Get-Home Systems

For long-range, single-engine motoryachts, there are a number of backup propulsion systems. Here's an overview.

Text and photographs by Steve D'Antonio

__Above__—The most obvious approach to providing get-home capacity to a single-screw powerboat is to add a backup propulsion system complete with its own shaft and propeller, as seen here at left. Note that the get-home prop is a folding model, to minimize its drag during normal operations.

There's an active debate in the world of cruising-motoryacht owners and skippers over the preference for single versus twin screw. Sentiments on the subject run deep; just bring it up at a rendezvous or boat show, and you can count on opinions from all quarters. If you build or repair motoryachts, a customer has probably asked you, at one time or another, to share and justify your thoughts on the topic. On what information should you base your response? For many, including me, it will be personal experience. For others, it will be a simple article of faith that: (a) two engines are better than one; or (b) a single engine with get-home option is more economical and just as safe, albeit slower.

Several years ago I undertook a passage from the Chesapeake Bay to Bermuda aboard a 30′ (9.1m) single-screw trawler. In preparation there was a great deal of discussion about the propulsion system's reliability and the potential need for a backup, commonly referred to as a "get-home" system.

We briefly considered a Yanmar diesel outboard; however, those motors were at the time, and remain, unavailable in the U.S. because they fail to meet emissions standards. And there wasn't room for a second inboard engine. In the end we opted to go solo: one engine, one shaft, one propeller. We were careful to ensure that the engine and running gear were in good working order and well tested, that the fuel was clean (we had upgraded the primary filtration system, so minor fuel contamination wouldn't be debilitating), and that sufficient spare parts and tools were on board. As it turned out, the engine never skipped a beat over the course of the nine-day round trip.

The law of five Ps—proper preparation prevents poor performance—plays an essential role in the successful completion of any offshore passage, including ours. A get-home system should never be thought of as a substitute for adequate preparation. Many single-screw vessels, recreational and commercial, ply the oceans of the world safely and reliably, because their propulsion systems are well designed and properly installed and maintained.

Having said that, and having discussed the subject with many cruisers, I think it's likely that some of your single-engine customers simply won't feel comfortable without having an alternative means of propulsion—either twin engines or a get-home system.

This line-fouled prop is as crippling to a single-screw vessel as a mechanical failure is in the main engine or transmission, and argues for including a separate get-home system with its own prop and shaft.

Is It Worth the Expense and Complexity?

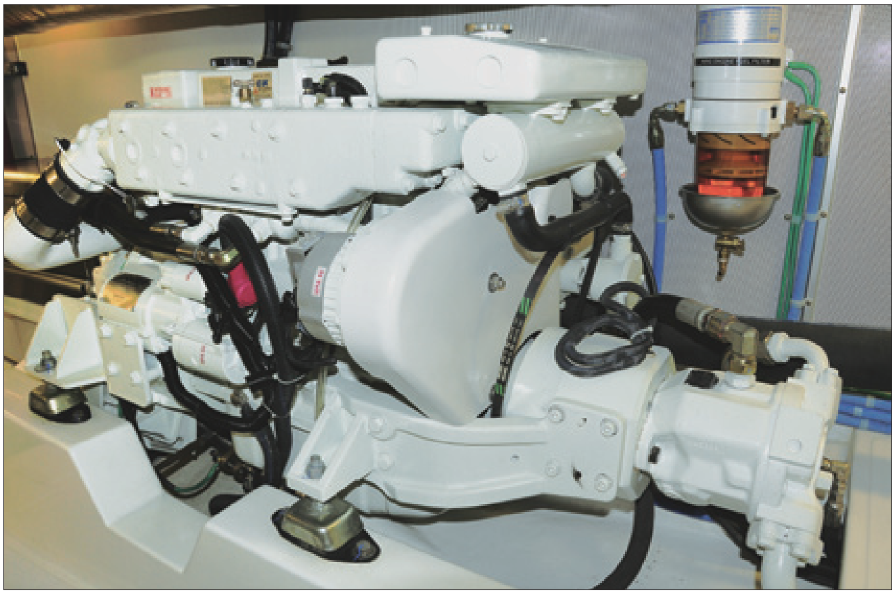
Where and how one cruises are important factors to consider when weighing the options and determining the necessity for a get-home package. Those who cross oceans, or travel well out of sight of land (and VHF/cellphone range) or off the beaten path far from knowledgeable professionals, understandably feel a greater need for propulsion self-sufficiency. When the subject of a get-home system arises, you should ask questions to determine your customers' comfort level, because that plays into the decision-making process.

A variety of options are available, but there's precious little readily available information about them. Some equipment manufacturers are more responsive and customer-oriented than others. I suggest you establish a dialogue with them to gauge and ensure adequate support before guiding your customer or deciding on the purchase and installation of a proprietary get-home system.

Wing Engine Pros and Cons

Among the most popular mechanical get-home options is the standalone wing engine. Many would argue that it represents the most reliable and proven option. It's also among the most costly. A wing engine essentially transforms a single-engine vessel into a twin screw, albeit with a significant disparity in power between the two engines. A get-home system is likely to propel a boat more slowly than the primary engine, particularly in a seaway and especially in a head sea. In my experience, most wing engines will propel a boat in moderate wind and wave conditions at roughly half the hull speed.

A wing engine typically includes all the same accessories, options, and related components, and falls under the same manufacturer installation requirements as the main engine. Notably, many wing-engine installations I encounter do not follow those guidelines, perhaps with the thought that the engines are less important than the primary engine. Nothing could be farther from the truth. Like a



A tidy wing-engine installation like this one is a costly but effective get-home option. The relative accessibility of the secondary diesel power plant and its fuel supply system makes it more likely that the system will be well maintained, and in good working order if it is needed in an emergency.

parachute one hopes to never use, a get-home system must be completely reliable; and because of its chronic and unavoidable disuse, it's more likely to suffer a failure when these requirements are ignored.

The wing engine shaft passes through the hull via a stuffing-box and shaftlog assembly, just like that of the main engine. However, unlike most main engine shafts, which pass through the keel, the wing shaft is not on centerline and requires a strut for support, which makes it more vulnerable in the event of a grounding or collision with a floating object.

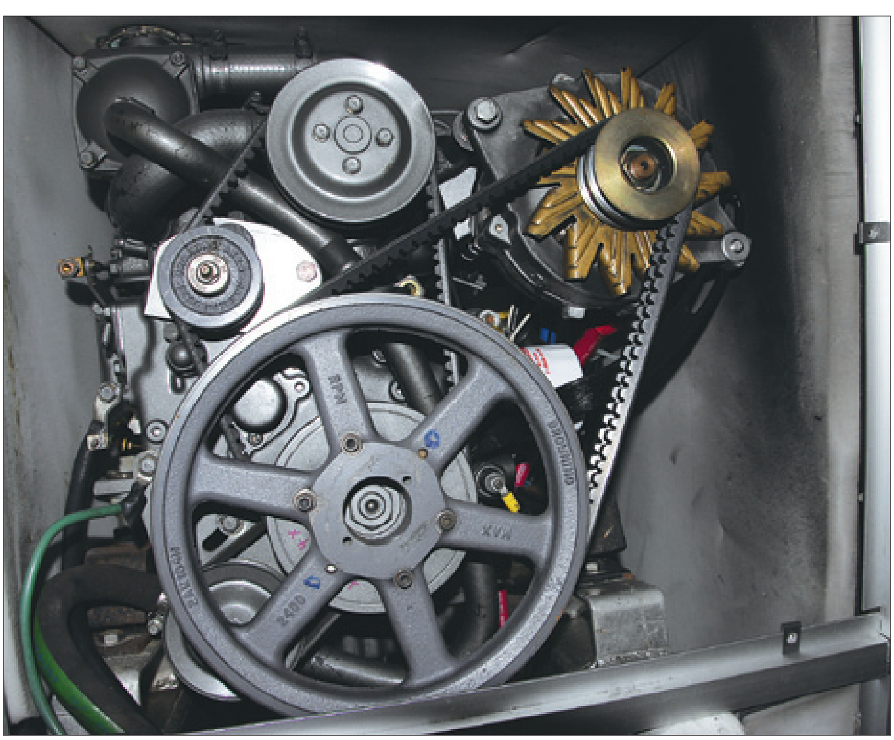
The outboard location of the shaft also imparts an effect on the boat's tracking while the system is running, and requires a steering offset of as much as 20°, which can be hard on the autopilot, not to mention the helmsman. In addition, drag from the wing's external running gear affects fuel economy to some degree, and because nearly all wing installations rely on folding or feathering propellers, they can fail to deploy when needed, especially if used or maintained infrequently. On several occasions, I've encountered wing props that required significant effort to open during haulout inspections. As a rule, haulout personnel should carefully inspect them, and service them if they are corroded or difficult to deploy.

All gear aboard a vessel benefits from being used regularly, perhaps none more so than engines: main, wing, and generator. I've replaced at least one wing engine that seized, very likely as a result of disuse. Moisture, which likely migrated as vapor from water trapped in the exhaust system via opened exhaust valves, had accumulated inside the cylinders and caused the piston rings to fuse to the cylinder walls. I'm virtually certain this would not have occurred had the engine been run more often.

Disuse promotes corrosion and allows oil to drain from bearings, cylinder walls, and other surfaces inside the crankcase. Wing engines should be started and run *under load* to propel the boat for 10–15 minutes, at least monthly. During the workout, the operator should ensure that the engine coolant and oil reach operating temperature. Such use circulates oil throughout the engine, and heats the exhaust system, crankcase, and combustion chambers to disperse moisture and ensure the propeller's mechanism is free of marine growth and deploys properly.

One method of ensuring the wing is exercised regularly is to enable it to power the vessel's hydraulic gear such as thrusters, windlass, and hydraulic bilge pump. Wing engines can also be set up to operate large alternators for more effective and efficient battery charging. This way, the wing will be used every time any of the accessories it powers is needed.

During haulout, carefully inspect



A smaller wing engine is set up with a large alternator to efficiently charge batteries. This secondary use means that the get-home power supply will be regularly exercised and maintained.

Above—*During a haulout the running gear for the wing engine should be given the same attention as the main prop and shaft, including cursory inspection of shaft alignment and Cutless bearings, and replacement of anodes.* ***Left—****The gear mechanisms of folding props should be cleared of any marine growth and packed with grease to ensure that they function reliably.*

wing running gear for marine growth, corrosion, and deployment resistance, and ensure that the shaft turns freely. Incorrect shaft alignment and swollen Cutless bearings, both of which rob the engine of efficiency, can occur on any running gear. Treat the propellers, the strut, and the shaft with an antifouling coating appropriate for running gear to minimize inefficiency and interference from marine growth.

Feathering-propeller gear mechanisms are encased, and designed to be periodically disassembled, cleaned, and re-lubricated with high-viscosity water-resistant grease, which is often supplied or specified by the propeller manufacturer. Folding props, on the other hand, have no internally lubricated gear mechanisms and do not require lubrication service, but should be inspected for marine growth that could affect operation. Packing the feathering propeller with grease isn't a bad idea, although it will ultimately be washed out of the gears when the boat is under way, even if the wing engine isn't operating. Choose high-viscosity grease specifically designed for seawater immersion.

Fuel

Wing-engine opponents note that contaminated fuel affects the wing engine just as much as the main engine, unless, of course, one installs a dedicated wing-engine fuel supply. Pacific Asian Enterprises, manufacturer of Nordhavn trawlers and motorsailers, and perhaps the most prominent adherent to the wing-engine concept, has over 400 wing-equipped boats between 40′ and 76′ (12.2m and 23.2m) in service, all with dedicated wing fuel tanks. While not nearly as voluminous as the main supply, a moderately sized dedicated fuel supply that is known to be sound will enable the operator to motor some distance while he resolves the issue with the main engine's fuel supply by polishing or transferring. In such a system it's important to plumb the proprietary wing-engine fuel tank with a means of resupply from the main fuel tanks, via a manifold and pump. In the event the fuel is not the source of the problem with the main engine, the user must have a means in place to refill the wing tank, which should be large enough to operate at wing cruising speed for a minimum of four and preferably eight hours.

Fuel in the wing engine's reserve should be "turned over" or periodically consumed; if chemically stabilized, it can be safely held for a year. Better yet is to periodically polish the fuel, which should increase its storage duration. Turn over the fuel by periodically running the main engine with fuel from the dedicated wing tank, and simply replenish that supply with fresh fuel. Again, when designing and installing such a system, you, the professional, are responsible for ensuring that your customer understands the operating protocols *and* the potential problems if they not followed.

A designated fuel supply for a wing engine means that if fuel contamination cripples the main engine, the get-home system will still be operational. The fuel in this tank should be replaced regularly to keep it fresh.

On the subject of mechanical isolation, it's worth mentioning that in addition to providing an independent *fuel source*, the wing-engine installation should be, to the greatest extent possible, isolated from the boat's other systems. It should rely on its own *starting battery*, which, along with the generator, should be the same voltage (12V or 24V) as the vessel's main engine and generator, to facilitate paralleling. The wing engine should also have its own *shift and throttle controls*; if these are electronic, in some cases they can share a helm twin-shift control, but the actuator or electronic interface should be isolated. Last is its own *raw-water supply*.

Left—*An alternative to a conventional propeller, shaft, and strut is to attach the wing engine to a sail drive for get-home service. Relatively easy to install through a single hole in the hull bottom, the sail-drive system presents a streamlined underwater profile and is fitted with a proprietary folding prop* ***(above).***

Sail Drives

Yet another wing engine approach utilizes a pod, commonly referred to as a sail drive. (The first Saildrive was introduced by Volvo Penta in 1973; the term has become generic, referring to any of several manufacturers' products that look similar and accomplish the same task with a Z-format drive mechanism coupled to a conventional engine.) The sail drive eliminates the need for a shaft and strut, and its streamlined design has low drag. The unit includes a proprietary folding propeller, along with a proprietary anode. Like an outboard motor, the sail-drive wing engine has a major advantage in that it's a complete package from a single manufacturer and is relatively easy to install.

In most cases, the hollow, oil-filled leg is made of aluminum, so it needs to be properly maintained, coated, protected from corrosion with anodes, isolated in some cases, and

Freewheeling Bearings

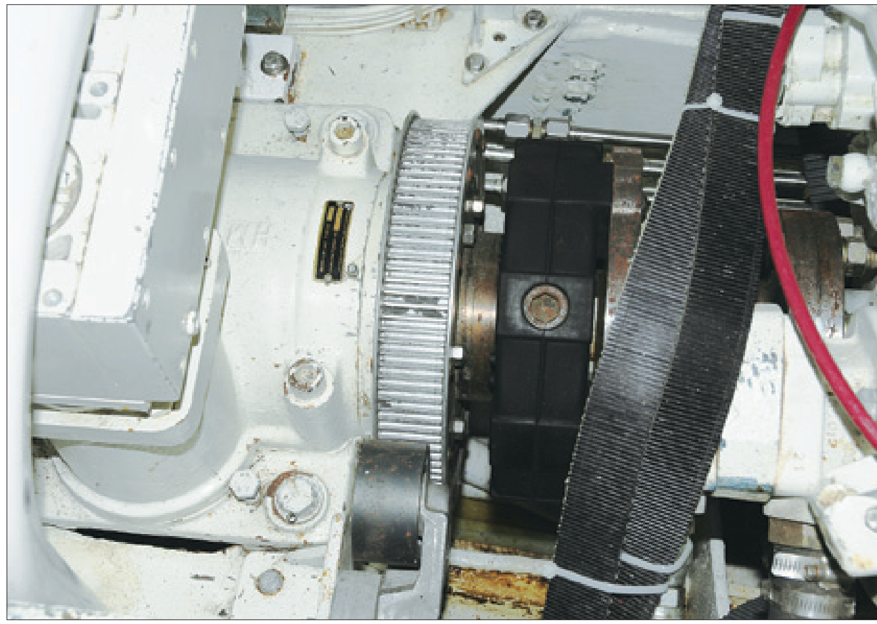
The issue of employing the main engine's transmission as a forward shaft bearing is worth additional discussion. Indeed, even if the main shaft and propeller are not used as part of the get-home system, they still require attention if the vessel is propelled by other means.

If the main shaft and prop are spun from an auxiliary hydraulic motor, the transmission's output shaft will spin, and its bearings will require lubrication. Most hydraulic transmissions (the dominant type of transmission on engines over 100 hp/75 kW) include a pump that supplies pressure to the clutches as well as forced lubrication to the internal components. However, if the transmission is being "back-driven" or "windmilled" by another means—a wing engine or hydraulic get-home, for instance, or while under sail—then it may require supplemental internal lubrication. Most transmission manufacturers provide guidelines for such operation, as it's essentially what happens when a boat is being towed.

Some get-home system manufacturers recommend the addition of transmission-case and/or fluid-temperature monitoring. Unless fully mechanical, such monitors are typically energized by the engine's ignition circuit, which will be de-energized when the vessel is under way using the get-home system. Therefore, if this instrumentation is

It is important to provide lubrication to stuffing boxes and bearings if the main shaft is driven by a freewheeling main prop, or by a hydraulic or belt drive when the boat is in get-home mode. This bearing is fitted with a supplementary water lubrication system.

In this get-home system a serpentine belt connects the main shaft to the wing engine if the main engine fails. The transition is technically complicated; and tie wraps, as seen here, are needed to keep the belt out of the way when not in use—both of which make testing cumbersome.



carefully monitored for signs of corrosion. The interface between the sail drive and the hull is achieved by a large rubber boot, also requiring periodic inspection and replacement.

Belt Drives

On a few occasions, I've encountered a hybrid belt-drive/wing engine system, wherein the wing engine's output was transferred to the main engine's shaft via a serpentine belt. This is a viable approach, and I'm certain there are other variations I've failed to mention. In all these get-home solutions the requirements remain the same: reliability, ease of implementation, and *safe operation*. Provided those goals are met, any variety or combination of systems may be employed. Beware of systems that require substantial in-house engineering and custom or unusual fabrication. While it's possible for such systems to operate reliably and efficiently, it is undoubtedly more difficult.

Generator Hydraulic Drive

Many boats already have the means for auxiliary propulsion on board in the form of a generator, commonly referred to as a genset. After all, generators are dedicated, independent sources of power that are, with the exception of the fuel supply, completely isolated from the vessel's primary propulsion system. And most cruising motoryachts already have one installed. The obvious challenge is how to put all that internal-combustion power to work.

The answer is by hydraulics. Hydraulic pumps, motors, and controls are common, well understood, and easily serviced and repaired in far-off places. Via a power takeoff (PTO), the generator's engine becomes the power source for a

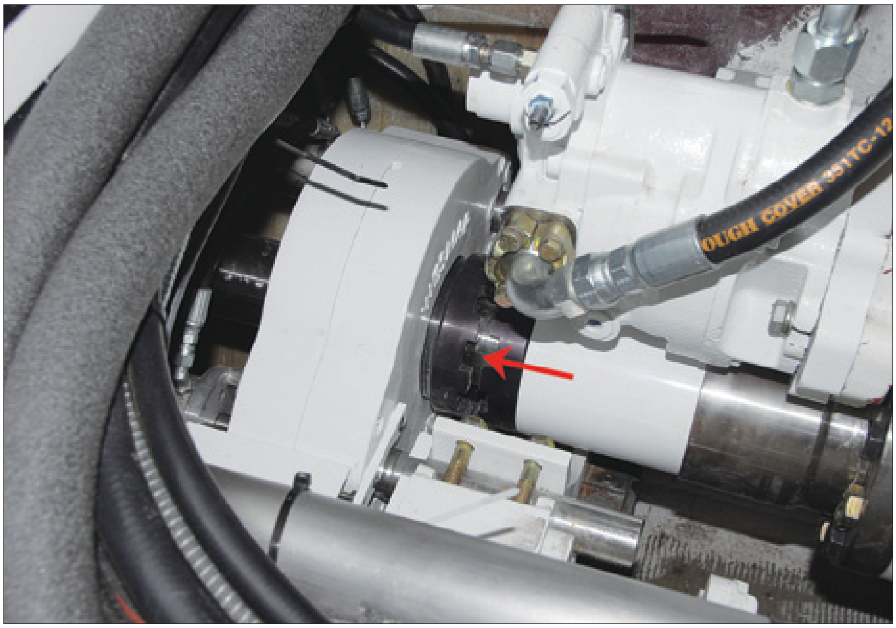
This electric water pump is installed solely to provide pressurized water to the stuffing box and Cutless bearings when the main shaft is freewheeling or driven by a belt drive while the main engine is not running and thus not supplying the necessary cooling and lubricating water.

to be employed with the get-home system, it has to be set up with another power source, one that does not inadvertently energize the main engine's ignition system, along with the injection system microprocessor, alternator field, low oil pressure alarm, etc.

Additionally, the spinning shaft will also create friction and generate heat in the stuffing box and Cutless bearing(s). If the vessel relies on pressurized water injection to provide cooling and lubrication to those components (nearly all dripless and many conventional stuffing boxes rely on such a system), then consider providing that water flow from another source. The water commonly comes from the main engine's raw-water pump; however, if that's idle as a result of an engine failure, then water can be supplied from a stand-alone continuous-duty raw-water pump (electric or hydraulically driven), or it may be tapped via the appropriate isolation valves from the generator's raw-water system. (Take care to avoid pumping stuffing-box cooling water back into the main engine's exhaust system and thence to the engine's cylinders.)

If the vessel relies on a wing engine, which does not utilize the primary shaft, then the shaft would be subject to windmilling. In that case, it can be immobilized with a shaft-lock mechanism, either proprietary or custom-made. Then there's no need to supplement the transmission's internal lubrication as well as lubricating/cooling the stuffing box and Cutless bearings.

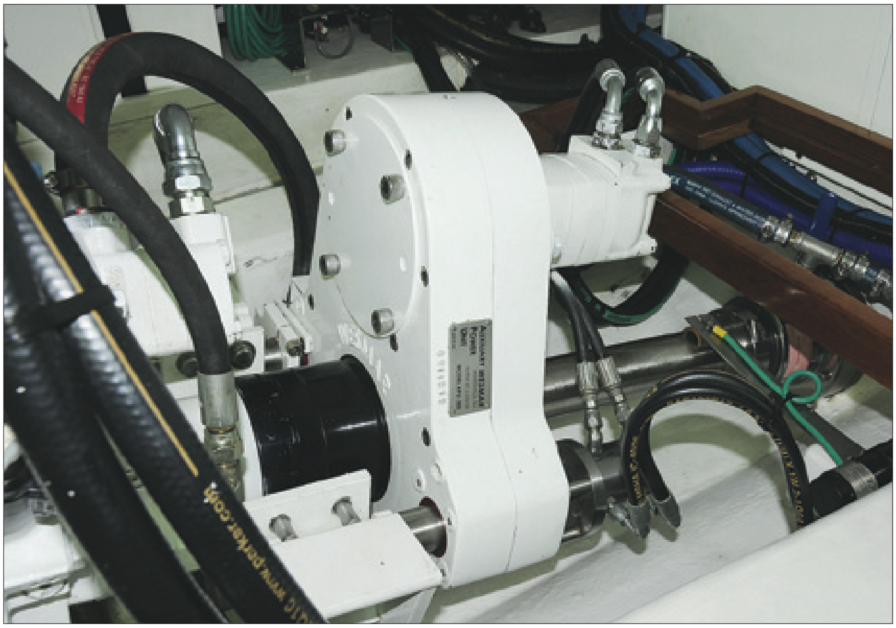
—Steve D'Antonio



Another get-home alternative is to run a hydraulic motor via a power takeoff from a generator. The hydraulic motor is installed around the main shaft, which it can quickly engage by meshing the clutch (red arrow).

hydraulic pump, which can be used to power a hydraulic motor that in turn propels the vessel. In this arrangement, the hydraulic power can be delivered via high-pressure plumbing from the generator to a hydraulic motor and from there to either the main engine's propeller shaft or to a stand-alone wing shaft. It's a neat, practical package that has been highly refined.

Not all generators are offered with a PTO option, nor do all have sufficient output for propulsion. PTOs are typically available on generators 12 kW and over (the output of a 12-kW generator is equivalent to 16 hp). The efficiency of such a system, in terms of power transfer from the generator's engine to the propeller shaft, is typically 80% to 90%. Therefore, the net expected output should be taken into account to determine if it will propel the vessel at the desired speed *in a variety of sea conditions.* Keep in mind that power employed from the generator's engine to propel the vessel is not available to produce electricity. So, if the generator is operating other gear such as refrigeration, that gear will probably have to be taken offline while in get-home mode—a small price to pay for the luxury of getting under way again. If the vessel is equipped with twin generators, which



The relatively modest hydraulic power unit fits into tight spaces around the shaft, while the generator can be located wherever is most convenient. The generator should be carefully sized so it can propel the boat in a variety of sea conditions.

is likely if it relies heavily on AC power, the problem is less acute.

By far the most common approach to the hydraulic get-home system involves a proprietary propulsion system installed either in-line with, or adjacent to, the existing main propeller shaft and engine. The existing transmission, shaft, and propeller remain integral parts of the vessel's propulsion system when the get-home is being operated. The transmission's output coupling also continues to turn and support the shaft while the hydraulic unit is operating (see the **sidebar** "Freewheeling Bearings"). Depending upon the design, the hydraulic power unit may actually surround the propeller shaft and engage it with a clutch mechanism—a set-and-forget assembly requiring the operator to engage it with only a manual or remotely actuated clutch.

Alternatively, the generator may be located alongside the shaft and provide locomotion via a belt or chain and sprocket.

If the hydraulic motor's power is transferred to the shaft via a belt or chain and sprocket, a clutch mechanism is needed to prevent the engine from "back-powering" and damaging the hydraulic motor when the engine is operating. In the absence of a mechanical or electromechanical clutch (in my experience, these are uncommon in such installations), a belt or chain would need to be installed when the operator wants to power up the system—hardly a set-and-forget system. Plus, if the propeller shaft remains attached to the transmission, as is likely, the chain would need to have an easily manipulated master link, and a belt would need to either be of the linked variety or be unshipped from the hydraulic motor pulley and laced and supported around, but not in contact with, the propeller-shaft drive pulley. While this more economical solution might seem reasonable, especially because of its probable infrequent use, it relies on the skills and dexterity of the crew to set up in a seaway. Furthermore, as a result of the effort required to rig them, such systems are unlikely to undergo regular testing.

The advantages of a hydraulic drive are that the vessel continues to use a propeller well protected aft of the keel, and steering is unaffected. There's no added drag from a separate, outboard shaft, propeller, and strut assembly. The drawback is that the system lacks 100% redundancy, relying as it does on the existing shaft and propeller. If, for instance, the propeller becomes heavily fouled with fishing gear or line, or is severely damaged or lost altogether, the auxiliary propulsion system will be of little value.

Alternatively, the generator's power may be directed to a hydraulic wing motor with its own shaft and propeller much like the aforementioned wing engine. This affords the operator the best of both worlds, connecting the generator's engine with a stand-alone shaft and propeller. The hydraulic motor occupies very little space, much less than the wing engine, and requires no raw water, fuel, or exhaust system.

Yet another variation on the hydraulic theme is the "steerable" outboard stern thruster. These hydraulic thrusters are a viable get-home option for smaller boats, and they can be used in pairs to increase thrust. They can stand alone, with the necessary related hydraulic pump or as part of an existing hydraulic system.

Whichever of the above-described systems is employed, the results are the same: the power of the generator's internal-combustion engine is employed to propel the boat, albeit slowly and, depending on which arrangement is used, with a mix of advantages and disadvantages.

Electric Propulsion

For a variety of reasons, including start-up loads and motor size, it is impractical to utilize a generator's AC output for propulsion. However, systems relying on DC motors fall into a somewhat different category. Although it's not specifically designed as a get-home, a parallel hybrid engine/electric propulsion/transmission generator package that is provided with a charge source can be employed in this mode. This package is offered by at least one engine manufacturer, Steyr Motors, of Austria (www.steyr-motors.com/marine-diesel-engines).

The primary goal of this system is to provide the vessel with hybrid electric propulsion. Such an arrangement can also be an effective get-home package if there's a means of charging the battery bank from which the electric motor is powered. The system relies on a battery bank (Steyr's is 48V) that is charged from the transmission generator when the engine is operating. In the event of an engine failure, propulsion power can still be drawn from the battery bank, which in turn may still be charged by a stand-alone charger powered by the vessel's conventional generator, thereby offering a limited get-home system.

The Sail Option

While not common or readily applicable to every boat, a sailing rig is an option that some designers and builders have successfully employed. Dashew Offshore manufactures an innovative aluminum fast patrol boat that can be set up for downwind sailing (see *Professional BoatBuilder* No. 113, page 12). Given the company's sailing heritage, this comes as no surprise. Of course, every motorsailer also has this option.

In reality, unless given careful consideration by the designer, making a powerboat sail efficiently is a tall order. Still, sailing downwind slowly is better than drifting with the current. The key to such an arrangement is to design, build, and test the rig before it's needed.

Testing

During a sea trial aboard a new boat with a parallel, hydraulic get-home, I asked the crew to engage the system for testing purposes. It took several tries, with much chattering and grinding of the integral clutch mechanism. This heightened my awareness of, and concern for, the robustness of the installation. Subsequently, I asked that the system be engaged and disengaged 10 times consecutively with one-minute intervals between engaging and disengaging—my standard protocol. The system failed to engage several times, suggesting something was wrong, and would probably only get worse over time.

A new system being sea-trialed should be operated at its manufacturer-specified maximum continuous load rating for a minimum of one hour, preferably three to four hours for an even more thorough test. While one hour is far from a definitive test of any propulsion system, blatant and egregious flaws in the system will likely reveal themselves during that trial.

Such testing is essential to the two important roles a get-home system performs. First, it affords the single-engine boat owner peace of mind: even if the system is never needed, it's there. Second, should the unthinkable happen, it's a reliable, safe way to return a boat and her crew to port. PBB

About the Author: *For many years a full-service yard manager, Steve now works with boat builders and owners and others in the industry as "Steve D'Antonio Marine Consulting." He is the technical editor of* Professional BoatBuilder*, and awaits the publication (by McGraw-Hill/International Marine) of his book on marine systems.*