Clamp Tonnage

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One concern when quoting a job is what press should be used.

This is dependent on: clamp requirements, shot size, recovery rate, press speed, available pressures, injection speeds, etc.

This Tech Tip will focus on the calculation of clamp tonnage.

First, we need to know the projected area of the entire shot. The projected area of the part is defined as the area we would see in the plan view of the mold. Either the A side or B side, whichever is greater, should be used and would include the runner in a two-plate mold. If we have a three-plate, or insulated runner, we need to consider which area is larger, the parts or runner system, and calculate from that part or system.

There are hundreds of issues involved in plastic processing. However, in this guide I am only addressing plastic flow rate during first stage.

For the following example, we will deal only with the cavity.

If we have 4 square inches of projected area and the general specification calls for 2 to 5 tons/in^2, the resulting clamp requirement would be 8 to 20 tons force to hold the mold closed. Using this calculation the mold is constructed and put in a 25-ton machine for first run sampling. To your surprise the mold flashes.

Now the question arises as to why the flash occurred when a machine capable of tonnage higher than what was originally indicated was used. Simply put, the wall thickness of the part was neglected in the calculations. In the past the projected area was the only thing that people were concerned with as the part thickness was generally in the 0.100" ± 0.025" range. But, now-a-days parts as thin as 0.006" with flow-to-thickness ratios of over 200:1 are becoming increasingly common in today's molding environment. As wall thicknesses are reduced and flow lengths are increased, the resulting cavity pressures are much higher than what was previously seen in thicker walled parts. Consideration of these variables must be made when considering clamp force requirements.

The terminology of what is thick wall or thin wall can be arbitrary. Some articles and books list them as follows:

<100:1=thick wall
>100:1=thin wall
>200:1=thin wall with special needs

To calculate the flow-to-thickness ratio, divide the length of flow in the part by the nominal wall thickness of the part. If the flow to thickness ratio is <100:1, the standard clamp tonnage range can be used. At 100:1, the use of upper limit values of clamp requirements is suggested. If ratios of <200:1 are present, the clamp tonnage to be used may exceed the standard rating by 1/2 to 2 times the normal amount. Additionally, you must consider the supports, steel selection and other mold construction methods used.

Additional points to consider in clamp-force requirements include, but are not limited to, slides, cam actions, stepped parting lines, taper and draft.