Mold Flow Analysis Report
Automotive Radiator Grille Injection Mold

Video Hyperlink:
Product

Automotive grille of Audi car
The 3D model is supplied by the customer, the mesh model is Dual-Domain.
The size of the part: 218.8 mm * 1075.0 mm * 435.7 mm
Volume of the part: 1578.6 cm^3
The global thickness of the part: 2.7 mm
Solutions

Case-1: 7 hot nozzles with valve gate
Case-2: 10 hot nozzles with valve gate
Case-3: 9 hot nozzles with valve gate

Customer-Oriented & Quality-Adherence
Fill time (Contour)

Case-1

Case-2

Case-3

Hesitation

Hesitation

http://upmold.com
Pressure at injection location XY Plot

Case-1

Case-2

Case-3

Customer-Oriented & Quality-Adherence
Pressure at V/P switchover

Case-1
Case-2
Case-3
Volumetric shrinkage at ejection

Case-1

Case-2

Case-3
We got the conclusion as below Base on the analyzing validation. 
case-1: the case have hesitation and pressure is high;  
Case-2: the case have hesitation, but the pressure is OK;  
Case-3: best than case 1 and case 2  
So we suggest use case3 and we did it in details as following pages.
Injection System

Valve gate control:

<table>
<thead>
<tr>
<th>The nozzle</th>
<th>Open time</th>
</tr>
</thead>
<tbody>
<tr>
<td>G1~3</td>
<td>0s</td>
</tr>
<tr>
<td>G4~9</td>
<td>2.83s</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Valve No.</th>
<th>NOZZLE DUCT (mm)</th>
<th>Pin (mm)</th>
<th>GATE (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>G1~G9</td>
<td>22</td>
<td>7</td>
<td>5</td>
</tr>
</tbody>
</table>

Customer-Oriented & Quality-Adherence
Injection System

Case-3

Cold gate 12*1.5mm

Cold runner

- Bevel-angled T-shape
- Width: 0.53 mm
- Height (diagonal): 8 mm
The contours are evenly spaced and indicate the speed at which the polymer is flowing. Widely-spaced contours indicate rapid flow; narrow contours indicate that the part is filling slowly. The fill time is 4.38 s.
Fill time

Case-3

The fill time is 4.38s, the V/P switch-over is starting when the filling volume is 99%.

G1-G3 0s

G4-G9 open at 2.83s volume is 63%
Fill time (Dynamic)  
Case-3

Click “shift+F5” Play

Fill time_1 = 0.0874[s]

Scale (600 mm)
We notice that maximum pressure is reached at 2.8 sec during filling, it is 76.4Mpa, and the holding pressure is about 58Mpa (About 76% of the Max. pressure).
The result depends on projected surface of the part and the injection pressure. A good clamp force history result should show that the maximum clamp force applied is less than approximately 80% of the machine limit, allowing the remaining about 20% as a safety factor.

The max clamp force is 1576 tonne.
Temperature at flow front

The flow front Temp. is 272.1~281.7°C, the difference of Temp. is 9.6°C, No hesitation, No short shot, No deflection. ★ Melt Temp. Setting: 270 °C; Melt Temp. Range (Recommended): 260°C~280°C
The air traps is at the end of the flow fronts and between two or more converging flow fronts, please consider to select appropriate locations for air vents.
We don’t observe any critical and brittle weld lines during filling for this part. All visible weld lines are located in corner and less visible areas with good quality.

Weld lines

= 135.0° (deg)
We don’t observe any critical and brittle weld lines during filling for this part. All visible weld lines are located in corner and less visible areas with good quality.

Weld lines:
Temperature at flow front = 281.4°C
The bulk shear rate should not exceed the maximum value (40000 1/s) recommended for the material in the material database. Exceeding this value would likely lead to polymer degradation.
Shear stress at wall

The shear stress should be less than the maximum recommended for the material in the material database (0.4 MPa). The shear stress can be compared directly with the values stored in the material database. Regions above this limit could be subject due to stress-cracking during ejection or in service.
During cycle time, pressure dynamic distribution

Click “shift+F5” Play
The Pressure at V/P switchover result shows the pressure distribution through the flow path inside the mold at the switchover point from velocity to pressure control. The packing is started when the filling volume is 99%, the pressure is 72.2Mpa at entrance point on the part, the time is 4.29s.
This plot shows the distribution of the volumetric shrinkage at ejection. It is high near the Gate point area. The target is to reach a homogeneous profile.
Sink marks estimate  

Case-3
The plot shows the throughput for each runner and we can know its efficiency.
**Frozen layer fraction (Dynamic)**

The Frozen layer fraction result shows the thickness of the frozen layer as a fraction of the part thickness. Ideally the part freezes uniformly and as quickly as possible.

![Graph showing frozen layer fraction](http://upmold.com)

**Case-3**
Conclusions

1. The fill time is **4.38** s; the V/P switchover start at 4.29s, when the part volume is filled at 99% of the volume, the V/P pressure is **72.2** MPa. And Max pressure is **76.4** MPa;
2. The Max. clamp force is **1576** tonne during the packing phase;
3. The air traps is at the end of the flow fronts and between two or more converging flow fronts, please consider to select appropriate locations for air vents. (P19)
4. The weld lines is between two or more converging flow fronts, Please check it. (P20~21)
Thank you