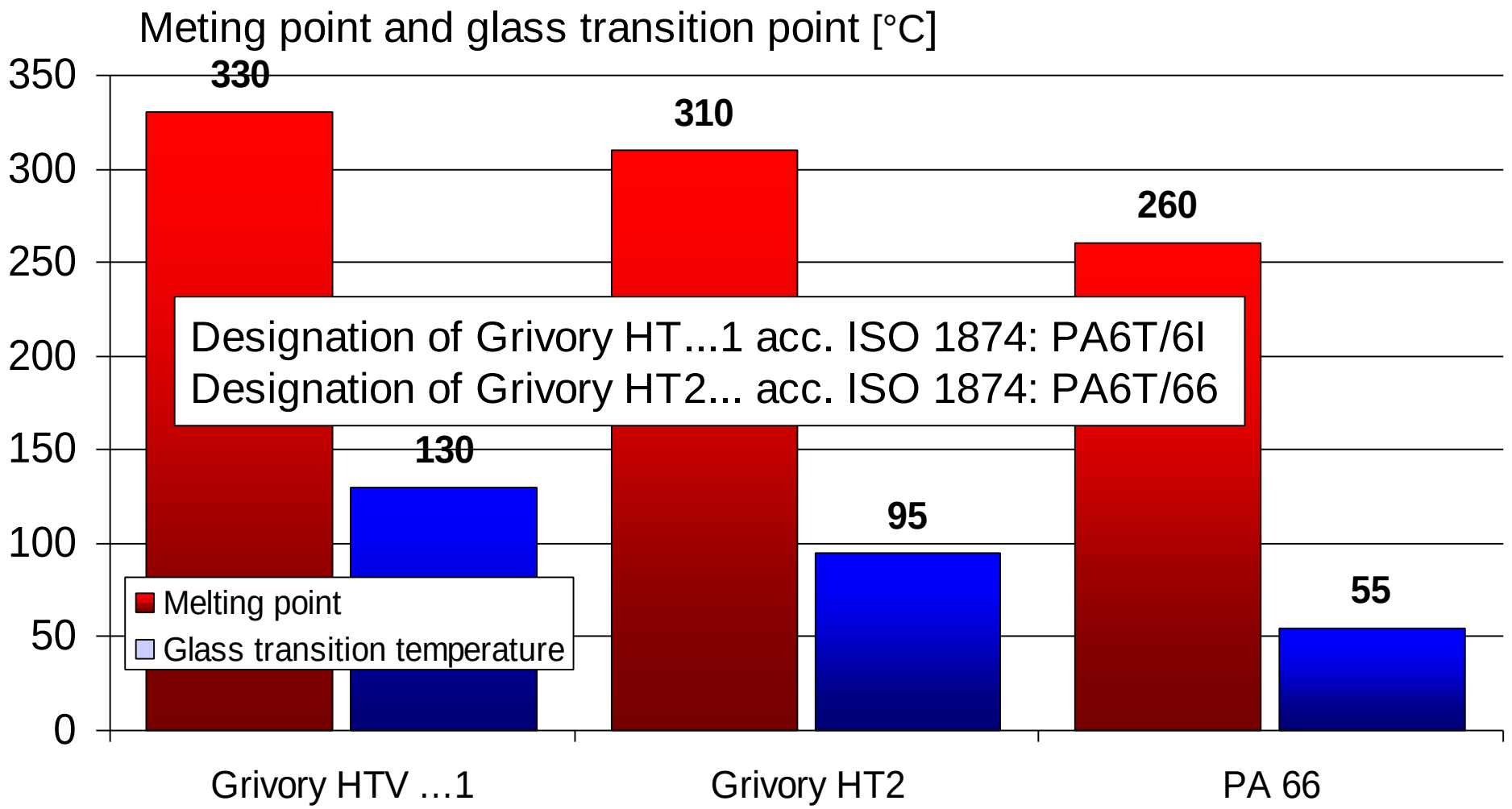


All Grivory HTV Grades Can be Processed on Commonly Used Injection Moulding Machines Suitable for Polyamides

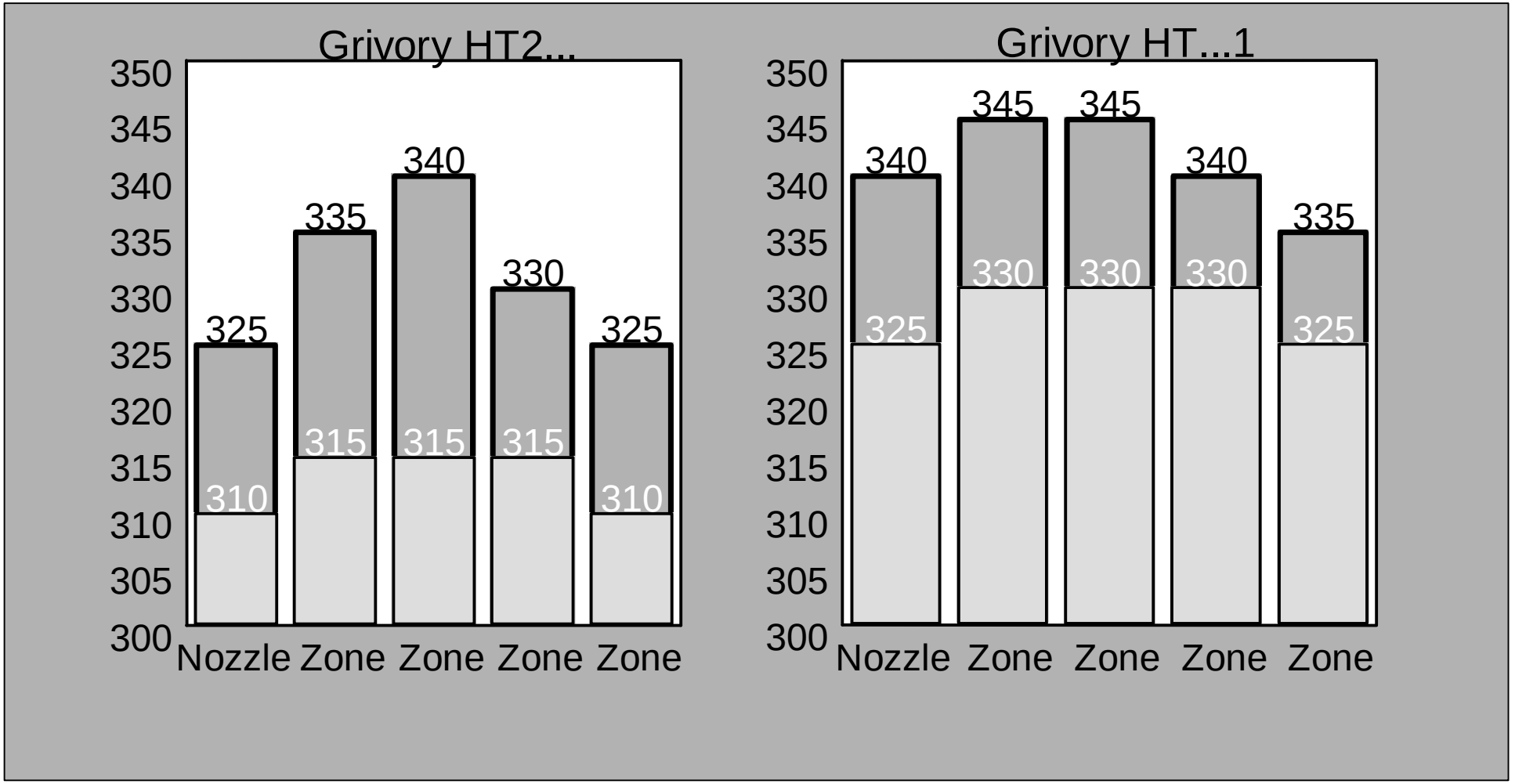
Optimal injection moulding equipment:

Clamping force:	■ approx. **7.5 kN/cm²** of the projected surface area is necessary
Plastification unit:	■ Cylinder with efficient heating system (3 zones) capable of reaching up to **350 °C**.
	■ Separate, well regulated nozzle heating
Air extraction:	■ Air extraction located in the vicinity of the nozzles
Mold temperature control unit:	■ capable of reaching approx. **160 °C**

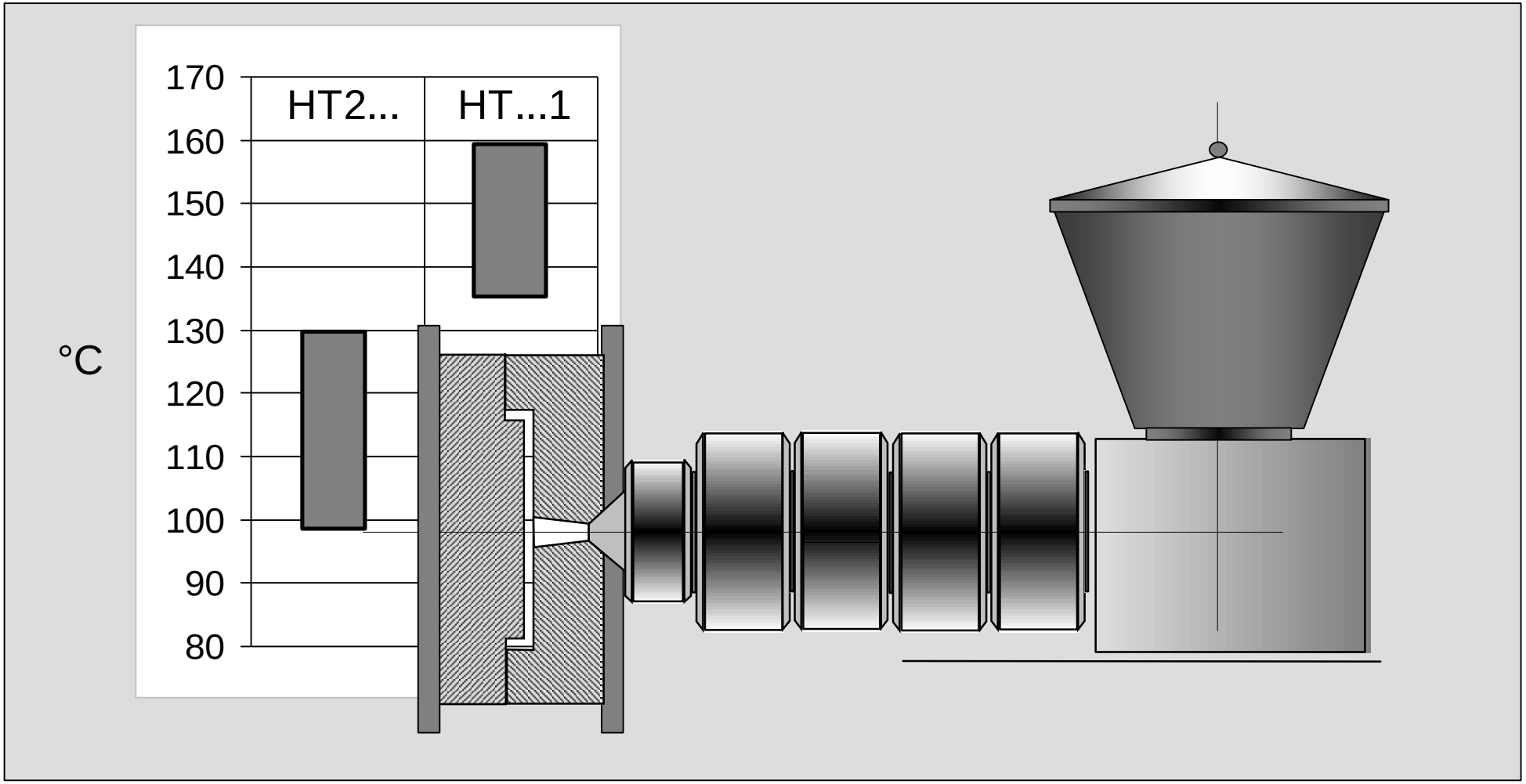
Grivory HT is a Semi - Crystalline, Partially Aromatic Co-Polyamide, PA6T/X



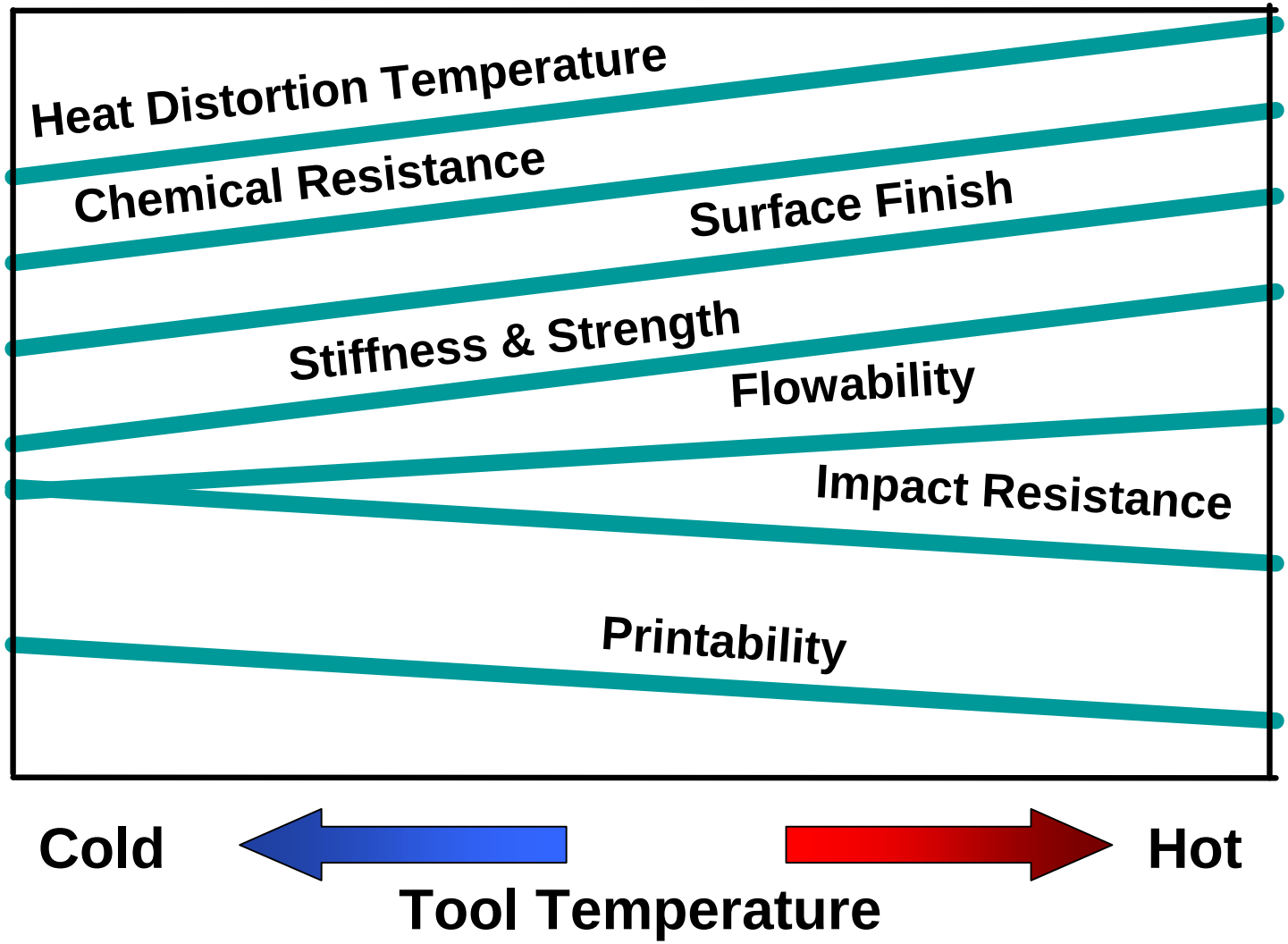
Injection Moulding of Grivory HT
Cylinder Temperatures



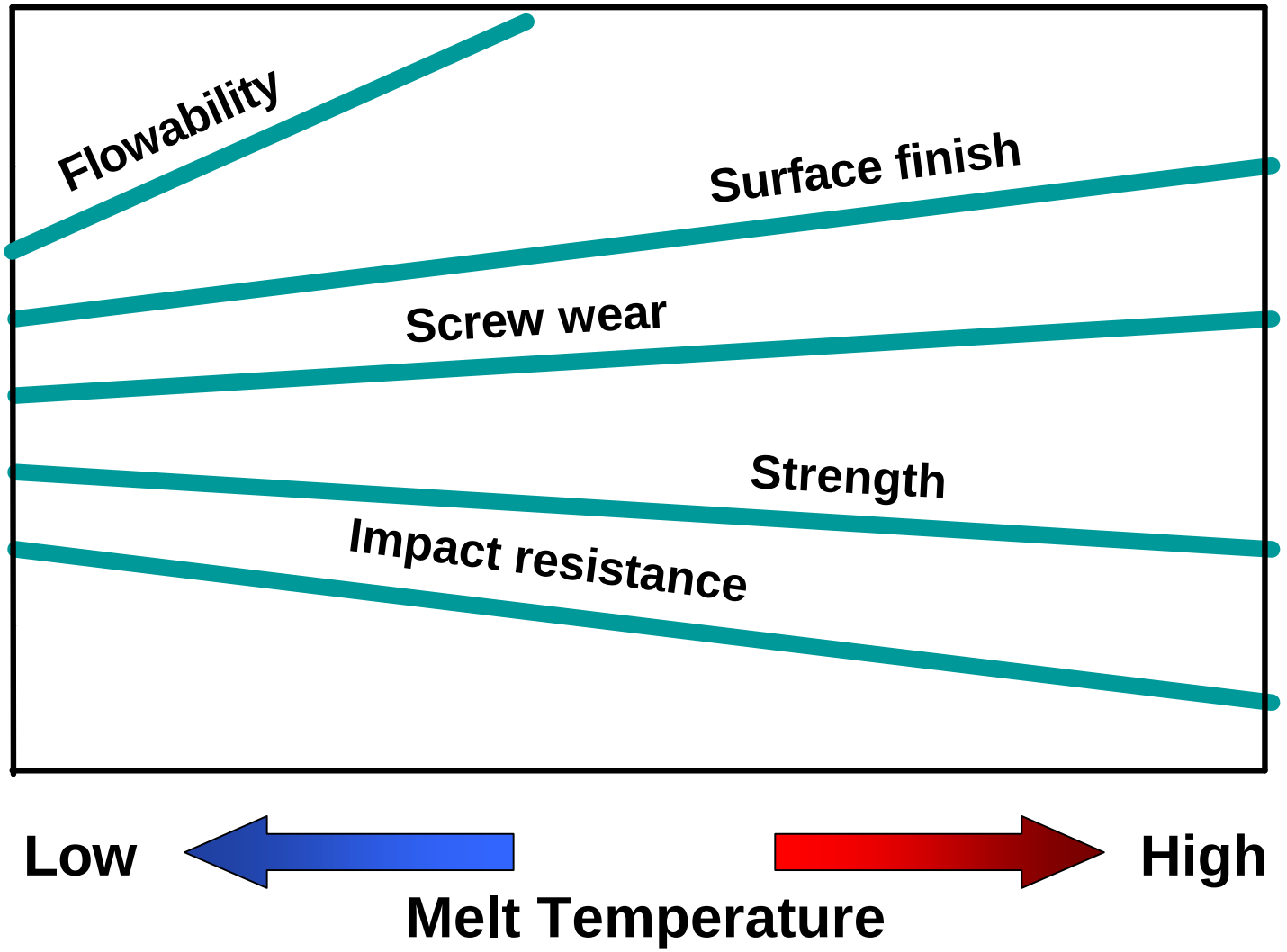
Injection Moulding of Grivory HT
Tool Temperatures



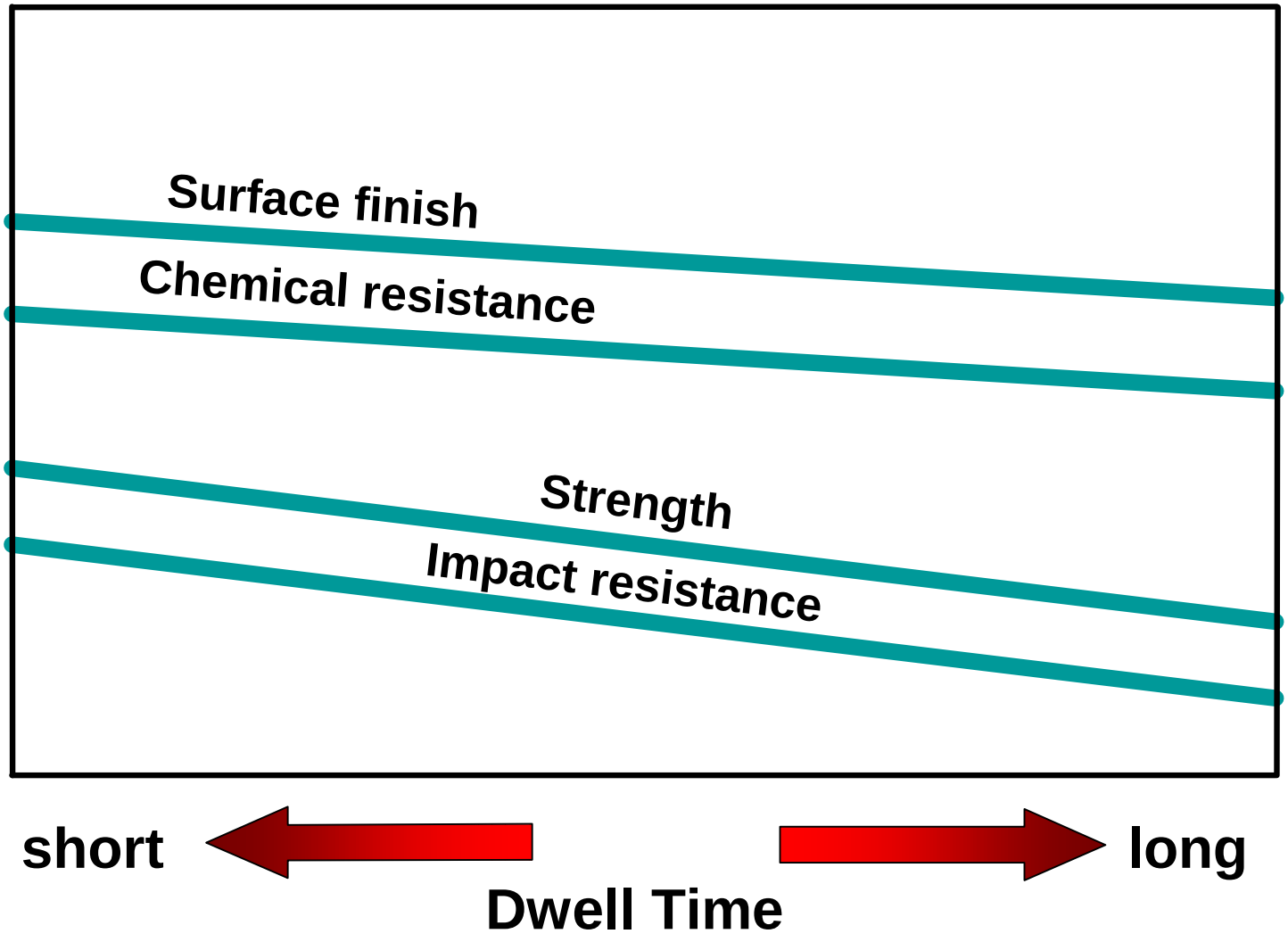
Influence of the Tool Temperature on the Product Properties



Influence of the Melt Temperature on the Product Properties



Influence of the Dwell Time on the Product Properties



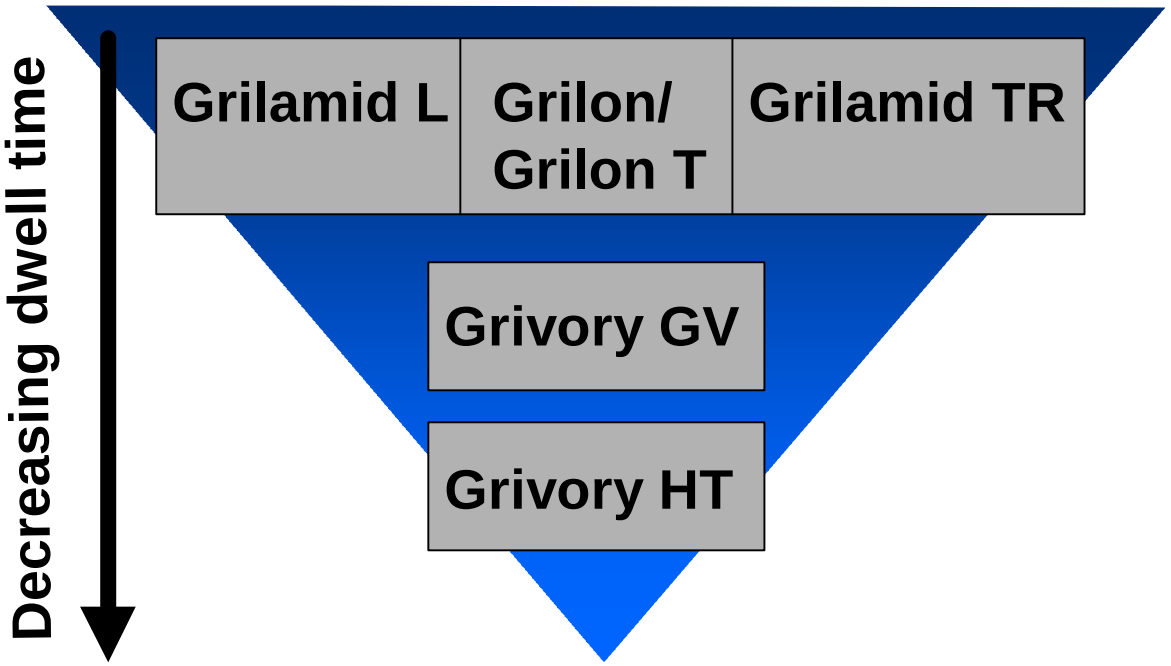
The Rate of Decomposition of Plastics is Dependent on Both Temperature and Time

$$\text{Dwell time} = \frac{\text{max. shot volume}}{\text{actual shot volume}} \times \text{cycle time}$$

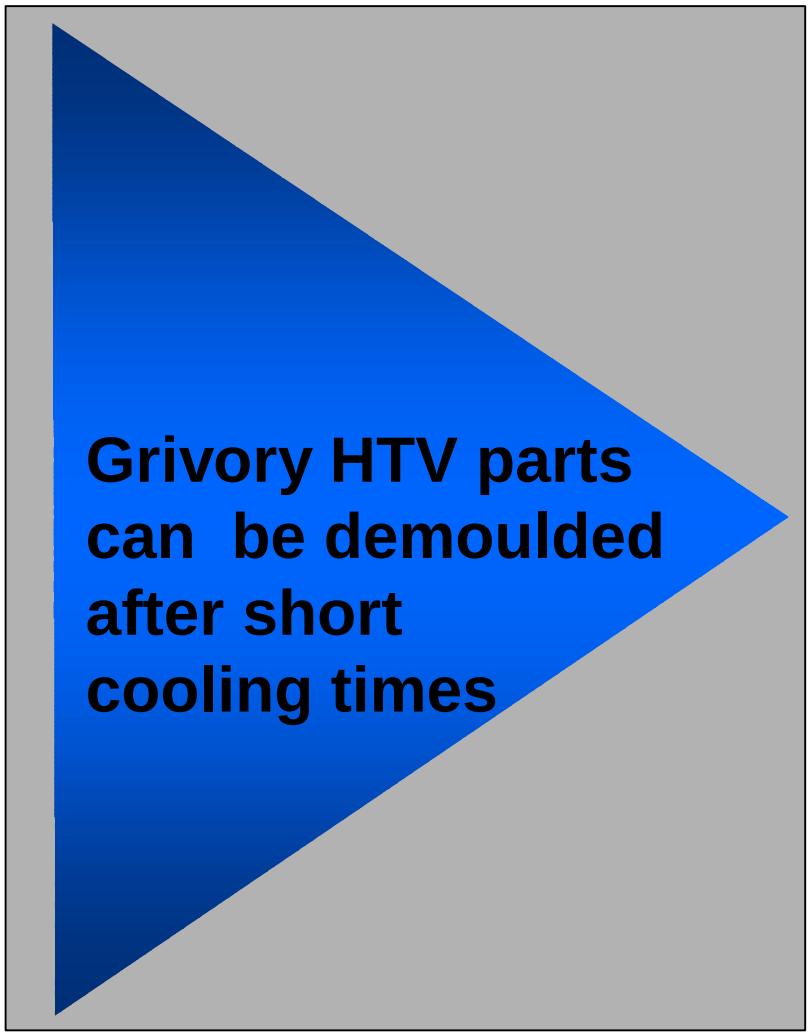
- The optimal dosing volume is 80 ~ 90% of the max. shot volume.

- If a hot runner system is used, the volume of this system will be added to the shot volume.

- Keep the dwell-time as short as possible!



Cooling Time Examples of Grivory HTV-5H



Wall thickness	Cooling time	
	Mould temp. 140 °C	Mould temp. 160 °C
1 mm	3 sec	4 sec
2 mm	7 sec	9 sec
3 mm	12 sec	18 sec
4 mm	22 sec	32 sec
6 mm	38 sec	58 sec

Demoulding Temperatures

	Demoulding temperatures to demould			Thermal diffusivity a_{eff}
	easy	fair	difficult	
Grivory GV -5H	150 °C	140 °C	130 °C	0.056 mm^2/s
Grivory GM-4H	140 °C	130 °C	120 °C	0.058 mm^2/s
Grivory HTV-3H1	210 °C	200 °C	200 °C	0.081 mm^2/s
Grivory HTV-5H1	220 °C	210 °C	200 °C	0.085 mm^2/s
Grivory HTM-4H1	210 °C	200 °C	200 °C	0.056 mm^2/s

High Flow Length Values With Grivory HT

The Grivory HT grades have a low viscosity!

→ Ratios of **more than 1:100** for wall thickness : flow path can be easily reached (valid for wall thickness of 1.5 to 5 mm)

Spiral flow test (1.5 x 10 mm)	Flow length 1.5 mm	Melt temperature	Mould temperature
Grivory HTV-4X2 V0	196 mm	320 °C	120 °C
Grivory HTV-4H1	197 mm	342 °C	140 °C
Grivory HTM-4H1	165 mm	335 °C	140 °C
Grivory HTV-5H1	180 mm	340 °C	140 °C
Grivory HTV-6H1	156 mm	347 °C	140 °C

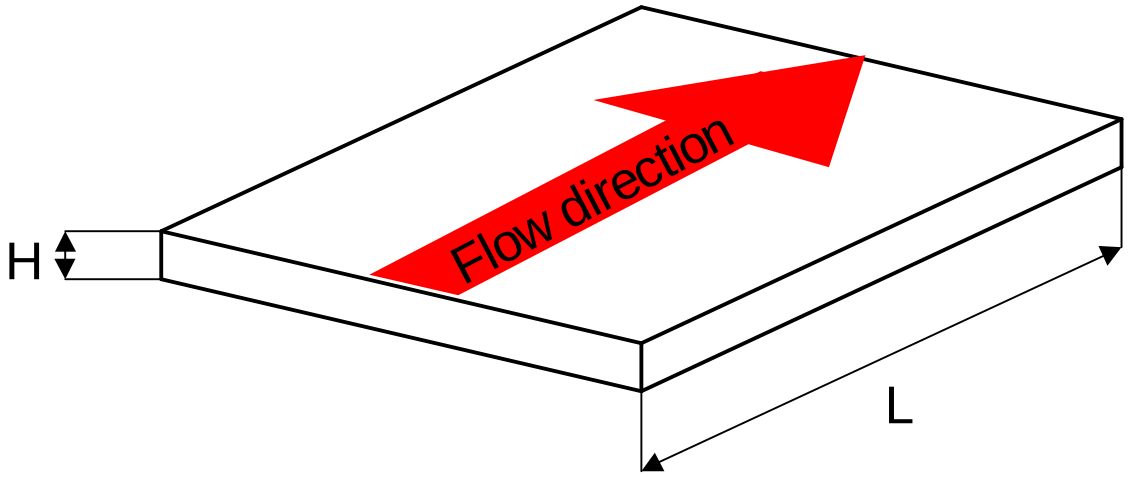
Most Important Influences on Flow Length

Wall thickness ↑↑↑↑

Melt temperature ↑↑↑

Injection pressure ↑↑

Mold temperature ↑



$$\Delta p = \frac{12\,\bar{v}\,h}{H^2}\,L$$

P = Pressure
H = Wall thickness
n = Flow speed
h = Viscosity

Mould Design
Sprue and Runner Systems

Conventional runner systems are preferred!

- Minimum diameter **4 mm**
- Maximum **1.4 x wall thickness** of the part

Requirements for hot runner systems:

- Achievable temperature **~350 °C**.
- Good thermal de-coupling from the rest of the tool
- Melt decompression relief via screw decompression

Mould Design

Gate Types:

- Basically all types of gates suitable for stiff GF reinforced thermoplastics can be used

Venting:

Venting is particularly important in the region of weld lines.
Venting can be improved by:

- Ejectors with clearance gaps
- Ventilation channels in the parting line (height 0.02 mm)

Demoulding angles:

- Demoulding angles of cores: 1 - 2 %

Bad Gate Locations Reduce the Mechanical Properties of the Part

Tensile test acc. ISO 527 in dry condition with various gate locations on the test bar:

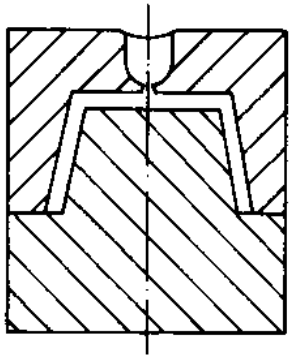
- **I.** One gate at the shoulder (standard gating)
- **II.** One gate in the middle of the thin section of the test bar
  → **Unfavourable glass fibre orientation**
- **III.** One gate at each shoulder of the test bar, injection from the side
  → **Weld line**

Result:

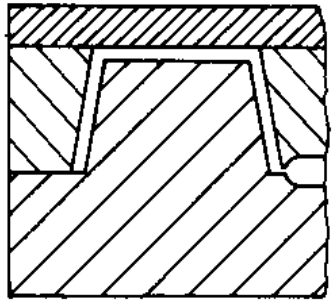
- The tensile strength of version 2 and 3 is significantly reduced.
- With version 2 the tensile strength is better compared to version 3 but the difference can be small.

Venting of Moulds

Air escapes through parting line



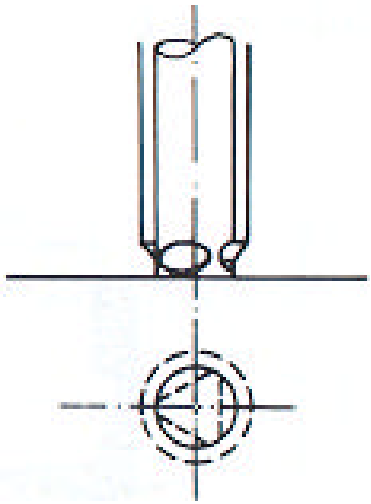
Air escapes through additional joint area



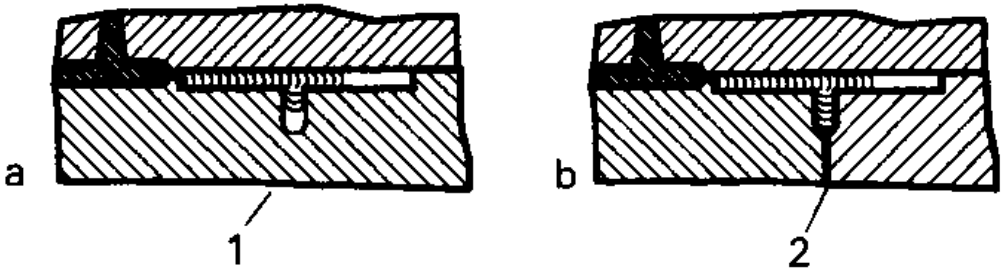
Melt flows around the core first and than rises slowly

Grooved

Ejector pin



Air escapes through additional joint area
For thin ribs additional venting channels are necessary



1) Air cannot escape from rib section

Example of Processing Parameter Setting Grivory HTV ...1

Temperatures:

Flange hopper region:	80 °C
Zone 3:	325 °C
Zone 2:	330 °C
Zone 1:	335 °C
Nozzle:	330 °C
Tool Temperature:	140 - 160 °C

Optimal melt temperature: 340 °C

Pressure:

Injection pressure:	1000 bar
Hold on pressure:	750 bar

Filling sequence: High injection speeds with speed reduction towards the end of the filling (burning and weld lines)

Processing of Grivory HTV
- Summary -

- The material should be dry. Moisture content < 0.1 % (desiccant dryer: 8h at 100 °C).
- Optimal melt temperatures: Grivory HTV…1: 340 °C
  Grivory HTV …2: 320 °C
- Injection speed should be high and dosing must be smooth
- Dwell time should be short (small screw diameter which gives a shot volume > 50 % of the max dosing volume)
- Tool Temperature must be 140 to 160 °C to obtain good surface finish
- Cooling time is short