Success Story of the Year

The Acuson Keyboard Base Casting produced by SKS Die Casting and Machining Inc.

Acuson Sonograph (now owned by Siemens) has been a customer of SKS Die Casting and Machining Inc., but not initially on the keyboard base casting. This part was being produced by the RPM (Rubber Plaster Molding) sand casting method. Due to good customer relations, Acuson came to SKS to see if the keyboard base part could possibly be die cast. The answer was "yes," and SKS worked with The Ohio State University to assist in showing that it was castable and also to assist in developing the die design. The die was designed in parallel with the computer analyses.

Approach

CAD files for the part in question were provided and used to prepare STL files for use in the evaluation. Top and bottom renderings of the resulting STL files are shown in Figure A.

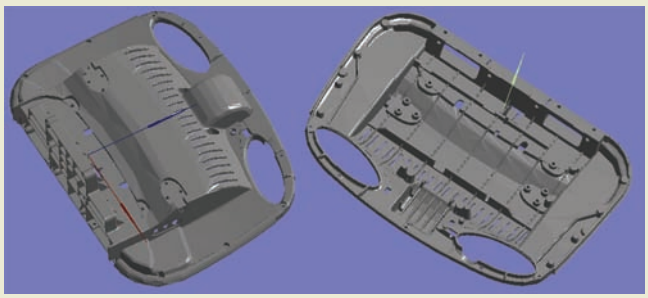

***Figure A:** Renderings of STL file.*

The approximate mass property data are shown in the Figure B:

Volume	84.62 in^3
Surface Area	1162.25 in^2
Volume/Surface Area	0.073 in

***Figure B:** Approximate Mass Property Data*

In order to judge potential fill difficulties and thermal characteristics, thin- and thick-section analyses were first run with CastView. The thin-section analyses did not suggest any major issues. The thinnest sections appear to be relatively uniform and were judged to not be an impediment to fill.

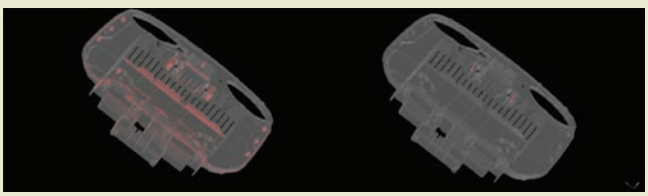

***Figure C (left):** Wall thickness greater than 0.178" total thickness (Red).*
***Figure D (right):** Wall thickness greater than 0.488" total (Red).*

Thick-section analyses were performed to determine the locations of the heaviest regions. A few regions are thinner; some are heavier, but the majority of the part is relatively uniform in thickness. The thickest sections are shown in Figure D and fall within the protrusions near the top of the figure. The thickest regions fall next to cored bosses and were considered to be somewhat slow to cool.

Next, thermal analyses were performed to get an approximate indication of the relative temperatures than could be expected. The color map used for temperature in Figure E (bottom view of the part) is not calibrated, but represents the relative temperature distribution within the part without regard for cooling or spray. These results suggest that the slide tip may experience the maximum temperature in the die.

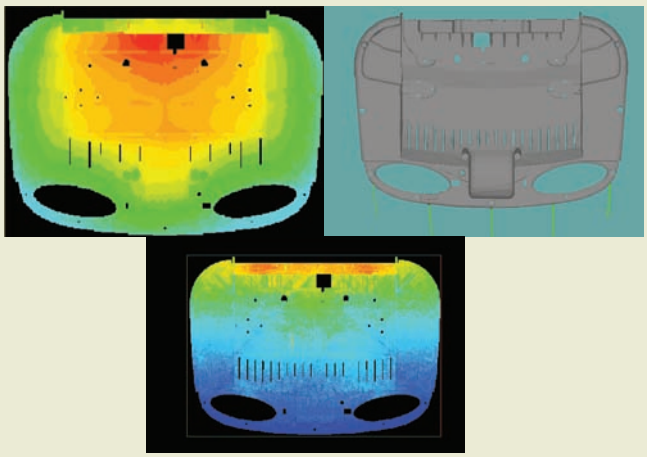

***Figure E (left):** Gate location and orientation.* ***Figure F (right):** Gate location and orientation.* ***Figure G (bottom center):** Surface color map: fill pattern – blue = early fill, red = late).*

Based on drawings provided and the characteristics of the part, it was assumed that the part would be gated along the front edge of the part on the side opposite the region where a slide would be required. The approximate gate location is shown in Figure F. The green lines at the bottom of the figure illustrate the general direction of flow at the inlet that was assumed for the fill analysis. The maximum fill distance for this part, measured as distance from the gate to the farthest extreme, is about 22.3 inches.

Without information about the size of the runner and gate and details of the overflows, estimates of the fill conditions must be approximate. Assuming a gate velocity of about 1,400 in/sec, for a part of this volume, the fill time would be roughly 40-45 msec. Based on the wall thickness data, the solidification time for the majority of the shell of the casting should be about 5.5-6 seconds based on an average .5 wall thickness of about 0.075" to 0.085". This puts the ratio of solidification time to fill time at more than 140 for the shell of the casting and more for the thicker regions. This estimate suggests that there should be ample time to fill the casting without problems from premature solidification or fill defects. Based on the gates shown in Figure F, a fill pattern analysis was performed.

In general, the fill pattern shows very good characteristics as shown in Figure G, which is a surface map of the pattern in which blue depicts regions that fill early, green fills intermediate and red at the end. The fill pattern calculation did not account for pressure, but there was no evidence of any fill-related difficulties in the heavy boss regions, and these should fill relatively early. Since it was decided that a slide will be used to form the section of the part where it is last to fill, overflows and vents were to be considered on the slide, if possible. This presented some challenges for venting to eliminate trapped air. Other than this characteristic, the part was considered to be very castable.

Results

The die was produced in alignment with the analytical results, sample parts were successfully run and the keyboard base was released for production.

Cost savings data shortly after the part was released for production showed that cost of the casting was cut to approximately 25% of the cost of the RPM casting, yielding a savings of $1.5 million per year. Since then, production quantities have doubled, doubling the savings to about $3 million per year over the previous casting method.