Factsheet
«Thermal Expansion»

Thermal Expansion in Injection Molding

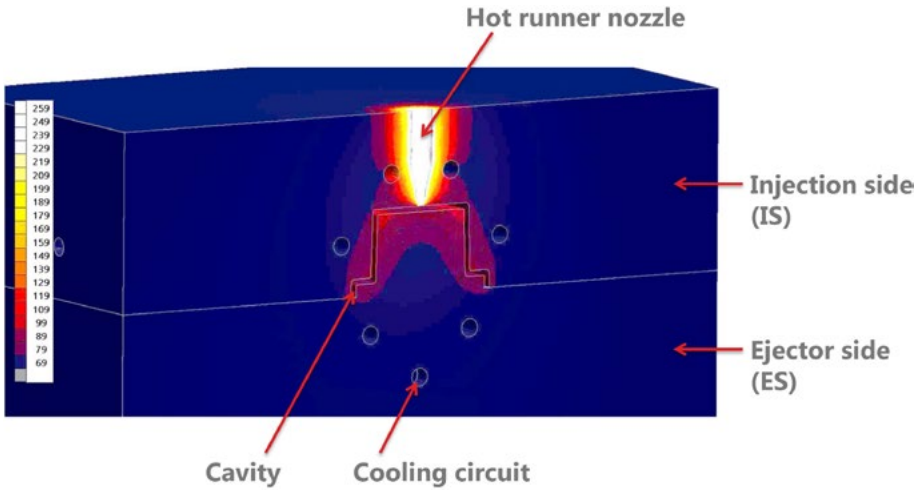
What is it about?

In injection molding – as in punching – preloaded roller guidings free of play are used for different guiding and centering applications. With regard to service life, rigidity and precision, they are superior to sliding guides. In injection molding, however, there are often concerns about the locally different thermal expansion, which can be compensated by roller guiding elements only to a small extent. This is why Agathon was the first standard manufacturer to have thermo-mechanical FEM simulations calculated in order to simulate the actual influence of thermal expansion on the roller guide elements.

What has been simulated?

A simple injection mold with three cooling circuits, one cavity and two built-in roller guide elements was simulated. The roller guides were represented by rigid, firmly interconnected nodes in the simulation. They were installed at a distance of 120 mm (4.72 inches) from each other. In order to simulate the influence of heat on the cavity surface, a moldflow analysis was performed beforehand. Their results form the basis of the FEM simulation. A total of three calculation runs were carried out, with the following parameters as initial value:

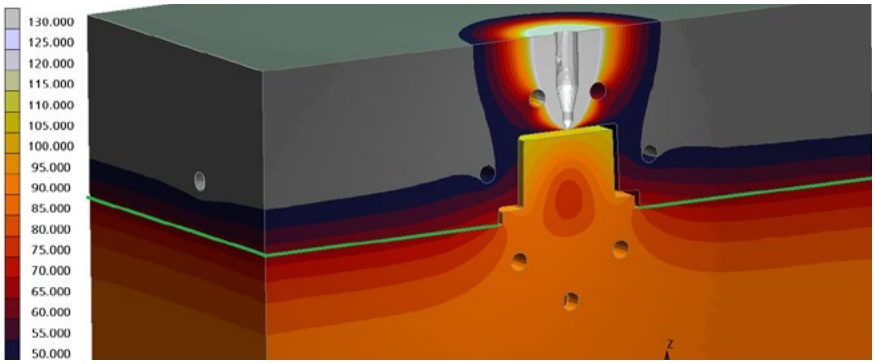
- Injection and ejector side (IS and ES) tempered to 70 °C (158°F) identically
- Temperature difference of 20 °C between ES (80°C / 176°F) and IS (60°C / 140°F)
- Temperature difference of 50 °C between ES (90°C / 194°F) and IS (40°C / 104°F)



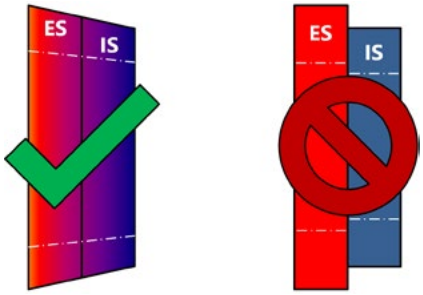
Picture 1: Setup of the FEM-simulation

What are the key results of the simulations?

In short, there is no cause for concern unless there is a temperature difference between the two mold halves. If there is a temperature difference between the nozzle and ejector sides, then the actual displacement of the column and sleeve is 3-5 times lower than when calculating the theoretical difference. The effect of the heat transfer at the contact surface (on the parting line) of the two mold halves ensures that there is no sharp separation of the temperatures of IS and ES, but a smooth transition in the contact zone.

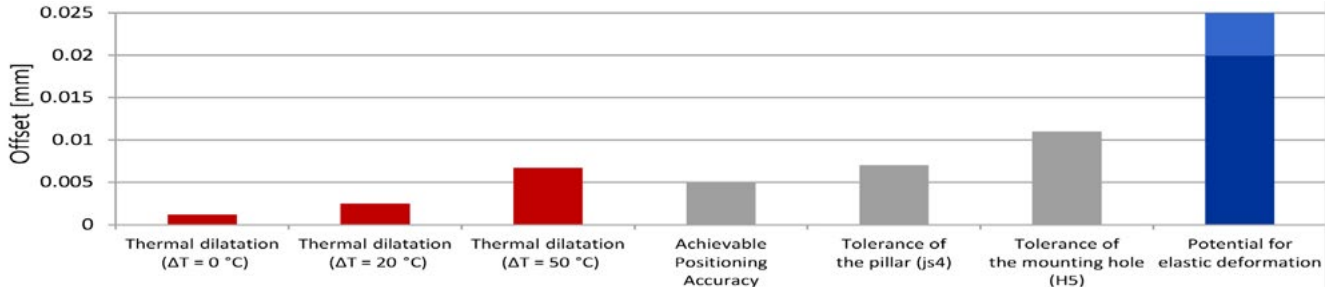


Picture 2: Heat transfer at the parting surface (green) between ejector and injection side at 50°C temperature difference



Picture 3: Representation of the temperature compensation at the parting line

Findings from previous simulations as well as the experience of Agathon AG show that roller guiding and centering units have a potential to compensate for different thermal expansion of at least two hundredths of a millimeter (in the case of the - very stiff - round fine centering series 7990). This consists of the elastic deformation of roller elements, pillar and bush and the fitting tolerances of the mounting holes.



Picture 4: Temperature offsets (red bars), manufacturing tolerances (grey) and potential for elastic deformation of rolling guides (blue) in relation to each other

What's the impact of the results on the mold design?

Agathon's roller guide elements, such as the main guiding system and round fine centering, can be used safely, especially when there are small heat differences in the tool. If higher temperature differences than 30° C are planned in the process, you can contact our support team and use the following design guidelines:

- The distance between the round fine centerings should be as low as possible.
- A uniform tempering of the tool: it helps to make the occurring effects predictable.

What support does Agathon offer?

Agathon supports you with regard to engineering including dimensioning and design of your guiding or centering system. Because Agathon's core competence in high-precision machining is in-house, custom-made products (eg corrosion-resistant, to company standards, ball cages for rotating threaded cores, ball cages with ceramic balls) can also be produced. Agathon can also advise you on your application and draw on 100 years of know-how, experience gained in numerous practical applications and the results of further FEM simulations. So, do not hesitate to contact us for critical applications!