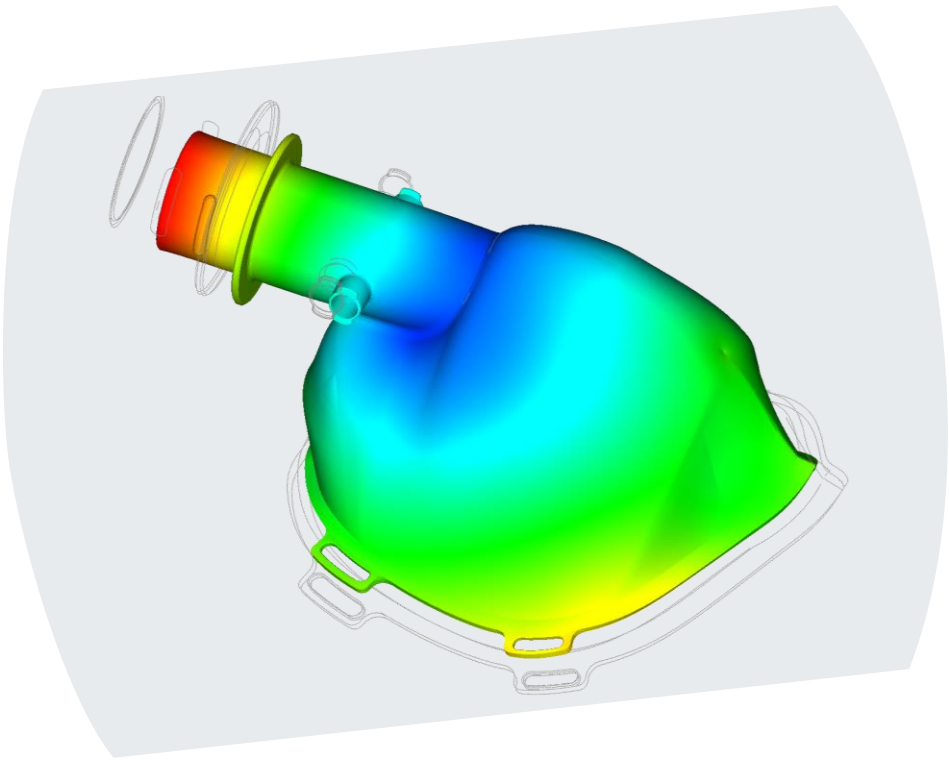

MOCOM

Guideline Shrinkage

What is "shrinkage"?

Shrinkage is the percentage difference between the nominal dimension of a molded part in the mold and its actual dimension after demolding at room temperature. This results from the volume contraction due to the cooling of the melt and crystallization (for semi-crystalline thermoplastics).

A distinction is made between

- demolding shrinkage (dimensional difference directly after demolding)
- processing shrinkage (dimensional difference after 16 to 24 hours in standard climate)
- post shrinkage

Post-shrinkage also includes effects from post-crystallization and stress relaxation in a part after a longer period of time.

Technical data sheets of MOCOM products usually state the shrinkage 24 hours after demolding acc. to ISO 294-4.

How is shrinkage influenced?

Shrinkage is not a pure material property, but is influenced by fillers, the part/component geometry, its wall thickness and the position and size of the gate. The processing parameters, such as mold wall and melt temperature, also play a decisive role. Particularly semi-crystalline thermoplastics (e.g., polypropylene, polyamide) react strongly to changes in process temperatures, as this can significantly influence crystallization.

In addition, it should be taken into account that anisotropic shrinkage is usually observed in fiber-filled plastics. The dimensional change is therefore dependent on the local orientation of the fillers.

In consideration of this situation, shrinkage values on technical data sheets are to be understood as guide values and cannot be specified as product properties.

However, shrinkage can be optimized to a certain degree by adjusting the injection molding conditions accordingly. Important molding parameters and their general influence on the shrinkage are listed below in the table.

Important injection molding parameter	Change of injection molding parameter	Shrinkage
Holding pressure	↑	↓
Holding time	↑	↓
Mold temperature	↓	↓
Cooling time	↑	↓

What is the difference between "shrinkage" and "warpage"?

Warpage refers to the undesired change in dimension and shape of a component or part. Due to locally uneven shrinkage, warpage already occurs during the cooling process after plastic components have been demolded. The causes of uneven shrinkage are manifold: Filler orientation, geometric influences (e.g., corner distortion), uneven mold temperature control and locally insufficient holding pressure are among the most frequent causes of warpage. Therefore, a warpage analysis should be carried out during the design process.

How is shrinkage measured?

For the purpose of comparing various thermoplastics and compounds, standardized tests are performed on test plates. MOCOM determines the shrinkage according to DIN EN ISO 294-4 on plates with the geometry 60 x 60 x 2 mm using standard injection molding parameters to produce these plates of the respective compound. This results in a value range which is stated on technical data sheets of our MOCOM products.

Example

- Shrinkage (longitudinal, 24h): 0.5 - 0.8 % ➡ 0° to flow direction / fiber orientation
- Shrinkage (transverse, 24h): 1.2 - 1.5 % ➡ 90° to flow direction / fiber orientation

The values from the standard test are free, unimpeded shrinkage. This means that the shrinkage of the flat sheet is not affected by ribs, apertures or other design features and that the volume of the molding compound can contract unhindered during cooling without building up significant internal stresses.

How can shrinkage be taken into account during part design?

Due to this multitude of partly component-specific factors, a generally valid and exact prediction of shrinkage is not possible. Therefore, before designing new injection molds, it is recommended to always determine the shrinkage of a thermoplastic compound on a geometrically comparable existing mold with the corresponding (planned) processing parameters and temperatures.

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