Air Traps

- Molten plastic traps air in part cavity as it fills
  - Air traps can lead to quality problems
    - Burn marks from compressed air heating
    - Incomplete filling of gear
  - Strategic vents in mold can eliminate air traps
  - Simulation can predict potential air traps

Air Traps Form at Plastic Flow Convergence

Cooling Times

- Analysis and simulation predict lower cooling times than currently used.
  - Analysis of heat transfer provides bounds on cooling times of 50-65 seconds
    - Assumed 1-D conduction heat transfer, no convection effects
    - Center cooled to below glass transition temperature (100 °C)
    - Determined cooling time from Heisler chart
  - Moldflow™ simulation estimates cooling time of 60 seconds
    - Assumed constant mold temperature
    - Incorporated variable viscosity during flow in sprue
  - Experiments suggest additional cooling in sprue
    - Center cavity temperature found lower than initial melt temperature
    - Heat loss possible in sprue due to conduction through aluminum mold
  - Further testing to verify quality of gear ejected at lower cooling time

<table>
<thead>
<tr>
<th>Process</th>
<th>Fill Time</th>
<th>Cooling Time</th>
<th>Ejection Time</th>
<th>Overall Cycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current (Lab)</td>
<td>2</td>
<td>118</td>
<td>5</td>
<td>125</td>
</tr>
<tr>
<td>Proposed</td>
<td>2</td>
<td>60</td>
<td>5</td>
<td>67</td>
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</tbody>
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