The M80 Stiletto at over 50 knots during sea trials. Photo courtesy of M Ship Company.

High-Speed Boat Brings New Wave of Special Operations Missions

M80 Stiletto Combines Large Payload Capacity with Shallow Draft, Smooth Ride

By David Gaines

While cruising near the Florida Straits in the M80 Stiletto ship, the U.S. Coast Guard came upon a high-speed vessel that looked suspicious, so they decided to take a closer look.

"When they arrived at the boat, sure enough, it was doing something illegal," according to Bill Burns, **M Ship Company's** lead designer and co-founder. "When the Coast Guard came alongside, the suspicious boat took off at high speed, but the Stiletto was able to chase them down because it's also a high-speed craft. When the go-fast realized that they could not outrun the Stiletto, they headed for shallow water in the Straits. They didn't realize that the Stiletto had a draft of only two-and-a-half feet. The Stiletto was able to continue the chase until the go-fast ran out of gas. The Coast Guard crew then made the arrest and confiscated the illegal cargo."

When they pulled the suspects over, the Coast Guard deployed a rigid inflatable boat (RIB) that's 36 feet in length to send the rapid deployment team over to make the arrest.

"This story highlights the benefits and importance of a shallow draft craft that can go fast and carry all of the equipment that you need to make these arrests," says Burns. "And the RIB can be launched in only a few minutes. I think that there are only a few boats in the U.S. Navy today that have this capability."

Burns believes that this marine vessel, the M80 Stiletto, would have been perfect for rescuing the kidnapped American freighter captain from Somali pirates, chasing down deep-water drug smugglers, or for terrorism surveillance in seaports laden with gigantic freighters. "Right now, they're chasing these little pirate boats in little dinghies with billion dollar Navy ships, which doesn't make any sense," Burns insists. "We're trying to fast-track some of these boats into production so we can get them out there for these missions. The military needs a lot of boats, so the Stiletto is a fairly inexpensive craft for its capabilities."

M Ship Co. (**www.mshipco.com**), headquartered in San Diego, Calif., was founded with technology related to the M hull designed by Bill Burns and his partner, Chuck Robinson. The M80 Stiletto design blossomed five years after the company was founded. The first live demonstration using the M hull design was for water taxis and a ferryboat in the canals of Venice, Italy. Burns and Robinson wanted to harness the bow wave, reduce the wake in the water, and create an environmentally-friendly design.

"We delivered two small boats to them to use for water taxis," Burns recalls. "Based on the water taxis, they came back to us to build something bigger to replace their water buses. For the water bus, we built a 65-foot M hull design. It was well received and exceeded all of the requirements for a low wake boat. But it was only used for a short time; the government changed and replaced the water transportation authority with a new agency that wanted to do their own thing."

U.S. Military Shows Great Interest in Modern Hull Design

Back in the states, the U.S. military showed great interest in the M hull design. Military engineers wanted to know if M Ship Co. could design a faster version of the water taxis. The speed limit for the water bus was 12 knots, but the company's boats were capable of cruising at 20 knots. The military, however, wanted to be able to run at 40 to 50 knots, so the design company had a single M prototype built to show the engineers a high-speed M-hull design.

"Since we were here in San Diego, the U.S. Department of Defense came to visit us to see the boat," Burns enthused. "They were impressed with a lot of different features of the boat, and said 'Let's see if you can make it go faster.'"

The contingent was led by Vice Admiral Arthur Cebrowski, of the Pentagon's Office of Force Transformation. The admiral, known as an innovator while in the U.S. Navy, was also the president of the U.S. Navy War College in Newport, Rhode Island. "He was looking at ways to explore new technology for the military," Burns continued. "He was very interested in rapid development and rapid prototyping. He basically said, 'If you guys can build a Navy ship in less than a year, prove that it can go 50 knots, have shallow draft, have a smooth ride quality, and use advanced materials, like composites, I'll give you some money to do that.' So this is how the first U.S. military prototype came about."

The uniqueness of the hull design goes back to the origins of the boat. Burns and Robinson's innovative idea of harnessing bow wave energy to convert it to a useful form— instead of letting it dissipate through the water as a wake or wave—is one of the key features of the M hull technology. "Once we captured the bow wave energy, we could use it to redistribute the lift under the boat for a more efficient, stable design," Burns explains. "A typical planing craft has one basic lifting point under the boat at the stagnation point. The boat's dynamic lift is centered at this point and the design must balance about this point like a teeter-totter, always changing trim. You'll see this on the water, where boats are pitching up and down when they're going fast."

Boat is Well-Suited For Military and Security Missions

From hydrodynamic and ride quality standpoints, Burns says, a boat can quickly get out of trim, leading to inefficient operation. This is especially true in special operations missions—such as anti-piracy, drug interdiction, and patrol operations for harbor security and homeland security—that require a fast boat. From a ride quality standpoint, when a boat is pitching up and down, it can create havoc for boat crews. "These accelerations can actually hurt the operators of high-speed military boats," says Burns. "The crew can experience accelerations and G loads on the order of 20—higher than most jet pilots experience! These guys are getting hurt and their careers are getting cut in half, so the military is looking for ways to fix the ride quality problem."

At one point, an ABC-TV video crew shot a segment about the Stiletto. The day it was taped, the sea was rough and churning, causing a pretty rough ride on the craft. "This boat was designed for sea state three, and they were in a higher-sea state," Burns explained. "When you go 40 to 50 knots in a high-sea state, you're going to have a bumpy ride. But what they didn't mention was that all the other ships had to turn back; the Stiletto was the only boat that could stay out there in this high-sea state. We will, however,

The Stiletto operating at 40 knots in San Diego Harbor.
Photo courtesy of M Ship Company.

Manufacturing of Composite-Hull Boat Required Special Processes, Equipment

Before building the M80 Stiletto military interdiction boat, Knight & Carver Yacht Center (www.knightandcarver.com) had built many high-end boats out of versatile carbon fiber composite materials. "Our company is known for its custom yachts, but we've also manufactured many commercial vessels," wrote Giovanni Lococo, vice president of operations at San Diego-based Knight & Carver, in an email to Design-2-Part. "The implementation of a full carbon/epoxy structure posed some sequencing challenges, since carbon boats are engineered differently than standard composite structures."

According to Lococo, one of the biggest challenges in working with the composite hulled boat was climate control, working around the curing cycles of the epoxy resin that was used. "All the metallic components had to be isolated from the carbon skins, and we had to keep a very clean work environment whenever installing metallic objects to ensure carbon dust or filament did not contaminate the isolated areas," he stated.

Knight & Carver also had to purchase special tooling and equipment to work on the M80 Stiletto boat. "We had to manufacture a curing oven that could cure panels that were 10 feet wide by 41 feet long," Lococo explained. "We also purchased an impregnator that was compatible with the epoxy resins that were employed in this process. And we had to lease a climate control unit (dehumidifier) to maintain the proper humidity levels and temperatures."

The Stiletto conducting a mine countermeasure exercise with the Naval Special Clearance Team 1 as they prepare to launch a UUV (unmanned underwater vehicle) off the coast of San Diego. Photo courtesy of M Ship Co.

be looking at ways to design the next generation of boat for even higher-sea states."

One may wonder why the boat's designers decided to use a double instead of single M design for the military version of the craft. Of course, there was a very good reason to create a double M hull from an engineering standpoint.

"One of the things that Admiral Cebrowski wanted to know was the stability of the hydrodynamic phenomenon that happens under the M hull," says Burns. "He wasn't sure if we could scale the concept up from a single M to something larger unless we scaled it up as a 'geo sim' (geometric similitude). What you do with a geo sim is scale up the basic proportions of the hull—the length, beam width, draft, and height—along the same scale. Instead of just scaling it up twice or three times the size, we thought we could actually improve the hull concept by using two M's, instead of one longer and larger M. I think this was an important technology breakthrough for the M hull, because now we have multiple lifting surfaces, multiple tunnels, and shallow draft; even our larger designs only draw four feet of water."

Design Process Elicits Input From All Over the World

The boat's design process was handled as a collaborative, computer-aided design process—called a "virtual shipyard"—using 3D modeling and input from ship designers all over the world. Burns explained that when building these advanced composite designs, designers typically don't find all of the capabilities they need in one shipyard.

"Some of the work we did for the America's Cup and the high-speed racing market we applied to these Navy programs," says Burns. "We developed a concept called the 'Virtual Shipyard,' where we were not tied to one yard for the design and engineering. Instead, we tapped into the expertise of boatyards all over the world. We did just that for the Stiletto, using people as far away as Australia and New Zealand. This has been used in other industries, but it may be the first time in the boat building industry."

Sometimes, M Ship Co. would even tie into the expertise of its competitors. Surprisingly, competitors were very receptive to sharing their expertise and being part of the design process. "We thought they might be standoffish, but I think people are looking for learning experiences these days," Burns remarked. "In the ship building world today, a lot of yards realize that they need to do things differently; they can't continue to build boats they way they have in the past. The yards that recognized that were very cooperative. In order to compete, people need to know about the latest technology, so it was to their advantage to help out. When they need help in the future, they can come to us for assistance."

Another interesting feature of the M80 Stiletto is the fact that the entire hull was built with E-glass and carbon fiber composite materials. Many critical properties were enlisted using the lightweight, yet strong materials.

Because lightweight structures are essential for a fast racing boat, M Ship Co. used this concept to introduce composite technology to the military. Reportedly, Admiral Cebrowski also wanted to explore these high-tech building materials. "The reason we used carbon fiber composites was because the strength-to-weight ratio is phenomenal," Burns points out. "We can get higher strength with less weight, which allows the craft to carry more payload, go faster, and be more fuel-efficient."

Another benefit of using composite materials is that they reduce maintenance costs. The craft doesn't need to be painted continuously, and operators don't have to worry about the corrosion of metal parts. Like most pleasure boats, the composite hulls will last almost forever. "The other benefit of composites is that you can actually develop structures that allow for more volume and internal space inside the boat," says Burns. "So rather than having a design with a lot of bulkheads, frames, and stiffeners, like on a typical boat, we're able to have fewer bulkheads and more open space. This allows more modularity and flexibility for equipment, manned vehicles, or personnel."

Composite technology has been around for many years in the automotive, aerospace, and aircraft industries, but it's now being applied in new and inventive ways. "This is the biggest DoD ship ever built out of carbon fibers," Burns claims. "The biggest challenge has been demonstrating that these materials can work

well. One of the things that the Navy said when they first got the boat, because it's a demonstrator, was that they wanted to push it until something broke down."

One of the great benefits of composites is that many different materials can be built into the mix to achieve many different properties. "We don't have any ballistics protection built into the boat right now, but on future ships, we will have composite panels incorporated right into the structure," says Burns. "Unlike a steel material that adds a lot of weight, with composites, you can actually blend in materials for various properties and applications. For example, you can incorporate Kevlar®, ceramics, or different types of foams to help mitigate shock, and ruggedize the boat."

The boat designer says that this project has been a learning process from the beginning, due to the unique nature of the craft. Admiral Cebrowski also wanted to create a grand experiment with the boat. "He wanted to push the limits of what we can do, and try things that haven't been done before," Burns remembers. "This is part of what he called empirical development, blending science with the experimentation. You can't do one without the other if you want a rapid advancement in technology. This is really what we're doing with the Stiletto. We're taking our best tools for science and engineering, we're experimenting, applying them together, and then leveraging off of both as we go forward."

A great deal has been learned so far from real-time field testing of the craft. The load-carrying capability and the stability of the craft, says Burns, were greater than the designers expected because of the multiple lifting points under the craft. "In the past, to go fast on the water, a boat had to be long and skinny, but that put restrictions on your payload," the designer indicated. "What we've done is to transform that paradigm. Our craft can go fast, but it can also carry a lot of payload. We can operate as a mother ship for unmanned systems and special operations. For example, not only can we chase down a pirate craft, but we can deploy smaller craft, whether manned or unmanned, to enhance surveillance or capture capability."

When it embarked upon the project, M Ship Company wanted to evaluate the scalability of the M hull concept and explore how large a vessel could be built. It was believed, because of funding restrictions, that the largest craft that could use the double M hull design would be an 80-foot vessel. This allowed the designers to develop a concept that maintained the shallow draft, very high speed, and large payload capacity with good ride quality.

"There are certainly things we would change from an operational standpoint in a next-generation craft," Burns surmises. "For example, the accommodations on board will be different. But the structure will not be that different. We might make the production models a little bit bigger to accommodate more boats and unmanned vehicles, and more payload. Right now, they operate the boat with three crewmen, but we've had over 40 people on board and it's still very comfortable." Amazingly enough, the M80 is light enough to be lifted onto a Navy destroyer or other large transport vessel. In fact, it was once transported to the East Coast from the West Coast as deck cargo on a large ship. "With the next generation design, we're looking to use L-ships to transport the M80—meaning the LHAs, LPDs, LHDs, which are Navy landing crafts," says Burns. "The back end opens up and they flood the well deck, so the Stiletto could move right into the well deck to be transported anywhere in the world."