# 8 Ways to Ensure Your Thermoplastic Part Will Be the Right Size.

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# Part size is critical to part fit and function.

In a perfect world, every thermoplastic would have the same shrinkage, making it easy to cut any tool to the correct size. The truth is, every thermoplastic and every process is a little different, complicating how to decide what shrinkage is needed. Thermoplastic elastomers have a very wide range of shrinkage values and many times have directional shrinkage which makes this material class even more difficult to hit the correct part size. It's important to understand the shrinkage of the material and how part design and process affect it.

The shrinkage of thermoplastics refers to the volume contraction of the thermoplastic after processing. When the polymer is heated during the processing stage, the polymer volume swells, and once it returns to room temperature, the polymer volume contracts. The shrinkage of the material is the difference between the size of the cavity versus the size of the final part. Thermoplastic elastomer shrinkage is typically measured per ASTM D955 which uses specific plaque size to compare one material to another. Although this is a good starting point, parts differ in size and shape.

Here are eight areas to review before cutting your tool.

**1. Determine which specific grade of material you'll use** - Understanding which specific grade you're using is critical because they are not all interchangeable. Thermoplastic elastomers can have shrink rates ranging from 0.9 ~ 4.0%. To make things even more complicated, shrinkage can be directional which means that the part can shrink differently with the flow during processing versus against the flow. If the difference between with flow and against flow is not significantly different, an average is acceptable. Always start by seeking out the published shrinkage for the actually grade you plan on using and not just something that is close.

**2. Primary direction of flow in the part** - If the flow in your part is mainly unidirectional, selecting the shrinkage that corresponds to the main direction of flow in your part is optimal.

**3. Determine flow length** - Part thickness versus how far it needs to flow can drive how quickly the part sets up. This can change crystallinity and how the elastomer freezes in an elongated state. If you're close to the maximum flow length, a change from the published shrinkage can occur in addition to other defects like the warpage.

**4. Part size** - Looking at overall part size will help determine how critical shrinkage will be and the margin of error you have. If the part is small, you can be less accurate about the shrinkage you use. If the part is large, then you need to be sure to be more precise.

**5. Processing temperatures** - If you need to process the material at hotter temperatures than the temperature at which the shrinkage was measured, you may need to adjust your shrinkage. Hot material will take up a higher volume of space and will shrink more once it is back to room temperature.

**6. Overmolding onto a substrate** - If the shrinkage between elastomer and the substrate is high, this can cause part warpage unless the substrate is rigid. With medium to small differences, the elastomer will typically conform to the shape and shrinkage of the substrate.

**7. Complete a Mold Flow Analysis** – Mold Flow can calculate the expected shrinkage based on the basic material properties. In the absence of having a similar tool with which to measure shrinkage, this can be a good option. To improve the accuracy, it's important to use the correct mesh specifically around corners and areas in the part with large thickness changes.

**8. Similar tool** – The single best way to understand the shrinkage you can expect from a material is to measure the material's shrinkage in a tool that is similar to the tool that you are designing. Injection molding processing parameters like injection speed, tooling temp, cycle time, gate size & location, holding time and pressures, can all affect the shrinkage. When possible, use a prototype tool or a tool with a similar shape/size to measure shrinkage as this will be more accurate than the plaque used for the material supplier's published shrinkage data.

**For more assistance in ensuring your part is the right size, contact the Audia Elastomers Team. We're here to help!**