ENGINEERING POLYMERS: THE ‘TOP TEN’ MOULDING PROBLEMS

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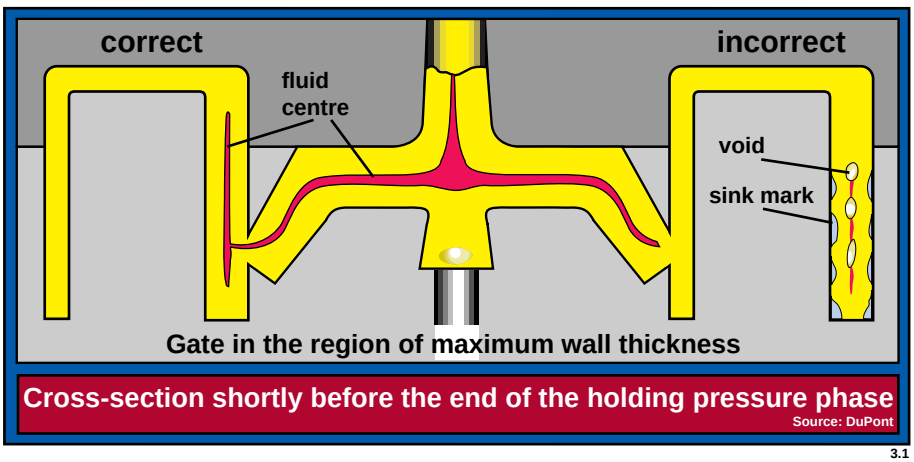
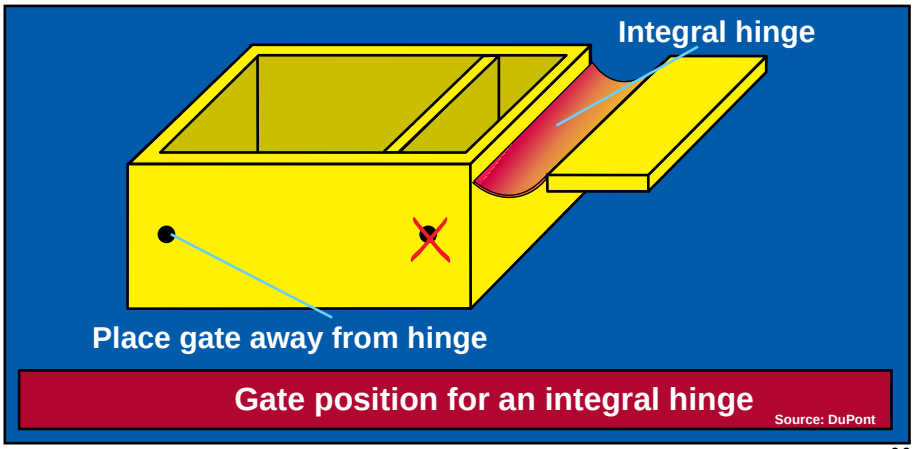
Chapter 3: Wrong Gate Position

1. Moisture in the granules
2. Feed system too small
3. Wrong gate position
4. Hold time too short
5. Wrong melt temperature
6. Wrong tool temperature
7. Poor surface finish
8. Problems with hot runners
9. Warpage
10. Mould deposit



The position of the gate is decisive for the flow front profile and the effectiveness of the holding pressure and, as a result, for the strength and other properties of the moulded part.
Since the position of the gate is usually specified by designers and mould makers, this article has been written especially with these persons in mind. Nevertheless, injection moulders should be also involved from the planning stage, to prevent predictable problems.



Possible negative consequences of poor gate position

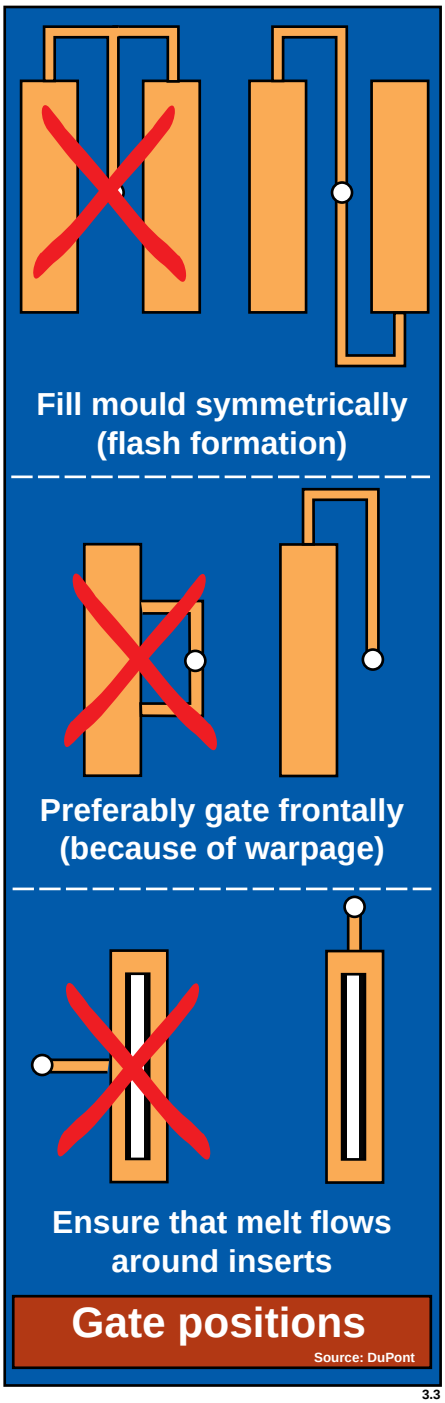
The properties of an otherwise correctly designed part made from a semi-crystalline engineering polymer can be ruined if the gate is not in the right position. This will be evident by the following symptoms, which apply to reinforced as well as unreinforced types of resin: weld lines and entrapped air, caused by the flow front profile, can influence the part's surface finish and, especially in the case of fibre-reinforced materials, its mechanical properties. Modifying processing conditions has no influence on these considerations.
Sink marks and voids are formed in the thick-walled part of a moulding if the gate is located in a thinner part of the moulding. Since the material crystallises sooner in the thin-walled section (see diagram), the thick-walled section, which requires a longer holding pressure time, can no longer be supplied with melt. Besides optical and mechanical problems, there will be increased shrinkage in that area, which can cause warping even in the case of unreinforced grades.
If the gates are too few and incorrectly positioned, flow distances can be too long and injection fill pressures too high. If the available mould locking force is insufficient or a polymer is being used which has low viscosity and crystallises too slowly, this can result in increased flash formation. Furthermore, the processing 'window' is greatly limited, so that it is no longer possible to fine-adjust tolerances via moulding conditions.

Recommendations for optimum gate position

- Always try to gate into the region with the greatest wall thickness.
- Gates should never be near highly stressed areas.
- Long parts should be gated longitudinally instead of transversely or centrally, if at all possible, especially in the case of reinforced moulding compounds.
- If there are two or more mould cavities, the parts should be arranged and gated symmetrically in relation to the sprue.
- Axially symmetrical parts such as gear-wheels, discs, impellers, etc., should preferably be centrally gated using a diaphragm gate, or by resorting to multiple gating with a three-plate mould, in order to achieve good true running properties.
- Parts which include integral hinges should be gated so that the weld line will be away from the hinge. Flow stoppages near the hinges should be avoided aat all costs.
- Cup-shaped parts (e.g. small housings, capacitor cups, etc.) should be gated near the base, so as to prevent air entrapment.
- In the case of tubular parts, the melt should first be made to fill the annular circumference at one end and then fill the length of the tube itself. This will prevent an asymmetrical flow front profile.
- When insert-moulding around core pins, melt-out cores and other metal inserts, the molten resin should be able to flow round the insert in a circle, so as to keep misalignment of the insert to a minimum.
- Exposed surfaces which have to be free from visual defects such as gate marks can be gated from the underside, using a tunnel gate feeding onto an ejector pin.

- The gate should be positioned so that even brief flow front stoppages (complex parts, multi-cavity moulds with different shapes, etc.) during filling are prevented as far as possible.

These recommendations obviously cannot cover the entire range of possible applications. Compromises will always have to be made, depending on the complexity of a particular moulding. The recommendations we have discussed should nevertheless be taken into account during the planning stage, as far as possible. Simulated mould filling trials can be an invaluable aid in such situations



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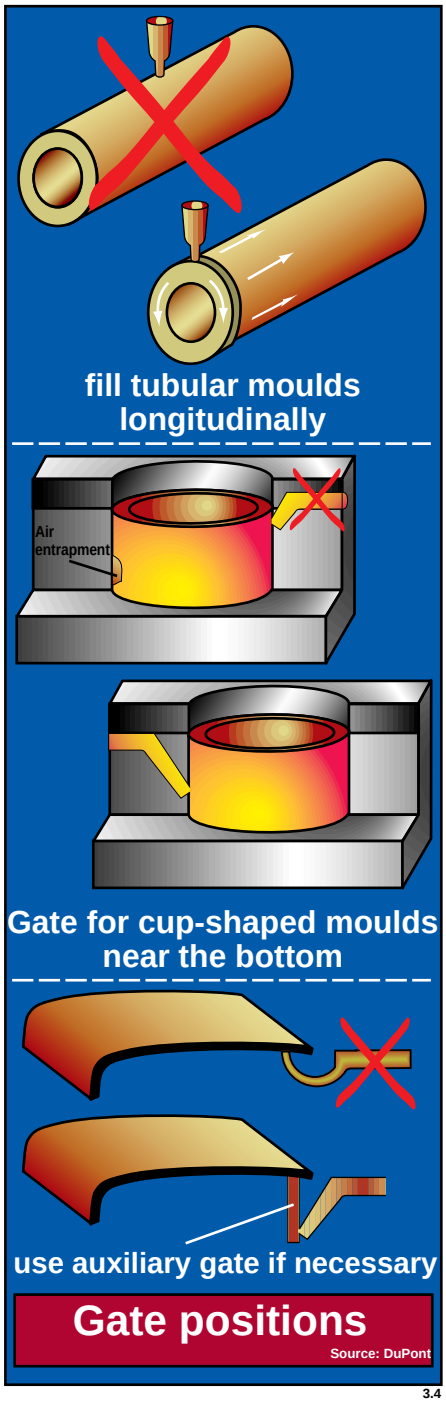

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