F I M M T E C H , I n c .

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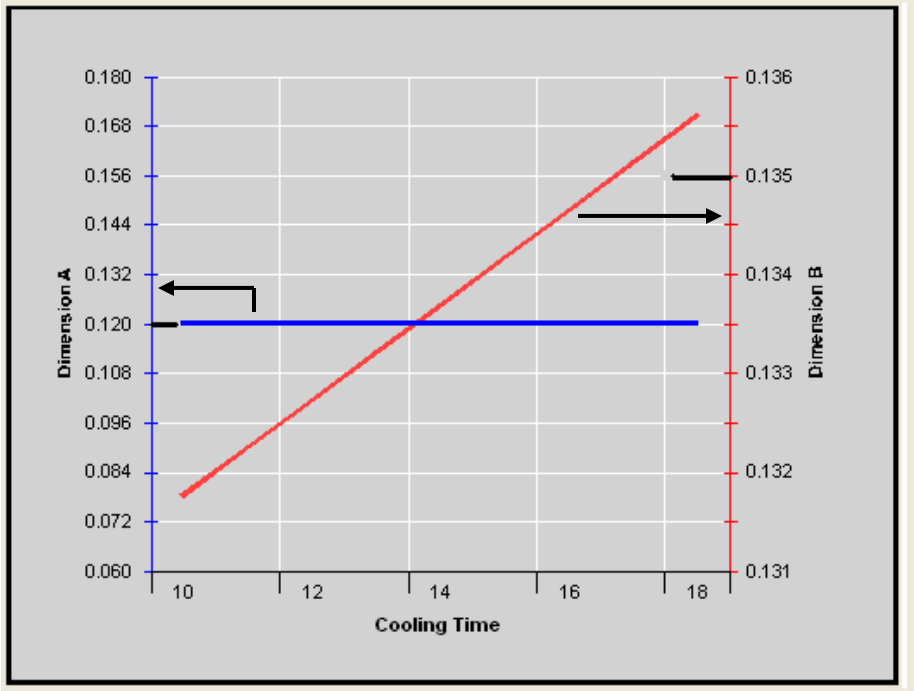
ESTABLISHING A ROBUST INJECTION MOLDING PROCESS, PART 6: THE COOLING PHASE.

Introduction to the cooling Time:

The plastic starts to cool down as soon as it hits the walls of the mold. Once the holding time is over, the cooling time starts. The mold remains closed till the end of the cooling time. The mold then opens and the part is ejected. Before the mold opens, the part must reach the ejection temperature of the plastic. If the part is ejected before it reaches ejection temperature, the part is too soft and will get deformed during ejection. Excessive cooling time is only a waste of machine time and therefore profits. Cooling time should also be set such that the part dimensions remain consistent and the process is capable.

Determination of the right cooling time can get complicated. With parts with thick sections, it is difficult to measure the internal temperature in the center of the thickest section. In some parts of the mold, it is difficult to get enough cooling and therefore cooling times have to be increased to increase the heat transfer. In some cases, the mold temperature can stabilize after as long as a couple hours. Shrinkage can also be influenced by changes in cooling times.

In the picture below, you will notice that some dimensions may be more sensitive than others. Dimension A is not influenced by the cooing time range experimented with. However, Dimension B changes with the cooling time. The target value for dimension B is 0.135”. So we can either set the cooling time at around 17 seconds or make steel changes to run it faster and achieve the same dimensions. Identifying the lower and upper limits on the graph will also present a graphical representation of where the cooling time can be set.



The following procedure can be used as a guideline to set the cooling time.

Procedure for determining the Cooling Time.

1. Mold three shots at various cooing times.
2. Measure the critical dimensions.
3. Plot a graph of dimension versus the cooling time.
4. Analyze the data to see how the critical dimensions are influenced with the cooling time.
5. Decide on the cooling time that best fits the data.
6. Run 30 shots at this cooling time and perform a statistical analysis to determine the process capability at this cooling time.

Cycle time is the most important factor since that is what makes the bottom line profit. In most case, if the process is capable at lower cooling times, one can make a change in the mold steel and achieve the same dimensions at lower cycle times.

About FIMMTECH:

FIMMTECH is a consulting firm that provides services in the area of Injection Molding of Plastics. FIMMTECH is also in the process of developing products that will increase efficiency of the molding process, educate personnel and better manage the molding facility. One of the first products to be released is the software 'NAUTILUS' that helps in the development of robust and optimized processes. Suhas

Kulkarni also teaches a course on Injection Molding at the University of California, San Diego that can be offered as In-House seminars. For more information please visit www.fimmtech.com

Thank You.

Sincerely

Suhas Kulkarni.