Story And Photography By Steve D'Antonio

AN UP-CLOSE LOOK

AT A MARINE INDUSTRY INNOVATOR

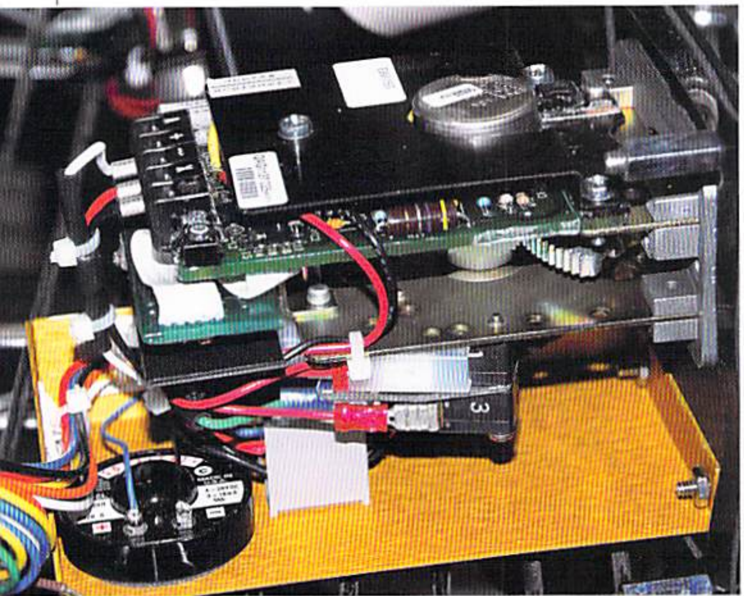
Last December, amidst some of the strangest weather I've ever encountered in California (record-low temperatures, rain, thunder and lightning, hail, and even a snow flurry), I paid a visit to two notable marine industry manufacturers. One of the companies, which you'll read about in an upcoming article, makes fuel filters and fuel distribution components. The other firm, TRAC—also known by the names ABT (American Bow Thruster), ABT-TRAC, and Arcturus Marine Systems—is a highly respected builder of hydraulic and electric bow and stern thrusters, stabilizers, and integrated hydraulic systems.

When I managed boatyards, I supervised the installation and service of scores of stabilizers, thrusters, and other hydraulic systems. During that time I was fortunate enough to work with the folks at TRAC. So, when the opportunity arose for a visit to the company's headquarters, I didn't give it a second thought. There's no hiding the fact that I love a factory tour, particularly when it involves a facility that does very fine work with a variety of components and materials, from precision machining using computer-controlled behemoths weighing several tons to intricate design and manufacture of complex electronic control systems. When it comes to hydraulics, the control thereof, and all the parts and pieces that make hydraulic systems work, it's difficult to overstate TRAC's manufacturing abilities. There's very little in this realm that TRAC *doesn't* do.

During my visit, I was hosted by TRAC's product development manager, Eric Folkestad (shown opposite). Eric knows the company and its intricacies inside and out, and I tested him in a marathon Q&A session regarding everything from the alloys TRAC uses to company history and lore. What I came away with was a thorough understanding of the immense capabilities of this midsize manufacturing firm. I asked Eric to run me through an accelerated version of the "captains' course" he teaches at TRAC's facilities. This class is a tutorial on the subject of hydraulics in general and TRAC's integrated hydraulic systems in particular. It's free of charge and typically fills up within a few days of the start of registration.

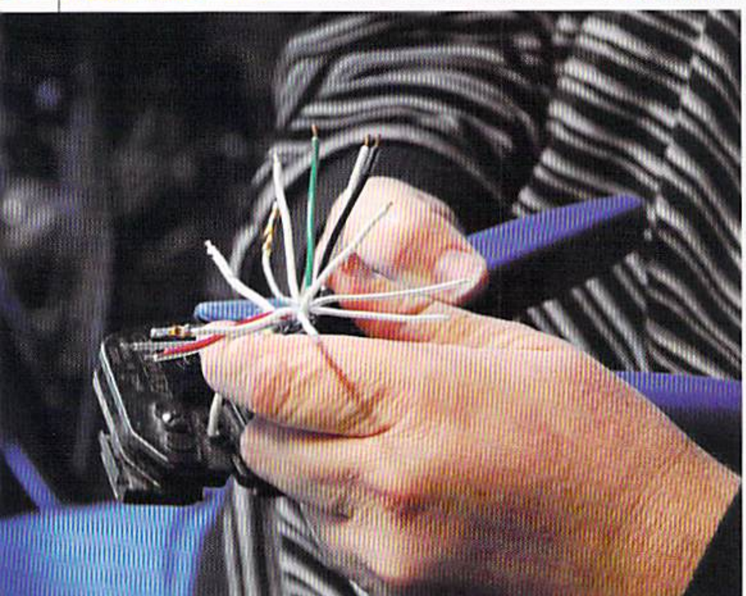
INSIDE

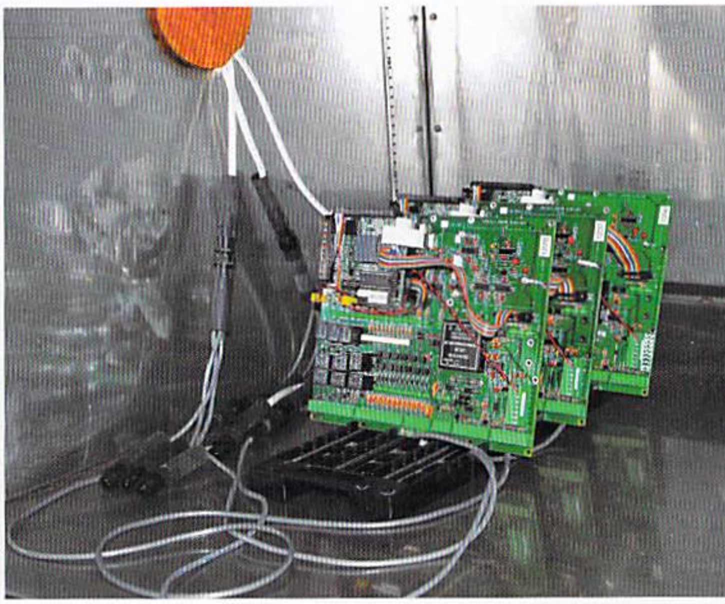
TRAC



aboard a vessel hydraulically, there's a good chance TRAC not only knows how to do it but has probably already done it and done it well.

The "source" for hydraulic power is a pump (or pumps), most often operated by the vessel's main engine. The pump typically is spun via a power takeoff, or PTO, that originates either on the engine block or at the transmission. Additional power sources include generators, wing engines, and even electric-motor-driven auxiliary power units (APUs). The latter might be used to power a dinghy crane or at-rest stabilizers (more on those in a moment) when no engines are operating. Some generator manufacturers are keen on supplying their gensets with PTOs. Northern Lights, for instance, offers a PTO suited for hydraulic applications as an option on all of its generators rated at 12kW or higher. Some marine engines also are equipped with PTO capability at the factory.





Top left: The business end of a thruster's joystick control mechanism. Because of the key role this equipment plays in vessel maneuvering, great attention to detail is paid to its design and assembly. Above left: Control cables are the "nervous system" of TRAC products and are custom-made for each project, vessel, or installation. Above right: Electronic control circuits are oven tested to ensure reliability in harsh marine environments.

HYDRAULIC PRIMER

The gist of hydraulics, especially as it pertains to recreational yachts, is the ability to efficiently and reliably transmit energy, which may manifest itself in the form of thrust, lifting, pumping, stabilization, or a variety of other functions. To put it plainly, there's virtually no end to the work that can be accomplished using hydraulics, from propulsion to hatch actuation. Of course, that's a broad statement, and whether it makes sense to use hydraulics for every work requirement calls for careful consideration. Still, if a job can be done

Using hydraulic pressure between 1,500 and 3,000psi, depending on the application (thrusters, for example, use higher pressure), fluid is sent by the pump(s) through hoses, most of which measure less than an inch in outside diameter, to the "consumers" of hydraulic power. As mentioned previously, the list of equipment that can be operated hydraulically is nearly endless and includes, in addition to the familiar thrusters and stabilizers, cranes, windlasses, washdown and bilge pumps, get-home propulsion systems, alternators, passerelles, and so on.

HYDRAULIC FEATURES AND BENEFITS

A common question and one I asked Eric several times during my visit is, how does hydraulic power differ from electric power? The answer is multifaceted. The primary advantage of hydraulically powered equipment is its rugged, robust, and reliable nature. The system or the part that's doing the work often is protected from the atmosphere, the elements, and water by a strong seal, which means hydraulic equipment can be used under exceptionally harsh conditions—a valuable attribute. Provided each component and the overall system are properly designed and installed, hydraulic equipment is long lasting and reliable. With the exception of the electrical and electronic control mechanisms, exposure to salt, humidity, and even free water has little effect on most hydraulic components.

Additionally, the versatility of a hydraulic system is especially appealing. Once one begins to think hydraulically, a whole new range of possibilities becomes available, some of which are simply impractical when using electrical power. A get-home system is one such option; hydraulically it's straightforward, particularly if the vessel is already equipped with hydraulic equipment. An electric get-home system, while possible, isn't exactly de rigueur. Other hydraulic attributes include 100 percent duty cycle capability (the equipment can operate continuously without overheating) and less weight for the "working end" of the system. The full-time duty cycle is especially important for thrusters, which may be relied on for extended use in heavy winds or during challenging close-quarters maneuvering. Many electrical components, especially thrusters and windlasses, have duty cycles that typically are considerably less than 100 percent; if they are operated for too long a period, they will overheat. Hydraulic thrusters and windlasses can operate at variable speeds, an attribute not shared by their electric brethren.

The fact that hydraulic gear often weighs a fraction of what electric equipment weighs is quite attractive. For example, a 40hp electric thruster motor tips the scales at about 500 lb., while a 40hp hydraulic motor weighs a mere 25 lb. When you add to that 25 lb. the weight of the supporting hydraulic components—the pump, fluid reservoir, manifolds, pressure regulators, and controls—the total for the hydraulic thruster system is about one-third the weight of the electric system. What's more, one hydraulic pump and system can be used to power a variety of hydraulic gear, so the weight is amortized over the entire package. Thus, the use of hydraulic equipment nearly always nets a significant savings in weight, another source of which is the minimalization of equipment such as battery banks and chargers.

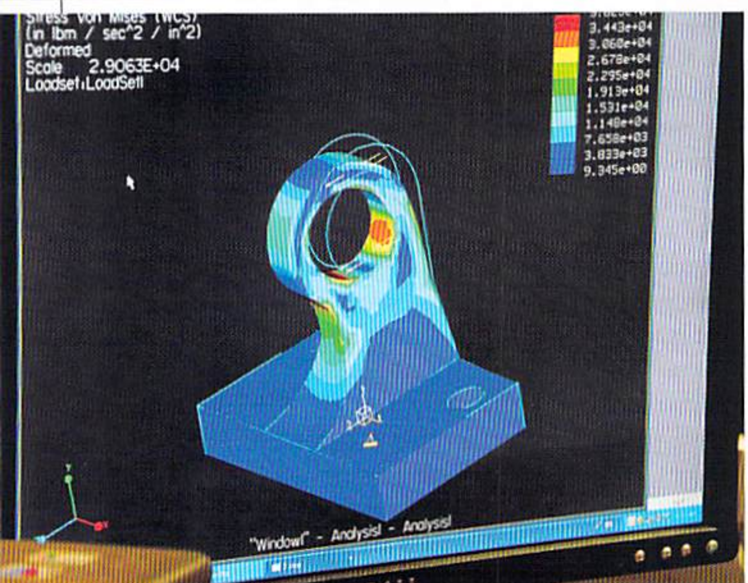
Of course, hydraulic power is not a panacea. When folks ask me if they should buy a hydraulic windlass or thruster, my response is rarely a simple yes or no. If the goal is to obtain efficient power for a variety of onboard equipment, then the answer may be yes. It's best to approach hydraulic equipment as an integrated system, preferably when the vessel is being built or is undergoing a major refit. If stabilizers are in the offing, then that's half the battle, and it surely makes sense to consider the integration of other hydraulic gear.

It's important to note not only that the hydraulic pressure and volume required for stabilizers is less than that required for thrusters, but also that stabilizers are used only while the vessel is at cruising speed, when the engine is at relatively high rpm and is able to supply the necessary hydraulic pressure and fluid volume. At idle, most diesel engines produce about 10 percent of their rated horsepower. Therefore, if the plan is to operate twin 35hp thrusters, one each at the bow and stern, from a single engine/PTO at idle, your boat would have to be equipped with at least a 700hp power plant. If it isn't, another source of hydraulic power—such as a generator or wing engine—would have to be made available. If you have a twin-engine vessel, a pump mounted on each engine could be used to supply the necessary hydraulic power.

TRAC HISTORY

TRAC is the brainchild of former merchant mariner and California Maritime Academy graduate D'Milo Hallberg. Thrusters were relatively new to the recreational marine industry back in 1987, and Hallberg astutely perceived that the market would grow to include both large and small recreational craft. Encouraged by his father, Don Hallberg, the originator of the Fortress anchor (now a veritable household name for ground tackle), the younger Hallberg established Arcturus Marine Systems in a small shop in Petaluma, California. Using the elder Hallberg's cruising vessel, a stretched 77-foot Hatteras, for R&D, the company developed and manufactured bow thrusters and their associated hydraulic components. John Champion, a shipmate of D'Milo Hallberg's from Cal Maritime, soon joined Arcturus as a sales representative, marketing its products in the United States and Asia. Champion has remained with the company ever since; he's now the sales manager.

In 1989, in an effort to make the bow thrusters more attractive to would-be buyers, D'Milo Hallberg



Top: Composites department foreman Paul Yarnal is one of many talented TRAC employees who have a hand in producing the firm's high quality stabilizers. Above: Computer-assisted design programs enable TRAC engineers to develop small, lightweight parts that are extremely strong and durable.

expanded Arcturus to include complete hydraulic system design and simultaneously introduced the Magnum Bow Thruster, again using dad's Hatteras as a test bed to perfect the equipment. As a former merchant mariner, he understood the importance of reliability and robustness, features that soon become hallmarks of TRAC hydraulic equipment and control systems. With the introduction of the dual-propeller counter-rotating thruster, the company became known as American Bow Thruster or ABT, offering thrusters up to 200hp. Recognizing that not every boat is equipped (or can be equipped) with hydraulic power, ABT also introduced both AC and DC electric thrusters.

Perceiving yet another trend, Hallberg delved into the world of hydraulic fin stabilizers, launching the TRAC Digital Fin Stabilizer System. Once again, the elder Hallberg's Hatteras acted as the test bed. With a new TRAC system installed, she circled the globe twice; Don Hallberg reported to his son that the Hatteras tracked as if she were on rails. Although apocryphal, it's been said that the adoption of the name "TRAC" is a result of this statement. In fact, "TRAC" stands for "twin right angle counter-rotating," in reference to the company's series of twin prop thrusters. The Hatteras still cruises today, with Don at the helm, out of her Ft. Lauderdale home port.

FOR MORE INFORMATION

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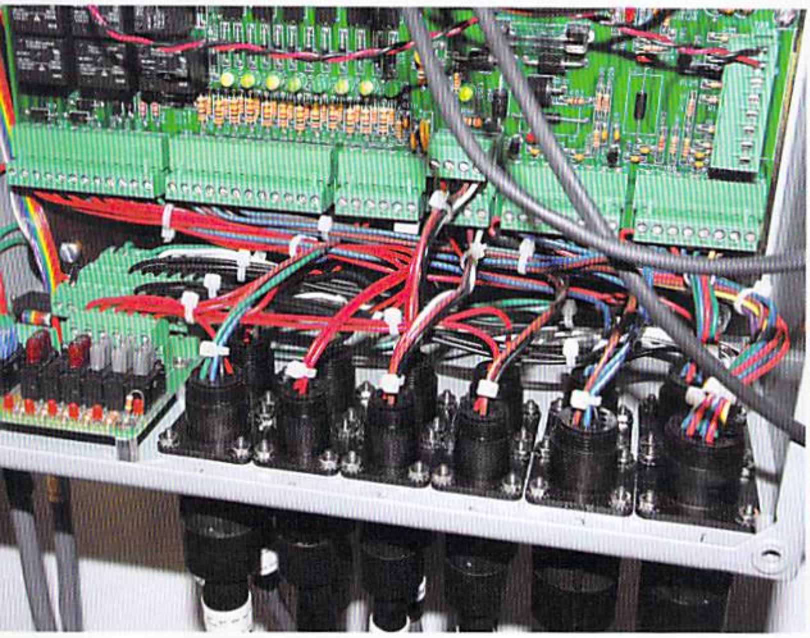
A product offering stabilization at rest, a feature long sought after by boatbuilders and owners, entered the TRAC lineup in 2005. TRACStar has proportionately larger, ultra-quick-acting fins powered by a PTO-equipped generator or by an electro-hydraulic power unit called the STAR Electric Power Unit (introduced in 2007), which is augmented by a nitrogen-pressurized accumulator system. This setup allows vessels at rest to achieve stabilization in otherwise roll-inducing anchorages. The STAR EPU offers builders a clean, tested, drop-in hydraulic power unit to supply hydraulic pressure to TRACStar, as well as to other hydraulic loads such as cranes, pumps, and passerelles.

In 2006, with the introduction of inTRAC, an interceptor-style stabilizer system, TRAC began offering a stabilization option to large, high-speed craft. inTRAC utilizes quick-acting, hydraulic vertical trim-tab-like protrusions mounted on the vessel's transom to control attitude and counteract roll.

Today, TRAC stabilizers, thrusters, and integrated hydraulic systems are in use aboard yachts from such notable names as Fleming, Kadey-Krogen, Nordhavn, Northern Marine, and Selene, to name just a few. TRAC provides full hydraulic design and manufacturing of thrusters from 7.5hp to 200hp and fins for vessels as large as 245 feet. With several sales and service offices on both U.S. coasts and in Europe, New Zealand, Asia, and the Middle East, TRAC offers truly worldwide support. Having installed and serviced TRAC's products, I can attest to their responsiveness. It's not unusual for TRAC to send its employees across



Left: The control junction modules for TRAC's stabilizer fins are complex yet reliable, thanks to the company's use of high quality materials, extensive employee training, and standardization of procedures. Right: Using specially made "extension tools," a TRAC employee installs a bow thruster flange.

the country or around the world to inspect an installation or to effect repairs when local resources are either unavailable or unable to correct a problem.

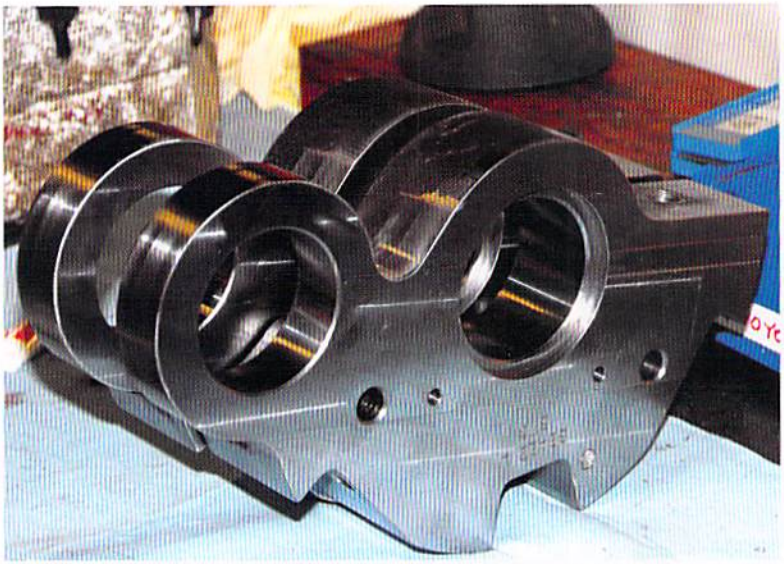
AN INTRIGUING TOUR

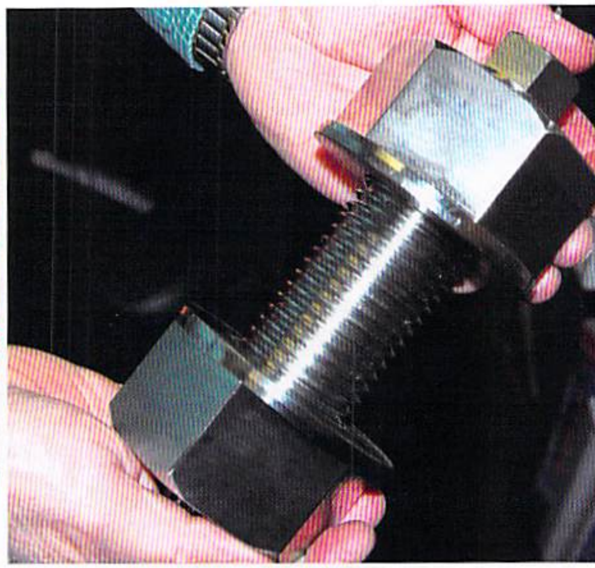
TRAC's facilities occupy five buildings on the grounds of a Rohnert Park, California, industrial park. Currently employing about 135 people, the company has added structures and floor space as it has grown. The main building includes design and engineering offices, as well as customer support and an impressive machining and assembly area. Within this building there are nine computer numerically controlled (CNC) mills and five CNC lathes that churn out various parts and pieces for TRAC hydraulic equipment, from stabilizer actuators to thruster drive legs. The largest machine operates on three axes and is capable of producing four fin actuators simultaneously. (I watched, mesmerized, as the machine did this—all without direct human intervention.)

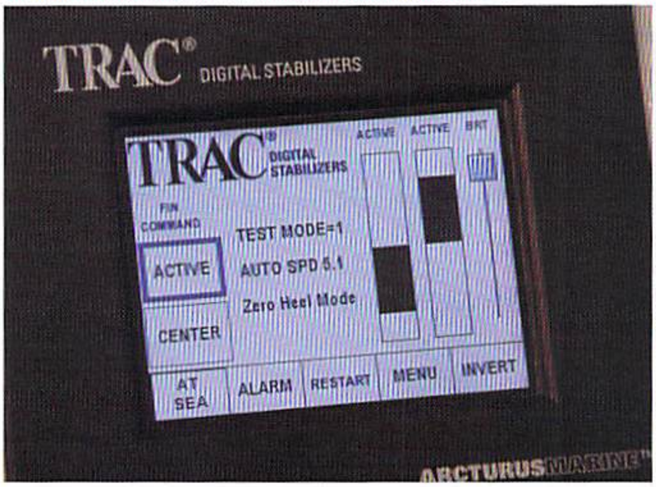
A short walk down the street, one finds the fiberglass lamination shop. Here, fins of every size are built. As soon as I entered the shop, I knew this was no ordinary lamination facility. Missing was the unmistakable odor of polyester resin. TRAC fins are built using epoxy resin, which makes them not only strong but also environmentally friendly. Unlike polyester and vinyl ester resins, epoxy emits very little in the way harmful by-products as it cures, and because there's very little odor, it makes life for those working in the shop more pleasant.

Competition in this business is intense, so I was restricted in what I could photograph. But I was allowed to watch as several fins were built, including such steps as glass fabric placement, infusion, and sequential application of a vacuum to ensure even application of resin and even pressure on the laminate. Each fin's glass reinforcement is "laid up" dry; in the process, a proprietary plastic material is temporarily placed over the layup to facilitate the vacuum infusion of epoxy resin. The result is a void-free, exceptionally strong structure. In spite of their strength, TRAC fins are specially constructed to break in the event of impact *below the shaft.* Contrary to popular belief, the steel shaft of a TRAC fin is not designed to "break away" if it strikes an immovable object. Instead, the integral fiberglass strut is designed to fail first, leaving the metallic shaft and through-hull penetration intact.

Another sidewalk stroll brought my host and me to the electronics and programming building. Here, the electronic alter ego of each TRAC hydraulic system is designed, assembled, and programmed. When Eric and I first walked into the shop, I sensed that the foreman was less than happy with the interruption, and understandably so. The work performed here requires intense concentration and careful attention to detail.







Top left: A freshly machined set of actuator components. TRAC's superior machining work, much of which is carried out in house, is by far one of the company's greatest assets. Top right: This Aquamet stud and Nitronic nut provide an exotic and highly corrosion- and gall-resistant combination for TRAC's fin assemblies. Above left: A user-friendly TRAC stabilizer touch-screen control panel. Graphic displays have revolutionized vessel motion-control systems, making user inputs intuitive and enabling at-a-glance confirmation of fin actuation. Above right: A stabilizer fin undergoes epoxy resin infusion. This fabrication method ensures a strong, void-free, and osmosis-resistant component.

The components are small and delicate, and I could imagine it would be difficult to stay on task when distractions are present. However, the foreman quickly warmed to our presence, and by the time I departed, I'd been given a crash course in programmable logic controllers and flash memory and how they are integrated into various TRAC components.

Most marine hydraulic systems utilize a significant amount of electronic control circuitry, and those made by TRAC are no exception. The wiring harnesses used in TRAC systems are custom-made; the builder or installer provides TRAC with the required length for each cable, and TRAC then creates the cable by cutting and connecting the appropriate heavy-duty locking plugs. In addition, each and every wiring harness is proven on an electrical test fixture. This means every plug, terminal, connection, and cable run is checked for proper function before it leaves TRAC's facilities, which translates into extremely low return and warranty-claim rates.

A short car ride away, at yet another building located within the same industrial park, I was privileged to be granted access to TRAC's UAV facility, where security is understandably tight. For those who are unfamiliar with the acronym, UAVs are "unmanned aerial vehicles"—pilotless, remotely controlled aircraft. A division of Arcturus builds the UAVs for military and government agencies for such

Don Hallberg's Hatteras, *Alicia Dawn,* has served as the test bed for many Arcturus Marine products, completing two circumnavigations in the quest to perfect ABT bow thrusters and TRAC stabilization systems.

tasks as surveillance, communications relays, erosion assessment, and border control. These aircraft look like larger versions of those flown by model enthusiasts, except that they're powered by 10hp four-stroke engines, are capable of climbing to more than 15,000 feet, and can loiter for as long as 16 hours. Although not directly related to its marine business, Arcturus' success in building these compact yet capable aircraft is another example of the company's tremendous aptitude for systems control and electronic integration.

THRUST AND STABILITY

What makes TRAC special is its commitment to quality even when it costs more, engineering without compromise, and excellent customer service. For example, using flash memory—rewritable computer memory that can be retained without a power source—for thruster and crane control systems is more costly, but it makes updating and adjustment easier for the customer. There are many other examples of how TRAC goes the extra mile: instituting variable power for thrusters improves response and control, using epoxy rather than polyester resin for fin components increases strength and reduces water absorption, making thruster shaft components from Aquamet 22 rather than ordinary stainless steel provides better corrosion resistance, and casting thruster housings and props from an alloy called nibral offers improved corrosion resistance and strength. Even the alloys used for the stabilizer shaft stud and nut—Aquamet 22 and Nitronic 60—are proprietary and were chosen for their resistance to corrosion and thread galling.

As I mentioned in the opening lines of this article, I enjoy factory tours, and over the years I've visited countless marine industry facilities in the United States and abroad. I also managed boatyards and the folks who work in them for more than a decade. As a result, when I tour a manufacturing facility, it doesn't take long for me to assess the attitude and level of interest of the folks who are building the product. What I look for is a commitment to excellence and attention to detail.

I'm happy to report that the folks who make TRAC products what they are possess ample measures of both, and it shows in the end result: rugged, reliable, world-class marine hydraulic equipment.

Steve owns and operates Steve D'Antonio Marine Consulting (www.stevedmarineconsulting.com), providing consulting services to boat buyers, owners, and the marine industry.