Bottom Dwellers: Bilge Pumps II

The low-capacity bilge pumps we tested included 10 models from Shurflo, Johnson Pumps, Rule/ITT, and Attwood.

PS's electric bilge pumps test wraps up with a look at low-capacity models.

In the Feb. 15, 2004 issue, *Practical Sailor* reported on our extensive test of electric bilge pumps, which covered products from seven manufacturers with flow rates that ran the gamut. In 2000, we tested dozens of pumps: manual units for the April 15 issue and electric pumps for the June 1 issue.

This year, we divided the test field into two groups of centrifugal electric bilge pumps based on output to enable more of an apples-to-apples comparison and to make the data easier to digest.

Keep in mind that advertised output is usually the flow rate at the outlet and doesn't reflect real-world capacities. Recently, the American Boat and Yacht Council began stipulating that manufacturers also rate pumps under two more realistic conditions: with a head height of 1 meter and a hose length of 3 meters, and with a head height of 2 meters and hose length of 6 meters. Head height is the vertical height of the hose outlet above the pump outlet. When comparing output specs on two different pumps, make sure the rating criteria are the same.

WHAT WE TESTED

In our September issue, we looked at eight bilge pumps with a rated output of 1,600 gallons per hour (GPH) or more. This month, we compare the performance of 10 pumps rated at 1,500 GPH or less to see how they fared in exhaustive bench testing. These lower-capacity pumps typically use less power than the larger ones like those we reviewed last month. They also can fit in the tight confines of small-boat bilges. For most applications though, we recommend using one in this size range as a daily-use pump to take care of rainwater or other incidental bilge water since it has a low energy appetite; you would want to have a larger-capacity pump mounted as well to handle the bigger pumping jobs. (See "Tips & Techniques" on page 30.)

Four manufacturers—Attwood Marine Products, Rule/ITT Corp., Shurflo, and Johnson Pumps—submitted electric pumps for the evaluation, including three automatic pumps.

From Attwood Marine, a deck hardware maker and marine accessories supplier, we tested the Attwood Sahara Series S1100 (1,100 GPH) automatic pump and the Tsunami T-1200 (1200 GPH). Rule, a division of ITT Corp., provided the 1,500-GPH Model 02 and the Rule-Mate 1500 automatic pump. We also tested a 1,500-GPH bilge pump (Model 358-000-00) and a 1,000-GPH pump (Model 355-100-00) from California-based Shurflo, which is part of Pentair Inc. Johnson Pumps, a leading pump maker for over 30 years, fielded four bilge pumps in this group: the Ultima Bilge 1,250-GPH automatic pump and three cartridge-style pumps (the 1,250 GPH, 750 GPH, and 500 GPH units).

HOW WE TESTED

As with our comparison of higher-output pumps, testers measured flow rates and power ratings on all pumps at two voltages (12.2 and 13.6 volts) while pumping fresh water into a tank set 4 feet above the pump. We also tested for compliance with the American Boat and Yacht Council (ABYC) standard that requires a bilge pump to be able to run dry at design voltage (13.6 volts for a 12-volt pump) for at least seven hours without failure. In the final analysis, we picked the top-rated pump based on performance, warranty, wiring, and price.

We mounted each pump to the test bench, added crimp-on ring connectors to the factory leads, and then connected them to a fuse panel. Two feet of No. 14 wire connected our 50-amp CSI Speco PSR-50 power supply to fuse blocks energizing the pumps. We monitored the supply voltage with a Fluke multimeter and the pumps' temperatures with a Craftsman infrared thermometer.

Testers ran the pumps for one hour

Photos by Frank Lanier

Bilge Pump Features

Some important factors we considered in our evaluation of bilge pumps were how easy a pump was to clean and whether the automatic pumps provided an external way to test the float switches for proper function. To clean the Johnson cartridge pumps we tested (1), you can pull the cartridge to clear the impeller, but to get between the pump body and base/strainer, you have to unscrew the base. The Tsunami pump (2) is a snap to clean; it breaks down easily. Both the Ultima (3) and Sahara (4) pumps feature switch test capabilities, unlike the Rule-Mate 1500.

at 12.5 volts, then at 13.6 volts for seven hours. All pumps passed the dry run portion of our test for ABYC compliance.

To rate flow output, testers monitored supply voltage and used a Craftsman clamp-on ammeter to record power usage; voltages and current draw were both measured at the power supply. Testers timed how long it took each pump to fill a container of known volume, then used this to calculate each pump's flow rate. Each pump was tested twice at each voltage, and outputs listed in the Value Guide on pages 28-29 are the average.

The pumps were tested using standard bilge pump hose sized to fit the pump discharge, which in all but two cases was 1 1/8-inch diameter hose. The Johnson 750 and 500 GPH pumps utilized three-quarter-inch hose.

Some of the pumps can be rotated so that the outlet can be re-positioned after the pump is mounted. If the Value Guide lists a pump's outlet as having two outlet mounting positions, that means the pump has the typical two-prong mount and can be rotated 180 degrees. Those with four position options can be rotated in 90-degree intervals, and those listed as being 360-degrees can be swiveled so that the outlet can be set in any position.

SETUP DETAILS

The test setup included a plastic 45-gallon supply tank and an 18-gallon receiver tank. Prior to each test run, the supply tank was filled with approximately 30 gallons of fresh water. Each test pump was temporarily mounted onto a half-inch-thick piece of wood, placed at the bottom of the supply tank, and held in position with lead weights.

Testers used appropriately sized Shields VAC XHD Series 148 hose (in 6-foot lengths) connected to each pump with a single clamp. It is smooth bore tubing and is recommended for use as bilge pump discharge hose. The other end of the hose was attached using a single clamp to a typical plastic bulkhead fitting mounted in the receiver tank, which was marked in two-gallon increments and located 4 feet above the level of the pump to simulate static head pressure.

Head pressure is the resistance that a pump has to overcome when pumping water from the bilge, up and out of the boat. It includes the resistance generated by the vertical distance the pump has to move the water up and any resistance generated by the discharge hose due to kinks, ribbed interior, and the like. Our test runs included 4 feet of head, which was more of a challenge for the pumps than the 3 feet of head most makers use in their GPH-rating tests. Because of this difference, our GPH results for the pumps were lower than those makers claim.

The Speco power supply fed each test pump through 15 feet of No. 14 wire. The wiring for all pumps was 16-gauge tinned copper. One aspect of the wiring that is of most concern to an installer is the length of the leads, which in our opinion, can't be too long. If the leads are too short to reach the bus bar, you'll be forced to add more wire with a butt connection or junction box, either of which provides an opportunity for corrosion. The longer the leads, the farther away you can keep the connectors from the corrosive environment of the bilge.

RULE

We tested the Rule Model 02, rated at 1,500 GPH, and the automatic Rule-Mate 1500. Both well-made pumps are common on recreational boats. Of the three 1,500-GPH pumps tested, the Rule-Mate 1500 provided the least output but was the most expensive of all the pumps tested. Like the other Rule-Mate model tested (September 2010), the 1500 features a mounting base strainer and a removable, secondary mesh strainer that help keep debris from clogging the pump. Its built-in float switch triggers the pump, but the design doesn't offer a way for users to test the float's function.

The Model 02 was a moderate performer; however, the Model 02 reached the hottest temperature of the group (179 degrees) during our dry run test. A pump that is too hot to hold can be cause for concern when a float switch gets stuck or

PS VALUE GUIDE — BILGE PUMPS, 1500 GPH and below

MAKER	RULE		SHURFLO		ATTWOOD		JOHNSON
MODEL	02 (1,500 GPH)	RULE-MATE 1500	358-000-00 (1,500 GPH) ★	355-100-00 (1,000 GPH) $	T-1200 (TSUNAMI) ✓	S-1100 (SAHARA) ✓	ULTIMA (1,250 GPH)
PRICE	$60	$121	$56	$28	$34	$78	$66
AUTOMATIC	No	YES	No	No	No	YES	YES
CARTRIDGE STYLE	No	No	No	No	YES	No	No
OUTLET PIPE SIZE	1 1/8 in.	1 1/8 in.	1 1/8 in.	1 1/8 in.	1 1/8 in.	1 1/8 in.	1 1/8 in.
WEIGHT	2 lbs., 14.1 oz.	3 lbs., 12.6 oz.	4 lbs., 14.5 oz.	14 oz.	13.9 oz.	15.7 oz.	1 lbs., 3.4 oz.
FUSE SIZE	10 amps	10 amps	10 amps	6 amps	5 amps	6 amps	5 amps
WIRE SIZE AWG	16	16	16	16	16	16	16
LEAD LENGTH	29 in.	45 in.	60 in.	33 in.	32 in.	32 in.	29 in.
WARRANTY	3 yr. limited	3 yr. limited	3 yr. limited	3 yr. limited	3 yr. limited	3 yr. limited	3 yr. limited
OUTLET OPTIONS	2 positions	2 positions	360 degrees	2 positions	1 position	1 position	1 position
DRY RUN MAX TEMP	179 degrees	142 degrees	108 degrees	92 degrees	96 degrees	93 degrees	118 degrees
CLAIMED GPH* (3 FT HEAD) @ 13.6 v	1,200 GPH	1,200 GPH	1,700 GPH	840 GPH	900 GPH	973 GPH	800 GPH
TESTED GPH (4 FT * HEAD) @ 13.6v/ 12.2v	1,029 GPH / 857 GPH	973 GPH/ 800 GPH	1,565 GPH / 1,385 GPH	766 GPH/ 655 GPH	818 GPH/ 720 GPH	900 GPH/ 783 GPH	692 GPH/ 621 GPH
AMP DRAW @ 13.6 v / 12.2v	5.7 amps / 5 amps	5.5 amps/ 4.9 amps	7.8 amps/ 6.2 amps	3.8 amps/ 2.3 amps	4.5 amps/ 2.8 amps	4.3 amps / 3.6 amps	3.3 amps / 2.9 amps
PUMPING TIME (10 GALLONS) @ 13.6 v / 12.2v	35 seconds / 42 seconds	37 seconds / 45 seconds	23 seconds / 26 seconds	47 seconds / 55 seconds	44 seconds / 50 seconds	40 seconds / 46 seconds	52 seconds / 58 seconds
COMMENTS	Hottest pump during dry run test.	Built-in, non-Mercury float switch; provides no way to manually test switch operation.	Highest output. Heaviest pump tested. Has unique 360 degree swivel mounting.	Best performance of pumps rated 1,000 GPH and below.	"Twist and lock" mounting base. Separates for easy cleaning.	Built-in, non-Mercury float switch; has external knob to test float switch operation.	Uses electronic sensing to detect water. Comes with 1 1/8" and 1 1/4" discharge options.

★ Best Choice ✓ Recommended $ Budget Buy *Makers' claims for GPH were rated with 3 feet of head; PS tested using 4 feet of head.

the pump is left on by mistake. The Model 02 also had the shortest leads of any of the 1,500-GPH pumps tested.

Bottom line: Both Rule pumps were outperformed by others with better pumping capacity (for less money).

SHURFLO

Shurflo had two entries in the 1,500 GPH and below group: the 1,500-GPH Model 358-000-00 and 1,000-GPH Model 355-100-00. Testers liked the quality of construction of both units and the "heft" of the 1,500-GPH Shurflo. At 4 pounds, 14.5 ounces, it was the heaviest pump in the test group. We also liked the unique 360-degree swivel mounting option of the 1,500-GPH model, which was the coolest running pump in the dry run test, as well as its 60-inch leads.

The best testimonial to the Shurflo 1,500 GPH pump however, was its output rate. It filled our test tank faster than any other pump in this group at both test voltages. While it drew about double the power of the other pumps, it delivered in terms of water moved, clearing 10 gallons in 26 seconds. The 1,000-GPH Shurflo needed 55 seconds to move the same volume.

	JOHNSON		
	42122 (1,250 GPH)	32702 (750 GPH)	32502 (500 GPH)
	$50	$38	$24
	No	No	No
	YES	YES	YES
	1 1/8 in.	3/4 in.	3/4 in.
	11.8 oz	12.2 oz	10.9 oz
	5 amps	5 amps	5 amps
	16	16	16
	29 in.	29 in.	29 in.
	3 yr. limited	3 yr. limited	3 yr. limited
	1 position	1 position	1 position
	115 degrees	126 degrees	102 degrees
	952 GPH	700 GPH	525 GPH
	679 GPH/ 581 GPH	480 GPH/ 425 GPH	387 GPH / 316 GPH
	3.1 amps / 2.6 amps	2 amps/ 1.9 amps	1.8 amps / 1.5amps
	53 seconds / 62 seconds	75 seconds / 85 seconds	93 seconds/ 114 seconds
	Includes fittings for straight and 90-degree discharge. Poor access for cleaning.	Includes fittings for straight and 90-degree discharge. Poor access for cleaning.	Includes fittings for straight and 90-degree discharge. Poor cleaning access.

Bottom line: Based on output, warranty, pricing, and construction, the Shurflo 1,500 is testers' top pick in this test group, and the 1,000 GPH Shurflo is our Budget Buy.

ATTWOOD

Attwood provided two pumps for our comparison, the Sahara S1100 automatic pump and the cartridge style T-1200 Tsunami model. Both pumps are well made and performed well during our tests.

The Tsunami has a twist and lock mounting base, and can be disassembled into three parts—cartridge (replaceable motor core), housing, and base—for easy cleaning and servicing.

The Sahara came closest to matching its advertised output with 3 feet of head. Rated for 973 GPH with that head pressure, the Sahara measured 900 GPH (at 13.6 volts) and 783 GPH (at 12.2 volts) in our bench tests.

One of three automatic pumps tested, the Sahara uses a float switch, and features an external knob that allows users to test the float's operation. Its appetite for power ranked in the middle of the 10-pump field.

Bottom line: The Tsunami was our favorite cartridge-style pump with regards to price, output, and ease of cleaning. In the automatic pump category, the S1100 outperformed the Johnson Ultima and output was comparable to the larger Rule-Mate 1500, but costs $43 less.

JOHNSON

Johnson Pumps fielded four entries in this test: The Ultima Bilge 1,250-GPH automatic pump, and three cartridge-style pumps rated at 1,250 GPH; 750 GPH; and 500 GPH. Testers noted that all are well constructed and reasonably priced.

The Ultima uses electronic sensing technology to detect water. An external touch pad allows users to test the switch's operation. Unlike a float switch, the digital sensor has no moving parts and cannot be fouled by debris or oil, the maker claims. According to Johnson, because the sensor is totally sealed, there are no exposed parts that can corrode. Testers like the idea of a sensor that can't jam with debris, so long as it works as advertised, which it did during our tests.

We tested the Ultima and 1250 model with the standard 1 1/8-inch hose, and tested the 750 and 500 with three-quarter-inch hose. The 1,250, 750, and 500 GPH models used the least power of any pump tested, but their performances reflected that. With considerably smaller output hoses and outputs rated at about half that of the other pumps, the 500 and 750's comparatively lackluster performances are understandable.

Testers were not impressed with the accessibility of the strainer for cleaning in the 1250, 750, and 500 cartridge pumps. The cartridge separated easily enough from the body, but for complete access to the strainer, users have to remove the pump mounting screws, turn the pump upside down, then remove the two screws holding the strainer to the base.

Bottom line: Among the cartridge pumps, the Johnson models lagged in ease of cleaning/servicing and performance. While we like the idea of digital sensors for automatic pumps, the Ultima's output didn't match that of the Sahara.

CONCLUSIONS

When selecting the best overall pump from such a diverse group, a number of factors have to be considered to make the choice meaningful as it relates to the real world. In addition to performance, all of our top picks rated well for price, wiring, quality of construction, and warranty.

Topping the 1,500 GPH and under field was the Shurflo 358-000-00, which notched Best Choice honors in this group. It also was the only pump with a 360-degree output option.

We Recommend the Attwood Sahara ($78), our top pick among the automatic pumps we tested. Testers liked the Ultima's sensor technology, but performance took precedence in this test.

Testers also recommend the Attwood Tsunami ($34), the best of the easy-to-service, easy-to-clean cartridge pumps tested. The Shurflo 355, the top performer among the 1,000 GPH and under pumps, takes Budget Buy honors.

CONTACTS

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RULE INDUSTRIES
www.ittflowcontrol.com

SHURFLO, 800/854-3218,
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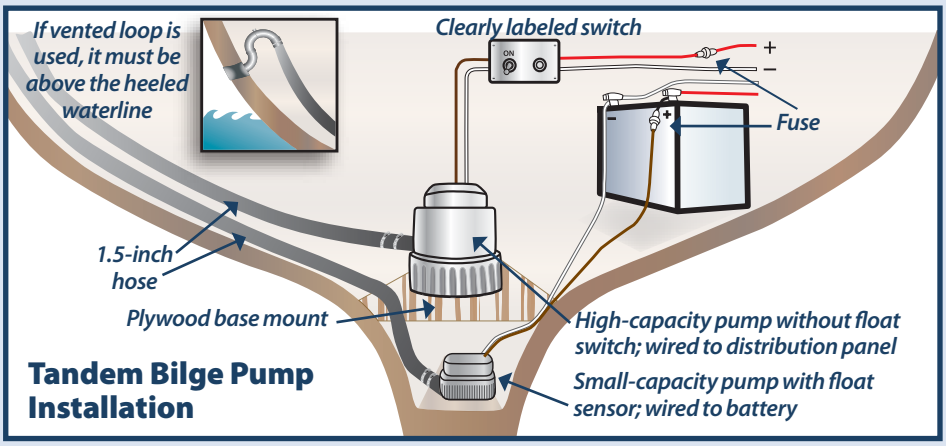
Rules of Thumb for Bilge Pump Installations

The best bilge pump in the world won't keep your boat dry if it's not properly installed and maintained. While bilge pump installations are fairly straightforward—and definitely within the scope of DIY projects—there are several factors to consider (capacity, wire size, hose diameter, fuse size) before you begin, and there are some good rules of thumb to follow.



This illustration, adapted from one in "This Old Boat" by Don Casey, shows one way of installing a tandem bilge-pump system. Other variations can be just as effective.

CHOOSING AN ELECTRIC PUMP

The first step is selecting the right bilge pump(s) for the job. We recommend installing two electric centrifugal pumps (preferably one with automatic water level sensor): a smaller pump mounted at the belly of the bilge to handle the incidental bilge water (rain, stuffing box drips, etc.) using minimum power and another pump mounted a few inches higher to handle bigger jobs. There are several reasons for this; the main one being that a back-up is always installed should one pump fail.

• **Capacity**: For most mid-sized boats (30-35 feet in length), we'd recommend a 1,000-1,500 gallon-per-hour (GPH) pump for the primary and one with a capacity of about 2,000 GPH for the backup. The American Bureau of Shipping recommends one 24-gallon-per-minute pump (roughly 1,440 GPH) plus one 12-GPM (720 GPH) pump for boats shorter than 65 feet.

When comparing output specs on multiple pumps, be sure the rating criteria are the same. New standards set by the American Boat and Yacht Council (ABYC) require that compliant makers rate pump capacities so that they reflect real-world usage. The ABYC stipulates that pumps be rated with a head height (also called vertical lift) of 1 meter and a hose length of 3 meters, and with a head height of 2 meters and hose length of 6 meters. Head height is the vertical height of the hose outlet above the pump outlet. Head pressure (also referred to as static head) is the resistance that a pump has to overcome when pumping water up and out of the boat. It includes the resistance generated by the vertical distance the pump has to move the water up (vertical lift) and any resistance generated by the discharge plumbing (hose kinks, ribbed hose, fittings, and bends). Some ratings also will be given at 13.6 volts, rather than the more realistic 12.2 volts (for a 12-volt system). The latter will more accurately reflect capacity in real-world conditions.

• **Key features:** An automatic pump will rely on a water-level sensor such as a float switch to activate the pump. This can be a separate unit or one that is integral to the pump. This sensor should resist fouling and be easy to test for proper operation. Common float switches should be in a housing, otherwise they are more prone to fouling by debris in the bilge. An easy-to-access strainer (or strum box) is also important, as are long wire leads, which help keep connections out of the wet bilge area.

INSTALLATION

The illustration above (adapted from Don Casey's "This Old Boat") shows one recommended setup for automatic bilge pump installation.

• **Location:** According to the ABYC, the pump inlet must be positioned so that bilge water can be removed when the boat is in a static position and when it is at maximum heel (ABYC H-22). The mounting location also should make it easy to service the pumps and to clean them, particularly their strainers.

The discharge outlet (thru-hull) must be above the maximum angle of heel so that water outside the boat is not siphoned inside the boat. According to ABYC H22, if you can't position the discharge this way, a vented loop (installed above the heeled waterline) and a properly installed seacock must be included in the setup. (Check valves should not be used in this scenario.)

When installing two electric pumps, the lower-capacity pump should have a built-in float switch, be mounted at the lowest point of the bilge, and be wired straight to the battery through a fuse. The higher-capacity pump is installed a few inches higher, but not directly above the smaller pump. As the illustration shows, you can mount the larger pump to a piece of plywood that's bonded to the bilge sides. It should be wired to a dedicated breaker, which can be used as a switch, or it should also be wired to a dedicated, clearly marked toggle switch.

• **Plumbing**: When plumbing an electric bilge pump, be sure the setup is designed to reduce head pressure as much as possible to maximize discharge capacity: use smooth hose sized to meet maker recommendations; keep hose runs as short as possible; and try to avoid bends, turns, and elbow fittings in the run. In terms of adding resistance, using a 90-degree bend in a 1-inch-diameter discharge hose is the equivalent of adding 3 feet of hose to the line, which is like a 3,000 GPH pump being reduced

to a 2,000 GPH pump, if the battery is fully charged. According to pump maker ITT/Rule, small electric submersible pumps are rarely useful with more than 4 feet of vertical discharge head and medium/large submersibles are similarly ineffective with more than 7 feet of head.

The discharge line should rise steadily to the through-hull or loop. If there are any low spots in the run, water will pool there once the pump cycles off. This can create an airlock when the pump is activated again, and the pump likely will stall. Hose connections, as recommended by the ABYC, should be made with non-corrosive clamps and should be airtight.

• **Wiring:** Use correct size wire and fuses: The proper wire size reduces voltage drop and properly fused wiring reduces risk of a locked rotor (a motor that's trying to turn, but can't) causing an overcurrent situation and potential fire hazard.

Consult the American Wire Gauge 3% voltage drop table (*www.marinco.com/page/three-percent-voltage*) to be sure you're using large enough wire. Remember that the run length given in wire-gauge tables is the sum of the positive and negative legs of the circuit; a pump 10 feet from the battery will be referenced as having a 20-foot wire run.

For the fuse size, simply go by the pump maker's recommendation, and you should be set. The fuse, per ABYC standards, should be installed within 7 inches of the power source.

If the pump's leads are too short, extend them carefully. Use oversized tinned marine wire and adhesive heat-shrink connections. ABYC standards recommend using a length of water-resistant electrical cable, sealed at the pump connection, so all electrical connections can be made above the max bilge water level.

• **Accessories**: A few accessories to consider adding to the bilge pump system include a visual/audible bilge alarm, bilge switch, and a cycle counter. ABYC standards require an alarm on boats with enclosed berths. Be sure that the alarm is loud enough to be heard over engine noise while underway and ideally by passersby or marina personnel when docked.

Automatic pumps should always be fitted with a readily accessible and clearly marked manual switch so that even if the owner isn't around, anyone (crew, marina neighbors, or passersby) can locate and activate the switch when the need arises. Switches also should offer visual indication that the pump has power supplied to it. Our top pick for mercury-free bilge switches, reviewed in the January 2006 issue, is the electronic Water Witch 230.

If the larger-capacity pump has a float switch, we highly recommend connecting it to a bilge alarm (and alarm cut-off switch). That way, hopefully, the horn will get someone's attention before the constant cycling of the pump drains your batteries. We reviewed the Aqua Vigil Alarm in the May 15, 2001 issue, and deemed it "simple but quirky." We plan to revisit bilge alarms and cycle counters, including combo units like the Aqua Alarm pump monitor, alarm, and counter.

Two good references on bilge pumps and installing them are "This Old Boat" by Don Casey and Nigel Calder's "Boatowner's Mechanical and Electrical Manual."

MAINTAIN

Regular and frequent inspections of your bilge pumps are a must and should be included in the vessel's overall preventative maintenance program. This helps you know when to replace worn or damaged components (bad float switches, deteriorated hoses) before they fail. Before you set sail, it's always a good idea to make sure the pump has power and is working properly, keeping in mind that testing should verify the actual pumping of water overboard, rather than (in the case of electric pumps) simply switching the pump on and listening for motor operation.

Keeping your bilge clean can be a hassle, but it doesn't compare to the headache of a locked rotor or an impotent bilge pump in an emergency.

Continued from page 12

As pointed out in our February 2009 article, this sort of behavior is more the rule than the exception among many contemporary boats, and it can be exacerbated when in-mast furling enters the picture. The fin-keel version, with its longer keel and rudder, would probably be less prone to these tendencies. According to Douglas, the C375's rudder area was increased, improving helm balance when the boat is heeled.

The 40-horsepower Yanmar and fixed three-bladed prop move the boat well, pushing it at about 6 knots at 2,000 rpm, 7 knots at 2,800 rpm. The boat backed and turned responsively in tight quarters, and a bow thruster is one of the many options available.

CONCLUSION

Catalina's success is no accident. The company brings a consistency and responsiveness that its owners have come to depend on. Some might question the company's conservative philosophy, but they can't argue with the results.

Customer support on new boats is good, and Butler has been known to personally handle warranty claims. Catalina has cultivated a very strong community of sailors, so buying a Catalina boat is, truly, buying into the Catalina lifestyle. Catalina also tries very hard to retain its new boat owners, so the trade-in values tend to be strong.

Clearly, we were not as smitten by the performance of this boat as were some of our cohorts in the advertising-driven media, but Catalina has made several key decisions that add significant value. The lead keel, the sensible rig, and the quality hardware and systems will keep an owner happy for many years. And a decade down the road, when you're pondering a new boat, Catalina will have a good idea of what you are looking for.

CONTACT

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