

Moulding expert **John Goff** explains how to determine correct gate size in the latest article in his series on process optimisation and trouble shooting

The importance of gate size

The previous [article](#) in this series described how to determine the most efficient injection time for a mould tool–moulding machine–material combination with the aid of the relative viscosity/shear rate graph. Once injection time is selected, it must be verified. This is to ensure that the feed system incorporated in the mould tool, and the gate in particular, has been optimally sized so that the thermoplastic material is not structurally damaged as it passes in its molten state through the gate's orifice and/or along the flow path within the impression.

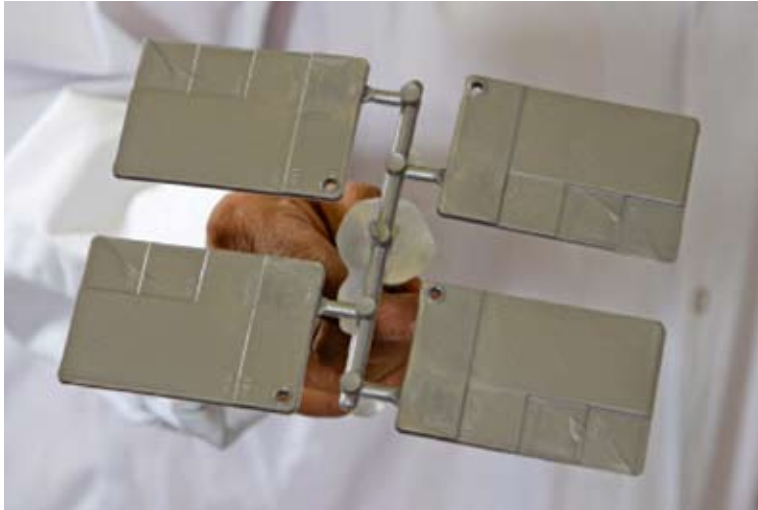
Penalties of incorrect gate size

In the injection moulding industry the following is a very common occurrence. The gate is initially machined at a value that is too small on the basis that this allows the opportunity for it to be increased, if required, at a later point in mould tool validation. Unfortunately, in many

cases, the moulding conditions ultimately selected are the result of a desire to overcome some of the defects caused by the inclusion of a small gate. These defects/issues with component quality include gate bloom; cracks appearing in the gate area some time after the moulding has been produced; high inherent stresses within the moulding resulting in premature failure whilst in service; gas entrapment within the moulding; porosity within the moulding (in particular in the region of the gate); excessive component shape change (deformation); the presence of sink marks, poor surface finish and lack of consistency of surface texture; poor optical properties and image projection issues; ovality within components; and the presence of voids in the components.

Thus, the overall situation is that a particular set of processing conditions has been manipulated to overcome issues of poor quality, which result in long

Cavity machining may be computer controlled but gate sizing is often left to trial and error, a decision that can compromise part quality, says John Goff (Image: Delcam)



Appropriate gate sizing is science, not art

because the internal molecular structure and inherent stress levels need to be controlled; too high a shear rate will cause chrome plating issues such as micro cracks, porosity and/or poor surface finish.

Use of the G&A calculation method provides the product designer, mould tool manufacturer and the processor with suitable information to allow the gate

aperture, type and geometry to be optimised before any components are moulded. It can also be used as a trouble shooting tool during mould tool validation to decipher whether the gate orifice and the relevant injection time are compatible.

The calculator (*see Table*) demonstrates that the values in red are too high and the acceptable figures are in green. From the example above, the calculated shear rate value for a 1-mm gate at the derived injection time of 0.8 s is $105,175 \text{ s}^{-1}$, which is above the recommended maximum for PP. By simply increasing the gate to 1.1 mm, the inherent shear rate reduces to $79,019 \text{ s}^{-1}$, which enables the material being processed to have the correct structural attributes. Furthermore, a process window from 0.7 s to 0.9 s could be applied.

More information

This is the thirteenth article in the Moulding Masterclass series, which discusses the fundamental issues that prevent optimal injection cycles. Recent articles can be accessed, [here](#), [here](#) and [here](#), respectively. John Goff is Managing Director of G&A Moulding Technology.

! www.gandamoulding.co.uk