

Vaupell saves time and money on investment casting with 3D Systems

SLA QuickCast® patterns on the ProX® 800 in Accura® CastPro™ Free dramatically reduce the time and cost of aerospace investment casting tools



Traditional investment casting—creating metal parts from a ceramic mold after a wax pattern has been burned away—has been around for more than 5,000 years. Over the last century, the process has benefited from many innovations, but it is still slow and costly to create this kind of tooling for complex parts. Production time is typically measured in months and costs can run into the hundreds of thousands of dollars.

But if Vaupell, a 70-year-old supplier of aerospace components and subassemblies and a more than 20-year veteran of 3D printing, is any example, the workflow is changing rapidly.

Vaupell is using QuickCast®, the stereolithography (SLA) process developed by 3D Systems for investment casting, to deliver unprecedented speed and quality to its customers at a fraction of the cost of traditional methodologies. The QuickCast process is ideal for the aerospace market, which often requires low volumes of highly complex parts.

CHALLENGE:

Produce high-quality investment casting patterns at a fraction of the time and cost.

SOLUTION:

3D Systems QuickCast® methodology using a ProX® 800 3D printer and Accura® CastPro™ Free materials.

RESULTS:

- Reducing delivery time for complex investment casting patterns from several months to a few days.
- Cutting costs from \$200,000-\$300,000 to \$6,000-\$15,000.
- Enabling iterative product prototyping.
- Providing the ability to consolidate parts and reduce weight.
- Delivering antimony-free material with the best burn-out efficiency.

Large, accurate builds

Andy Reeves, a Vaupell sales engineer for new business development, estimates that a specific 26-inch diameter part pattern can be produced with QuickCast on a 3D Systems ProX® 800 in two to three days for approximately \$6,000 to \$15,000. A wax tool for the same part could take anywhere from several months to more than a year at a cost of \$200,000 to \$300,000.

The ProX 800 has a large print envelope of 25.6 x 29.5 x 21.65 inches (650 x 750 x 550 mm), providing flexibility and speed for a single build of a large part or for quick runs of multiple parts.

"The large platform is a great advantage over other machines," says Austin Wong, rapid prototyping manager for Vaupell. "You can do a larger piece in one run that would take two runs on a smaller machine. Not only do you produce more in less time, but larger parts reduce labor costs—the fewer pieces, the fewer welds."

The accuracy of the ProX 800—0.001-0.002 inch (0.025-0.05 mm) per inch of part dimension—enables Vaupell to meet the exacting requirements of its aerospace customers.

"The ProX 800 gives us high-quality sidewalls, better tolerances, and that large print bed," says Wong. "We're saving time on the post-print finishing because the finish of the resins is so good, and we're also saving time from not having to build parts in two pieces and bond them together."

Meeting market needs

Reeves says the market for QuickCast investment casting stems from two compelling business needs: creating castings for parts that cannot be tooled in any other way, and creating castings for parts that are so complicated it would take up to a couple of years to deliver a production-worthy mold.

Aerospace companies have discovered that 3D printing can enable complex designs that allow them to reduce the number of parts in an assembly and lower weight while maintaining the same or greater strength and durability.

"A lot of these parts go into jet turbines, where they have to be perfect," says Wong. "Getting some of these contours molded with a wax tool would be very expensive with long lead times."

The need for production-worthy patterns from molds that would take long periods of time to design and produce in wax has created a substantial bridge-tooling business for Vaupell's rapid prototyping division, based in Hudson, New Hampshire.

"QuickCast patterns enable our customers to get a part long before a production or prototype tool could be designed, made, tested and brought online," says Wong.

Wong cites one project where Vaupell used QuickCast to create a complex investment casting pattern and produce 20 parts in just two and a half days, scaling quickly to 120 parts a month.

"The customer wouldn't have been able to fulfill the contract if we didn't use QuickCast to deliver the parts. Sometimes we produce 150 pieces of two or three QuickCast patterns a month over the course of a year while the customer is still developing and building wax tooling."





Less shrinkage, more iterations

One of the big challenges of investment casting—calculating shrinkage during manufacturing—is lessened considerably by QuickCast.

“A big advantage of QuickCast over wax tooling is that you’re only calculating metal shrink,” says Wong. “You’re not calculating for the shrinking of the metal and the wax on top of it. QuickCast patterns are much more accurate and can keep a tighter tolerance than any wax tool.”

According to Reeves, the QuickCast process is much more forgiving overall. If there is a mistake in the pattern or it does not perform as expected, it only takes a few days to create and print a new iteration, versus the weeks or months involved in modifying (or re-making) a wax mold.

For prototyping applications, the ability of QuickCast to enable iterations is critical, to the point where many traditional investment casting companies have gotten out of the prototyping business altogether.

“It’s not economically sound to do iterative design prototyping with traditional wax molds,” says Reeves, “but QuickCast really lends itself to iterative design to support both the part and process development.”

Antimony-free with better burnout

A major concern around investment casting in the early days of 3D printing was the quality and properties of available materials. That concern has been eliminated with materials such as 3D Systems’ Accura® CastPro™ Free.

CastPro Free is a transparent, polycarbonate-like material that is free of heavy metals. It is a highly accurate material for stable, high-quality investment casting patterns.

“Because CastPro Free is antimony-free, it doesn’t create occlusions and other defects when you final-cast the metal,” says Dave Pellegrino, advanced manufacturing technology manager for Vaupell.

CastPro Free burns out with lower ash content than any previous resins on the market, saving post-processing time while ensuring higher quality.

“If resin is unable to burn out completely, the customer is going to have an issue,” says Wong. “The complete burnout and cleanliness of the burnout provided by CastPro Free are definitely keys to quality.”

Support that delivers

Beyond the technical capabilities of the ProX 800 3D printer, the QuickCast process and materials, Vaupell relies on a 20-year-long partnership with 3D Systems to deliver the quality of service its customers have come to expect.

“Additive manufacturing comes down to who can do it faster, who can do it better, and who can do it cheaper,” says Wong. “Vaupell focuses on speed and quality. Unless it is a particularly large part, we promise delivery in one to three days. Timely support from 3D Systems ensures that we keep that promise.”



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