Design and manufacturing of plastic injection mould

08 – Runner system

Content

- Identification of injection location
- Cold sprue
- Runner system
- Type of gates
- Hot drop
- Hot runner

Aim of injection system

- Drive the melted plastic to the cavities

Parts

- Sprue
- Runners
- Gate

Type of injection system

- Cold injection system
- Hot injection system (heated)
- Combinated system

Identify the gate location

- Equal filling up of the cavities
- Minimal welding line
- Minimal distance
- Parting line geometry
- Esthetic viewpoint

Computer aided analysis

Best gate location
Sprue bushing

Sprue bushings convey the melt from the press toggle tip to the mold parting line.

Role of radii

A) ✓ B) ✗ C) ✗

\[ R_s > R_m \]

Catalogue components

With radius 0 / 15.5 / 40
Angle 0.5° / 1°
Diameter \( d_2 \)

Size of the sprue diameter

Runner system

- Short length
- Balancing
- Optimal cross section
- Simple manufacturing
Balancing

- Aim: same fill up time
- Naturally balancing: equal runner length
- Artificial balancing: adjust runner cross section

Natural balancing

Artificial balancing

Combined balancing

Runner cross section

Cold slug well

Figure 39 – Recommended Design of a Cold Slug Well

Collect the not too good quality material of the melt front.

Full round runners provide the most efficient flow.
**Runner diameter**

- Recommended diameters:
  - For low pressure, high velocity: T = 1, T = 2
  - For high pressure, low velocity: T = 3, T = 4

**Runner size**

<table>
<thead>
<tr>
<th>A</th>
<th>Full Round</th>
<th>Modified Trapezoid</th>
<th>Modified Trapezoid</th>
</tr>
</thead>
<tbody>
<tr>
<td>(in)</td>
<td>(mm)</td>
<td>(mm)</td>
<td>(mm)</td>
</tr>
<tr>
<td></td>
<td>(mm)</td>
<td>(mm)</td>
<td>(mm)</td>
</tr>
<tr>
<td>1/8</td>
<td>3.2</td>
<td>5.1</td>
<td>5.1</td>
</tr>
<tr>
<td>5/32</td>
<td>0.9</td>
<td>2.3</td>
<td>2.3</td>
</tr>
<tr>
<td>3/32</td>
<td>0.9</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>1/32</td>
<td>0.6</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>1/64</td>
<td>0.3</td>
<td>0.7</td>
<td>0.7</td>
</tr>
<tr>
<td>1/128</td>
<td>0.15</td>
<td>0.4</td>
<td>0.4</td>
</tr>
<tr>
<td>1/256</td>
<td>0.08</td>
<td>0.2</td>
<td>0.2</td>
</tr>
</tbody>
</table>

**Runner diameter**

\[ D = \frac{W^{1/2} \times L^{1/4}}{3.7} \]

where:
- \( D \) = runner diameter (mm)
- \( W \) = part weight (g)
- \( L \) = runner length (mm)

**Maximum runner length**

<table>
<thead>
<tr>
<th>Runner Diameter (in)</th>
<th>Maximum Runner Length (mm)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Low Viscosity</td>
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<tr>
<td>1/8</td>
<td>3</td>
</tr>
<tr>
<td>5/32</td>
<td>4</td>
</tr>
<tr>
<td>3/32</td>
<td>8</td>
</tr>
<tr>
<td>1/32</td>
<td>11</td>
</tr>
</tbody>
</table>

**Gate type**

- Sprue gate
- Edge gate / Side gate / Fan gate
- Pin gate / Drop gate
- Tab gate
- Diafragm gate
- Internal ring gate
- External ring gate
- Flash gate / Film gate
- Submarine gate / Tünel gate
- Curved tunel gate / Banana gate
**Sprue gate**

**Edge gate / Side gate / Fan gate**

**Edge gate / Side gate**

**Examples**

**Pin gate / Drop gate**

**Pin gate / Drop gate**
Tab gate

The gate tab can be hidden in the assembly or trimmed off after molding.

Diaphragm gate

The diaphragm gate, which extends from the center disk to the inside of the cylinder, must be removed in a secondary step.

Internal ring gate

External ring gate

Flash gate / Film gate

Submarine gate / Tunnel gate

Thickness of the gate

Flow length (mm)
**Hot runner system**
- Less material cost (no waste)
- Shorter cycle time
- More expensive mould
  - Nozzle min. 650 €
  - Manifold min. 1200 €

**System elements**
- Manifold
- Electric connector
- Temperature control system

**Parts of manifold**

**Nozzle types**
- Open gate
- General
- Simple
- Valve gate
- Special
- Complex
  - The order of opening is programmable
  - Pneumatic of electro magnetic actuator
  - Typical use: long parts

**System elements**

**Type of gates**
- Material
- Weight
- Cycle time
- ASK HELP FROM THE DISTRIBUTOR!
**Combined single nozzle system**

- More waste
- Cheaper mould
- Typical use: Deep cavity and high A plate

**New trends**

- Adjustable manifold with valve gate
- Complete injection size as catalogue part