Part Design Considerations for Manufacturability Optimization

By Drew Rosek, TZERO CAE Specialist

Part concept and design are vital elements to the molding process. Because of this, it is highly encouraged to spend some additional time analyzing your design before creating the mold. Significant opportunities to decrease waste and time-to-market can be achieved with some up-front work.

Factors that should be well thought out for part design are:

- Part and tool design
- Molding machine and performance
- Plastic material selection
- Universal process

For the purpose of this article, we will focus on part design itself, specifically wall thickness.

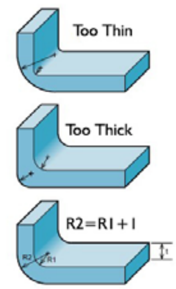
The Most Vital Rule

If there was only one rule for the injection molding part design, it would have to be to maintain uniform wall thickness.

Prior to part ejection, injection molded parts must be cooled down from processing temperatures to a point where they are able to maintain their shape and withstand the forces of removal. Once the plastic makes contact with mold steel, it immediately begins to cool. During this period, wall thickness alone is the driving factor in overall part quality (dimensions), solidification time, stress, and overall cycle time (time to part ejection).

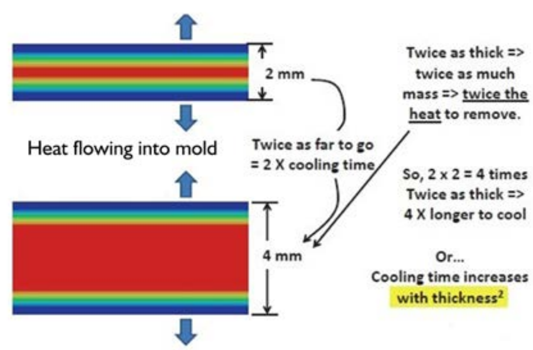
That said, determining the correct wall thickness for your application can have drastic effects on the cost and production speed of manufacturing. Wall thickness has no set restrictions and will typically be driven by the size and structural requirements of your plastic part along with the resin type and flow length needed. Choosing a thinner wall can yield overall cycle time reductions at the penalty of some physical characteristics (strength, chemical resistance, flame retardant properties, etc.). Inversely, thicker walls can help with these characteristics while increasing cycle time and manufacturing costs.

Right: Maintaining constant wall thickness in corners

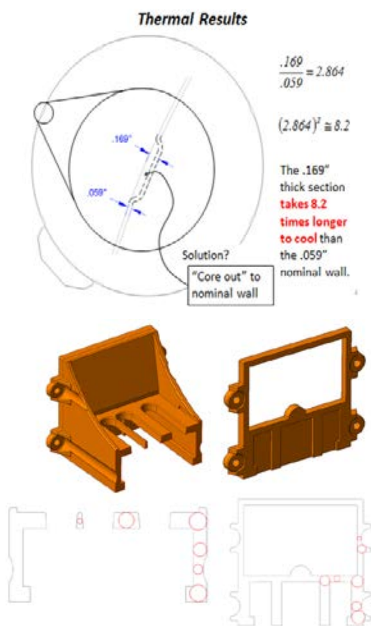


Cooling Time

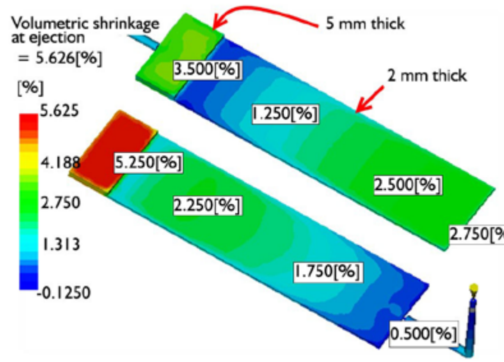
In regards to the effect on cooling time, a general guideline is that your cooling time will increase with thickness ^ 2. Why thickness ^ 2? To help explain this, we will use a 2 mm wall and 4 mm wall (shown below).

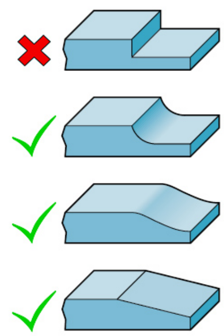


When you look at a cross section of the 4 mm wall, you can see that all the heat has twice as far to travel before it can exit the part. The other factor is that you now have twice as much material that's trying to be an insulator. Thus, you could take whatever cooling time you had with the 2 mm section and multiply it by a factor of 4 to come up with your new plastic cooling time.



Above: Examples of wall thickness variation

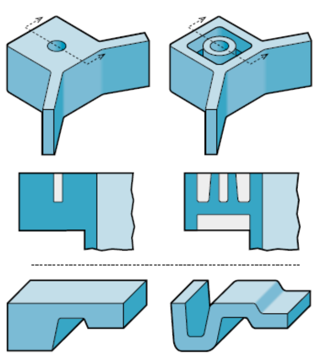




Source: "Moldflow Design Guide" from Hanser

Alternatives

If your part is so complex that you need variations on your wall thickness, consider alternatives, such as coring or using ribs in areas of concern.



Also, remember that sharp corners cause stress concentrations in molded parts. If you must make transitions in wall thickness, gradual transitions can help reduce pressure losses through the part, giving better overall dimensional control.

Conclusion

There are many creative ways to deal with the trickiest design requirements. The challenge that we have to deal with the most is convincing the OEM that the part design needs to be altered to provide a better processing window. The issues that have been discussed thus far simply cannot be "processed out" and can be a burden on the molder for the lifecycle of the tool. Getting the molder, toolshop, and OEM involved and communicating early on in the process is key to the overall success of any complex project. If you'd like asssistance in getting the mold right the first time, RJG's TZERO™ program is an engineering/consulting service that helps molders with the mold design and concept process.

Drew Rosek is an RJG TZERO Support Engineer/Consultant. His duties are to collaborate closely with our customers through the entire TZERO process, with an emphasis on simulation and *eDART*™ sensor application during a tool launch. During his 10+ year career at RJG, Drew has helped our customers with sensor, *eDART*, and design applications. His expertise has helped countless customers produce consistently good parts. Drew is the king of nerf gun retrofits and placed second in RJG's best beard competition. In his free time, Drew is a Subaru rally racer, dog walker, and brewmaster.