Gas Assist Case Study 322-2

Seat Cover for Personal Watercraft

Excerpted from "Gas Assist Injection Molding", by Paul Dier and Rick Goralski

Seat Cover for Personal Watercraft

In this case study we will examine the process by which we converted a new mold to gas assist, for the sole purpose of reducing clamp tonnage. The mold was for a bottom seat cover for a personal watercraft. The resin was standard polypropylene.

The problem this customer faced was due to the thin wall thickness and large surface area of this part. **(See Fig. 322-2A)**

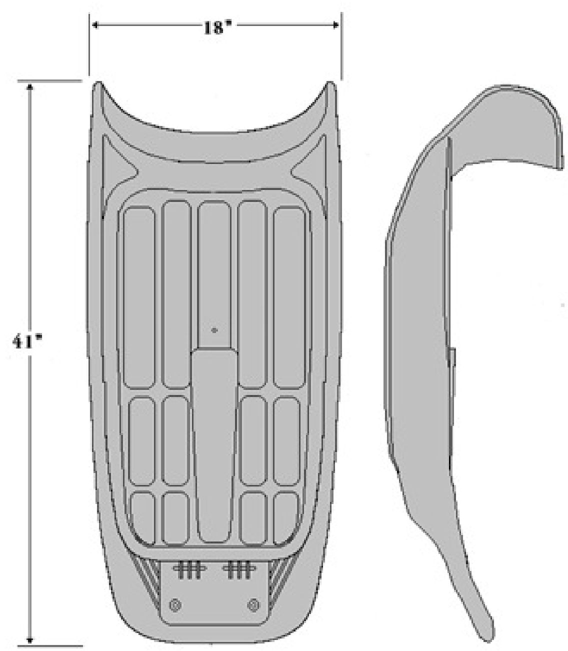

FIGURE 322-2A To deal with the thin-wall thickness and large surface area of a watercraft seat cover, the molder would have had to purchase a 1500-ton press; gas assist allowed the use of an existing 1000-ton machine.

They would need to purchase a 1500 ton injection molding machine in order to provide adequate shutoff in conventional molding. The largest machine they currently had available was a 1000 ton. They wanted to see if gas assist would lower the clamping force enough so that they could produce this part in their 1000 ton machine, eliminating the need for a new machine purchase.

After reviewing the current mold, we agreed that this would be possible with the addition of gas channels to aid the resin flow. We would then short shoot the part, and inject gas through the nozzle. The gas would complete the fill of the cavity and pack out the part.

Since the part was already set up with a center sprue gate, we proposed adding gas channels in an **X** pattern from the gate, directed to the four corners. In this instance, due to the objective of reducing clamp tonnage, the size of the gas channels would be somewhat larger than the usual standard of 2 ½ times nominal wall. A ball cutter was used on the cavity half of the tool to cut the channels in a half round configuration. The channels were gradually tapered down to nominal wall thickness at the ends to prevent gas permeation into the thin wall. **(See Fig. 322-2B)**

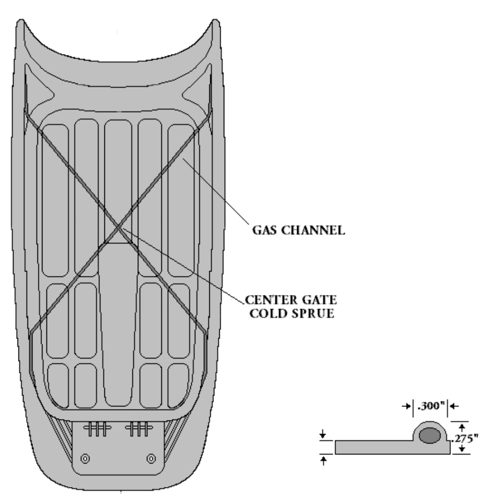

FIGURE 322-2B This part was already set up with a center sprue gate; gas channels were added in an X pattern and tapered down to nominal wall thickness at the ends to prevent gas permeation into the thin wall.

The mold was then set in their 1000 ton molding machine. The gas was injected at the tip of the injection nozzle, forward of a resin shutoff valve to prevent gas from entering the machine barrel. The gas was to be vented by using sprue-break. The start of gas signal was set at ½ inch before bottom. In order to have accurate shot control, the screw was set to bottom out with no cushion. It was also necessary to disable the cushion correction feature on the molding machine to maintain shot repeatability. The pack timers were set on the molding machine at zero. The hold timer was set at 0.5 seconds to prevent the screw from bouncing back after each shot. The fill speed was set at 1.5 inches per second, and the cooling time was set at 50 seconds. The gas settings were set as follows:

Gas Delay Timer	1.5 seconds
Injection First Stage	4.5 seconds at 2000 psi.
Injection Second Stage	3.5 seconds at 1500 psi.

All other pressure stage settings were not used. The delay timer was set at 1.5 seconds to help prevent gas permeation into the thin wall sections of the part. The idea was to allow some time for the thin wall to set up before injecting gas. We short filled the cavity approximately 95%, and then injected the gas. The first part was a blow through, or short shot, so 1 millimeter of material feed was added. The second shot held gas. The parting line was examined and showed no signs of flashing, but there was permeation of gas into the thin wall sections all around the gas channels.

We started experimenting with longer gas delay times and lower gas pressures. The longer gas delay times seemed to show little improvement, but the lower gas pressures helped a great deal. We added a third stage of pressure and tried to ramp the gas up a little at a time. This also helped improve the problem. We finally produced acceptable parts with minimal gas permeation using the following gas pressure profile:

Gas Delay Timer	2.0 seconds
Injection First Stage	2.5 seconds at 1000 psi.
Injection Second Stage	1.5 seconds at 1200 psi.
Injection Third Stage	4.0 seconds at 1500 psi.

We now had acceptable parts, so we attempted to optimize the process. We were currently running at a 58 second cycle. We lowered the cooling timer two seconds every two shots and we were able to run acceptable parts consistently at a 48 second cycle.

As an experiment, we wanted to see how far we could lower the clamping force without flashing the part. We started lowering the clamp force settings. The part showed no evidence of flashing, even at 700 tons of clamp pressure.

Simply by adding some gas channels and utilizing gas assist technology, the molder was able to produce this part without having to purchase a larger molding machine.