CASE STUDY – Precision Sand Castings

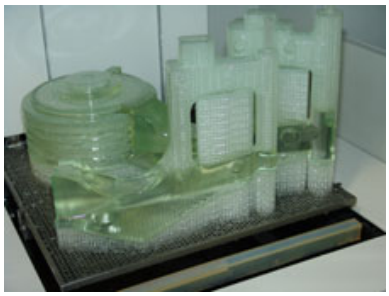
Racing *Against* The Clock

Planning, scheduling and a number of rapid prototyping methods come together to accelerate product design for an electric hybrid scooter.

When Vectrix Corporation (Newport, RI)—a developer of zero-emission vehicle (ZEV) platform technologies—took on the challenge of developing its fuel cell electric hybrid scooter, the company called upon several companies that worked together to effectively produce the fuel cells, assembly patterns, and Precision Sand Castings using various rapid technologies to create a prototype of the scooter. From initial design to finished prototype, it took companies like Parker Hannifin Corporation (Woburn, MA)—a manufacturer of motion and control technologies and systems; Moeller Design (Seattle, WA)—a provider of rapid product development solutions and **General Foundry Service (San Leandro, CA)—a Precision Sand, Rubber Plaster Molding (RPM), No-Bake Sand, and Permanent Mold Casting provider.**

According to Peter Hughes, Vectrix's vice president of technology, the initial concept of developing a two-wheel electric vehicle happened back in 1996. Andrew MacGowan—the founder of Vectrix—formed an alliance with Lockheed Martin Corporation to gain assistance in fine-tuning his concept. Then, Vectrix engineers began their long journey to design this unique vehicle. Once Vectrix finalized its development partners, Tom Ollila—technology manager, fuel cells for Parker Hannifin—took on the role of project manager, coordinating the efforts between all of the parties involved. "The challenging part of this project was the fixed timeframe we worked in," he notes. "We had roughly six months to put the demonstrator vehicle together—with our end goal being a working electric scooter with the integrated fuel cell on board to display at two tradeshows. Getting everyone to work together was quite a challenge—logistically and organizationally." Still, it was a challenge Ollila met head-on. "There was a design kickoff meeting, regular weekly meetings, conference calls, etc.," he says. "Once a month we'd get together to work through any issues. There was a lot of going back and forth on specifics and of negotiating between the companies involved so each could get the specifications they needed. The good news is that we were all relatively close together—so when we needed to—we could get to each other the same day. If we were trying to do a West Coast/East Coast kind of thing, it would have been more of a nightmare."

Casting Concerns



When the scooter began the product development stage, Vectrix ran into its first snag. The foundry that was originally producing the Swingarm casting said it could not do so within the timeframe allotted by Vectrix. Parker Hannifin recommended General Foundry Service to complete the castings. Keith Krook, business development manager of General Foundry Service, notes that they were able to produce the castings in less than three weeks. However, before General Foundry Service could complete the castings, they needed the patterns to be used in the Precision Sand Casting process—which Moeller Design provided using StereoLithography (SL). According to Jeff Smith, the director of metal casting applications, after General Foundry Service supplied them with the CAD data representing several of the aluminum cast components on the scooter, they built the geometries on their SLAs (SLA-500 and SLA-5000s). "We then finished the patterns to a high finish level and accuracy necessary for developing tooling for castings," Smith states. Then General Foundry Service produced *loose* tooling to produce ten swingarm castings. "We split the geometry into two halves at the parting line developed with our customer and created a 'Corebox,' "Krook explains. "This was used to produce a 'shell' core that produced the passages inside the casting. We pinned the SLA pattern halves onto a wood board. This was our temporary tooling and we used the wood board/pattern-half arrangement and put it inside of a 'flask' (metal frame). We then poured a mixture of sand, clay, and water against the pattern half to make a sand mold, flipped over the entire flask and put sand in the other side of the flask on that side of the pattern board, separated the flask and pulled the pattern board out and put the two mold halves back together after inserting the shell core." Then the mold was ready to have metal poured into it. Using loose tooling versus *matchplate* (an option in which the pattern is machined or cast into a plate, generally made of aluminum) reduced lead-times by about forty percent, Krook notes. After heat-treating, the castings were machined and delivered within three weeks.

Photos

Top: Next generation scooter by Vectrix.
Middle: Close-up of aluminum castings manufactured at General Foundry Service.
Middle: Close-up of swing-arm assembly on Vectrix scooter.
Middle: Stereolithography (SLA) patterns on the SLA platform at Moeller.
Middle: Close-ups of heat-sink on Vectrix scooter.

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