

Going Down with Metal

An investment cast, stainless steel helmet offers deep sea divers peace of mind, pleasing aesthetics and performance.

By Shea Gibbs

Protecting the head is a tricky business. Sometimes, it goes beyond making sure the skull doesn't get crushed.

"The biggest thing that we see with metal helmets is with the divers that have a more traditional attitude," said Pete Ryan,

Kirby Morgan Dive Systems, Inc., Santa Barbara, Calif. "They say, 'I don't want to dive with a plastic helmet on.' They want metal."

Kirby Morgan currently offers an array of two-piece metal helmets, but the pro-

duction process, which Ryan refers to as a "barn operation," is long and involved.

To more efficiently answer the demands of the diving world's traditional metal heads, Kirby Morgan last year sought a rapid prototype for a one-piece, stainless

The REX 77 requires some assembly to make it dive-ready (r), but the stainless steel casting combines a shell and locking mechanism that were cast separately on its bronze predecessor.



plication of detail achieved by our ceramic shell allowed the casting to have its fine surface finish and superior cosmetic appearance," said Blum.

Aristo-Cast is able to reproduce the exact surface finish of the plastic SLA pattern in their ceramic mold, said Blum.

Thus, the casting exhibits the same smooth surface as does the pattern. As Blum noted, the ceramic mold is far smoother than molds made from green sand, and a sleeker surface finish results.

It is that kind of superior cosmetic appearance that Kirby was after, according to Ryan, and investment casting made the most sense. Just as the use of metal for the helmet design is largely to set the mind of the traditional diver at ease, the smooth finish is to round out the appealing package. And to smooth the helmet out even further after the casting is poured, the steel piece will receive a 40 to 60 grit sand blast finish.

"An expensive piece of diving gear should have a very good finish," said Ryan.

A Detailed Return

The dimensions and intricacy of the helmet also made investment casting the ideal process for its manufacture. With a surface area of about 712 square in., the helmet shell varies in wall thickness from 0.10 in. (0.25 cm) to just under 1 in. (2.54 cm). And if that didn't make casting the piece difficult enough, the stainless steel end product was to include cast-in details that previously had been applied in the finishing room.

"We were able to include a lot of detail that did not require machining," said Blum.

Prior to the development of the REX 77, the metal dive helmet that Kirby Morgan offered was in fact a sand cast product. The AMCO bronze two-piece, which consisted of the helmet itself and the locking mechanism that attached it to the dive suit, came to a whopping 45 lbs. (20.41 kg)—32 lbs. (14.51 kg) heavier than the REX 77. As a green sand casting, the bronze helmet was twice as rough as the new helmet. The older version, while stain resistant, also eventually took on a green hue because of the effects of saltwater on copper-base alloys, even after polishing and chrome plating.

steel, deep sea diving helmet. While attending a trade show, Ryan floated the idea for the helmet to Express Pattern, Vernon Hills, Ill., which answered the call with a stereolithographic (SLA) rapid prototype. Aristo-Cast Inc., Almont, Mich., then stepped in, offering the ability to produce an investment casting using the plastic that composes an SLA pattern.

Working from the SLA prototype, Aristo-Cast created the REX 77 dive helmet for Kirby out of 316 stainless steel, using the investment casting process. In a traditional investment casting, a wax pattern is produced, dipped in a ceramic bath until the desired shell thickness is achieved and finally melted out at high temperatures. An SLA pattern, composed of a honeycomb-like plastic, can be used in much the same way. The plastic is dipped in ceramic and then collapses when heated, eliminating any chance of breakage in the ceramic due to expansion. The collapsed remains of the pattern can then be "fired" out of the shell. But the material can leave some ashy sediment behind when this last step is taken. The difficult part is then getting the sediment out. Aristo-Cast is one of a handful of investment casting facilities with that ability, though spokesperson Larry Blum did not say exactly how it is done.

"What I can do is give you a list of ways it could be done," he said. "You can use air to blow it out, water to wash it out; there are many things that would help to get it out."

The REX 77 should go into production by the end of the year, according to Ryan. But prior to further testing and market

research, he is unsure as to how the piece will be produced. The prototype took Aristo-Cast 12 days to produce, and Kirby may wish to keep the product run limited, continuing to use a single prototype pattern repeatedly. Otherwise, if they wish to produce a large run, tooling will have to be developed.

A Low-Risk Investment

To achieve the cosmetics desired by Kirby, investment casting was the only way to go, according to Blum. "Investment casting cannot be 'all things to all people,' but it is a process that gives the most of them to all people," he said. "This part contains all the best features of the investment casting process. I do not know how else it could be produced."

Kirby wanted a stainless steel casting that combined fine detail, close tolerances (less than +/- 0.005 in.) and a smooth surface finish in a one-piece construction. And while there are other casting processes out there that could achieve some of those requirements, only investment casting could pull off the triumvirate. Diecasting might come the closest, said Blum, but a stainless steel product would then be out of the question. Older models of metal dive helmets have been produced using the sand casting process, but the lowest root mean square (RMS) roughness value that can be achieved through sand casting is about 250. The investment casting that produced the REX 77 reaches 125 RMS at the most, according to Blum. And the lower the number, the smoother the metal.

"The surface finish of the rapid prototype pattern and the exacting du-

“This is another generation of the product by going to the stainless steel,” said Blum. “Stainless steel is a buzz word in the diving industry as titanium is to the golf industry. It conjures up a whole bunch of positive imagery.”

A Vested Interest

The REX 77 isn't just a substitute for the old spun copper helmets, though. It's essentially the best of both worlds, as it is similar to Kirby Morgan's reinforced fiberglass models in appearance, while still giving traditional divers the peace of mind they desire. Both the REX 77 and the fiberglass composite line of helmets offer divers premier performance underwater. Indeed, the two products perform very similarly when it comes to strength and functionality.

“The performance of the helmet itself is not going to be much different [from the fiberglass models],” said Ryan. “The performance is based on the breathing system, which will be state of the art.”

Performance, though, sometimes extends beyond actual underwater use. Mike Brown at Epic Divers and Marine, Harvey, La., has been handling metal dive helmets on the user end for nearly 30 years.

He's found that, while the new generation fiberglass hats may be just as strong and reliable underwater, there's no substitute for metal when you're on dry land.

“The main advantage is it's much more indestructible if it should be dropped or something should hit up against it,” he said.

“ Investment casting cannot be ‘all things to all people,’ but it is a process that gives the most of them to all people. ”

“I've had a metal helmet since 1977. One time it fell out of my truck, and I bent a piece back and put it back on my head. I no longer dive, but I still loan mine out, usually when some other guy's fiberglass helmet has broken.” *ECS*