Gas Assist
Case Study 322-9

Headlight Mounting Module

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

Head Light Mounting Module, Sport Utility Vehicle

The molder of this product contacted us, proposing a large HMM project for a major line of SUV. The concept was conceived due to part design, and the shrinkage factor the designer was considering, if molded conventionally. The molder sent us all the preliminary drawings and contingencies.

The molders concerns were as follows:

1. Warpage. The part was to be 63 inches long. End to end warp was a great concern, due to the importance of mounting and securing the part to a vehicle. **(See Fig. 322-9A)**

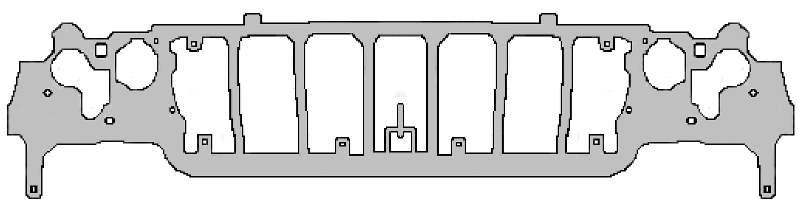

Fig. 322-9A

FIGURE 322-9A The molder of a 63-inch long SUV headlight mounting module turned to gas assist for help in controlling warpage, shrinkage, and weld lines and in keeping press size to 1450 tons.

2. Shrinkage. The part, again, was to have an end to end shrink factor of less than .5 mm.

3. Weld lines. If a hot runner system was used, the number of gates would cause the meeting of resin in many locations across the part. Since this part was to be an integral part of a crash, part integrity was of the utmost importance.

4. Molding press sizing. The molders largest machine was a 1450 ton, and had capacity to meet the requirements of the customer. The projected press size was determined to be a 2500 ton press, if this part was to be molded conventionally.

5. Cycle time. Even though the molding machine had capacity, the molder did not want to run into a capacity situation, if volumes were to increase.

6. Resin. The resin that was specified by the customer was a 30% glass filled PET. They were concerned about the use of gas assist, with this type of resin.

After evaluation, we contacted the molder and explained that the part design lent itself greatly, to the use of gas assist. We explained the facts that this product would be able to be molded with a single sprue and gate, eliminating weld lines completely. We also explained that the end to end shrink of the part would be almost zero. Warpage would not be a factor, due to the elimination of molded in stresses. The resin of choice was an asset not a detriment, due to it's properties and it's glass content.

We had to verify mold base size to determine if the tool would fit into their 1450 ton press. As long as the tool would fit in the press and had enough shot size, we would not have a problem with press size. This would prove itself, as the largest benefit of going with gas assist. The molder would save an enormous amount of capital on this fact alone.

We explained to the molder that the next step should be to have mold flow simulations performed. This would allow them to verify our recommendations. They agreed and ran a series of mold flows based on the following data. **(See Fig. 322-9B)**

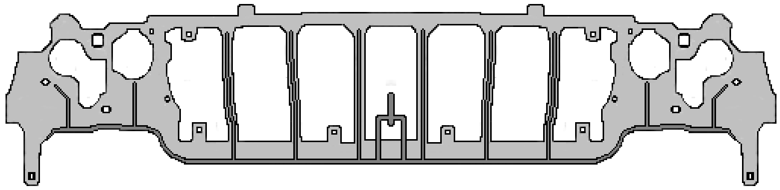

Fig. 322-9B

FIGURE 322-9B Mold-flow analysis could not confirm that the part could be molded with a single sprue and gate.

1. A centrally located sprue.
2. A cashew gate connected to the primary gas channel that would run the length of the part in each direction.
3. To eliminate a lifter along the bottom edge of the part, creating a 13 mm. gas channel.
4. To connect a series of sub channels to the primary channel, at a dimension of 6 mm each. These sub channels would aid in the filling of the extremities of the part.
5. To determine if the simulation would allow fill and packing of the part in a 1450 ton press.
6. To determine shrink factors based on the gas channel design.

The molder had many questions regarding the information we provided to him. We then were hired as sub-project engineers to assist with the mold flows. This was due to the disbelief of upper management within the molder's facility. We provided hands-on design to the CAD operator, so that he would better understand our concept of design. As with anything new, there was a learning curve that had to be overcome.

Twenty-three mold flows were performed overall on the project. Even though the proper information and data was entered, the mold flow program gave negative results. This caused the first uphill battle of the project.

We had, in the past, modified many tools similar in design. We knew in all practicality that the design would work, yet the hurdle of overcoming mold simulation was still there. We presented many parts with similar configurations as proof, but we were still perceived as too aggressive with our recommendations.

The chosen tool shop then performed its own mold filling analysis on the part, using the same data. The tool shop had a different software package which provided much more positive results. We then were able to present a series of documentation that bought us credibility.

Once our customers' upper management realized that our design held water, they allowed the project to begin. The only contingency was that the tool be built with the provision for a hot runner manifold system. The thought was that if the mold proved itself incapable, the manifold system could be added without interferences from other basic mold necessities such as cooling circuits. We suggested that this was not necessary, but were stifled on this subject. They were our customer, of course.

The mold was built by a tool shop that had a successful history with large tools. We attended many meetings, to help assure that proper gas channel design was allowed for. The tool was built in 17 weeks, and we were ready for trial. Although the tool had removable inserts acting as lifters, it was capable of simulating a production run. The trial took place at a facility that had vast experience with specialized tooling. This proved to be an important factor in the success of the program. The people that attended the tryout were from the resin supplier, OEM, and our customer. This project was receiving much attention.

Prior to the first shots, comments were still being made about the aggressiveness of the design. In our minds, the tool design was actually quite simple. Without having knowledge of the practical application, and exposure to a variety of tool designs, they could only question the capability of this tool.

The first few shots were taken, and the tool filled completely without even initializing gas. This indeed was a good sign. All we needed to do now was reduce the amount of resin being injected, and compensate that volume with gas pressure.

Parts were coming out of the tool consistently. The gas process offered a huge reduction in cycle time as well as dimensional stability, the latter being most important. The part had to mate with many other components. The tryout went from a test of filling to an actual capability run.

Results of the tryout:

1. The tool was capable of running in a 1450 ton press. Tonnage on the tryout machine was decreased to 1450 tons to simulate the scheduled press size.
2. The overall cycle time of the part was 72 seconds. Achieving consistent dimensional stability during this cycle time proved very beneficial.
3. The gas channel layout proved to be successful on the first run. There were to be no additional tool modifications.
4. We achieved weight savings of 38 grams. Comparison of full-shot weights to the gas assist part clearly illustrated evidence of resin reduction.
5. No spillover was required to completely evacuate the main channel. Today's proper tool design eliminates the need for such a costly configuration.
6. We ran the entire run of 170 parts consecutively. There was no scrap in between cycles, which proved that gas assist was a capable process.
7. We eliminated the concern for the use of cooling fixtures as well to assure dimensional stability. Warp and shrink were not evident on the run of parts.
8. In addition to saving the customer tooling costs by eliminating the hot runner system, there were absolutely no weld lines on the part except those around core pins.
9. Considerable savings were achieved by the elimination of a lifter to form the bottom edge of the part. This helped in tool building lead time as well.

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