2001-#3

DIY boat owner

the MARINE MAINTENANCE MAGAZINE

COLUMNS

DEPARTMENTS

UPGRADE

SPOTLIGHT ON LIGHTING

Modern lighting systems for boat interiors and decks have advanced significantly in energy efficiency, illumination output and longevity.

ELECTRICAL

ALL ABOUT ELECTRICAL PANELS

Modern electrical panels blend form with function so you can tailor your boat's electrical power distribution to your present and future requirements. Spend the time to choose the right panel and understand its configuration.
By Kevin Jeffrey

ENGINES

MECHANIC IN A BOTTLE

Fuel additives can never replace proper engine maintenance, but they can boost your engine's performance. Here's a skeptic's look at what brews are available and when to use them.
By Robert Hess

MAINTENANCE

HAULING, LAUNCHING, BLOCKING, CRADLING

Everything you ever wanted to know about boat haulout, blocking and storage, and how to select a competent boatyard…but didn't ask.
By Patricia Kearns

RIGGING

Repairing a Sloppy Rudder

Does moving your boat's rudder requires extra force, or turning it causes a grinding sound? A lack of lubrication is a common cause for worn rudder tubes on sailboats. Use these step-by-step instructions to repair the rudder tube using the epoxy resin fill method.
By Nick Bailey

Currents

Compiled by Jan Mundy

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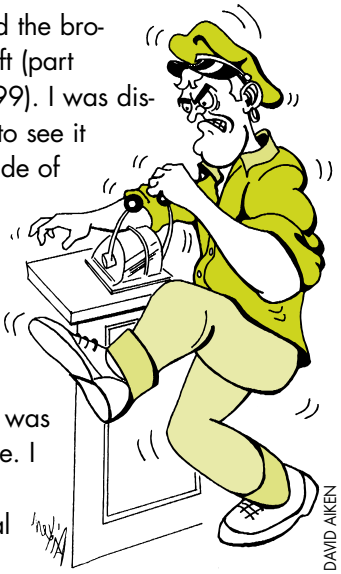
Unstrung on the Kemah

The night was dark and clear. Traffic on the Kemah Channel was heavy in both directions as boats of all sizes came and went. As I approached the pier in my 17m (56') Matthews (44 tons), all was running fine until I went to pull the port shift lever into reverse to adjust for the current. The shift lever snapped apart at the shaft and came off in my hand. The boat proceeded straight towards my neighbor's dock. Quick action was called for.

I spun the wheel to starboard and reversed the starboard engine. This brought the boat straight back out into the channel, giving me enough time to rush to the lower helm station where both shift levers would still be working. Another problem was quickly realized as in the salon the lights were blazing and people were partying. I couldn't see out the windshield, and the new chartplotter was so bright (as advertised, even in direct sunlight), it essentially prevented forward viewing.

In the confusion, the only solution was to throw the main 12-volt breaker, which also disconnected all lights and the chartplotter. (The engines are diesel and don't need 12-volt current to run.) This also shut off the running lights and VHF radio. I couldn't broadcast a "Securite" and boats were shining their spotlights on my darkened hull. Fortunately, they were alert and got out of my way. I opened the salon side windows (tinted, of course) so I could see out and cautiously made another approach that was successful.

The next day, I disassembled the Morse shift unit and removed the broken shaft (part #036299). I was dismayed to see it was made of pot (white) metal. The shaft for the throttles was the same. I went to our local boat boneyard and found three shafts, all broken in the same place. I ordered a new replacement and a spare (US$35 each plus shipping).


DAVID AIKEN

The previous owner had kindly given me two hours of docking training at an abandoned marina. He was very adept at frequent and violent shifting to get the boat to respond as he backed it straight into a slip in a crosswind. I was very impressed at the time. I was less impressed when the shift lever broke. Apparently, hairline cracks in the lever were caused by repeated hard shifting, saltwater invaded the cracks and finished the job.

While eagerly awaiting the new parts, I forgot the end of the broken shaft was still imbedded with corrosion in the handle. An overnight soak in penetrating oil was in order but omitted. A short soak in Coca-Cola, then a soak in lacquer thinner, followed by some violent tapping, and it moved freely. I reassembled the unit using lots of white lithium grease and lubricated all ends of all cables. Now I shift my gears with the greatest of ease!

Joe L. Jordan, Kemah, Texas

Pump Circuitry

After many years in the commercial aircraft business, I have had some experience with electrical circuit protocol. Any circuit that routes a primary pump, secondary pump and the alarm system through the same fuse or breaker, as shown on page 16, in the article titled, "Keeping Dry Below Decks", in DIY 2000-#1 issue, [and revised in DIY 2001-#1 issue, page 3], is not acceptable.

B. Hughes via email.

You're absolutely right. The primary pump and secondary pump alarm

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Forepeak for Midgets

You'll note a big change in sailboat cabin designs in the 2002 models. Boat designers have taken a page out of automotive textbooks and adopted the cab-forward arrangement. Increasing auto "cockpit" space is a boon for drivers and passengers. But in these new boat interiors, hold a party in the main salon but don't plan on sleeping two comfortably in the narrow, about 1.8m (6') long vee-berth. Makes one appreciate the older boats even more.

should all have circuits to a separate fuse or breaker. The American Boat and Yacht Council specifies this in its standards, and we've documented this in the DIY DC Electrical Systems CD as well as "Wiring Handbook," DIY 1998-#4 issue. We refrained from showing this in order to simplify the illustration.

Bonding Rebut

In your "Talkback" column on page 6 in the 2001-#2 issue, editorial titled "Bonding Bronze," DIY contributor Sue Canfield recommends bonding a bronze thru-hull to the engine ground (negative) terminal. I strongly disagree with this practice as it encourages corrosion. The thru-hull should be bonded to an underwater zinc and to nothing else. If the reader follows her advice, and someone in the marina near his boat has a shorepower electrical leak, then first to erode will be the nearby zincs, then the current will likely flow through to the boat's next sacrificial item, the bronze thru-hull and the boat will sink. The aluminum outdrive will also suffer corrosion but it has much more material to give up. I have seen too many instances of this happen over the years.
Stanley Feigenbaum, Beta Marine, Washington, North Carolina.

Sue Canfield responds:
The underlying question here is how best to protect against galvanic corrosion. In my response, I assumed the hull was fiberglass and that it was equipped with an inboard engine with an aluminum outdrive. All metals, when immersed in an electrically conductive fluid (an electrolyte) have a specific electrical potential that is measurable as a voltage. Since no two metals have the same

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Stairway Update

Aging "boomers" should like the Stowaway line of boarding ladders. There is no other ladder design that lets you climb or descend just like navigating stairs. Such comfort comes at a high price (US$302 and up), but if you use your boat for watersports, a Wesbar Stowaway can't be beat. Our review of one model in DIY 1998-#4 issue claimed the ladder to be "super tough." But the following year, after only three outings, our test model broke. These ladders fold like an accordion into a compact package. The aluminum ladder sliding rails can become extremely stiff unless they are sprayed with a lubricant. In the process of collapsing the ladder, the sliding standoff was retracted past the last locking hole position, damaging it and causing a step to break. Wesbar's technicians examined the unit but could find no defect in design, material or workmanship. To its credit, the company replaced the step and standoff and returned a reconditioned ladder. If you have a Stowaway ladder, be sure to routinely lubricate the sliding rails.

electrical potential, a voltage difference is produced when dissimilar metals are immersed in the same electrolyte. An electrical connection between the metals in addition to that provided by the electrolyte creates a galvanic cell. The electrochemical reaction inherent in a galvanic cell generates a current through the electrolyte that gradually consumes the lower-voltage metal (anode). The higher-voltage metal (cathode) will be unharmed.

The rate at which the anodic metal is consumed depends on the voltage difference between the two metals, the relative surface areas of the two metals, the conductivity of the electrolyte, and whether the electrolyte is moving. Since the greater the voltage difference, the greater the potential for corrosion, it's best not to mix underwater metals. In the reader's case, it would be best to replace the bronze thru-hull fitting with one made of non-conductive reinforced plastic, (i.e., Marelon).

A large cathodic area connected to a small anodic area will soon destroy the anode. A large anode, however, (aluminum outdrive, for example) will corrode more slowly when the cathode (the bronze thru-hull fitting) is relatively small. Bearing this in mind, the reader might reasonably decide to simply leave the bronze thru-hull fitting in place, particularly if his boat is kept on a trailer when not in use, or is used in freshwater rather than saltwater.

Bonding is the practice of electrically tying together, and connecting to the boat's ground, major metal objects on a boat, such as the engine and propeller shaft, metal fuel and water tanks, fuel deck-fill fittings, etc. This is done to provide a low-resistance electrical path between otherwise isolated objects,

Painting the Bilge

While you can use traditional marine enamels to brighten the bilge and give a hard, smooth surface for easier clean up, there are coatings specially formulated for the bilge environment. One product is Interlux Bilgekote. It resists penetration from oil and gas, and is lower in viscosity than traditional enamels at the same volume solids, which helps it penetrate into wood more easily. Some products may also meet SOLAS standards for flame spread in the bilge, but we couldn't confirm that BilgeKote has been tested.

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MEMBER ABYC Setting Standards for Safer Boating

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thereby preventing the buildup of voltage differences between them. As Stanley points out, by bonding dissimilar metals immersed in an electrolyte, we create the very circuit needed to promote galvanic corrosion. However, by connecting the bonding system to a piece of zinc immersed in the same electrolyte, it's the zinc (anode) that will corrode and provide protection for more cathodic metals, including both aluminum and bronze.

It's sometimes better to bond dissimilar metals and provide appropriate cathodic protection than to leave the metals isolated. This is particularly true where there is a likelihood that the dissimilar metals may be inadvertently connected by other means, such as when both may be immersed in standing bilgewater as well as seawater. For this reason, the reader may choose to bond his boat's bronze thru-hull fitting to the engine negative terminal. It would be prudent, at the same time, to install a sacrificial zinc anode on the hull and connect it to the outdrive. To ensure minimal voltage drop between a zinc and the bonding system, any connection should be at least #8 AWG. If an additional anode is not installed on the hull, the anodes on the outdrive will corrode faster than if there were no bonding system. Bonding the bronze thru-hull fitting to an underwater zinc and nothing else will achieve the same goal. This simply creates two separate bonding circuits, each with its own dedicated cathodic protection, one for the engine and one for the thru-hull.

Stanley's comments regarding the potential consequences of a "shorepower electrical leak" are misleading. Stray currents can originate within a boat, a marina's shorepower system, or a neighboring boat. In each instance, current leaking from a "hot" wire finds a path to ground through seawater, bilge water, or even damp structures within a boat, rather than through proper conductors. Any metal fitting that feeds stray current into water may corrode. Galvanic corrosion, which involves currents measured in milliamps and millivolts, typically occurs over several months or even years. Stray DC current, with its potential for far higher levels of current flow, can destroy underwater metal fittings in a matter of hours. Stray AC current, due to its alternating character, produces little if any corrosion. The shock hazard stray AC current presents, however, is a major personnel safety concern.

Stray DC current, like lower voltage galvanic currents, can find its way between boats via the green grounding wire in their AC shorepower cords and the marina's shorepower system. It can also find a path to ground through a bronze thru-hull. The thru-hull could be destroyed and the boat could sink. A zinc anode bonded to the thru-hull may provide little protection in such a scenario. Anodes are installed for cathodic protection against galvanic corrosion and are not sized to prevent stray current corrosion. Preventing stray current corrosion depends on proper wiring installation practices, equipment selection, and electrical system maintenance. [Ed: Scheduled articles in DIY 2002 issues will cover corrosion causes and cures, and grounding and bonding of DC systems.]

Winterizing the Water System

If winter puts your boat in a deep freeze, you'll need to protect the water system. First, drain the tanks and water heater and disconnect both from the water system. Insert a length of hose of the same outside diameter as the pump inlet connection in a jug of non-toxic antifreeze. Next, slip the other end of the hose over the intake fitting on the pressure pump and clamp. Turn on the pump and open a faucet. When antifreeze begins to flow, close the tap. Repeat this step with each faucet until antifreeze flows through the entire system. In the spring, fill the water tanks and flush the system with purified water, turning on each tap in succession until all antifreeze is purged from the system.

Winners of DIY Draw

Winners of DIY's Product Information Card Giveaway from DIY 2001-#1 issue who received a 3M Marine ScotchBrite High Performance Cleaning Cloth are: David D. Beach, Chicago, Illinois; Kelly Bishop, Desert Hot Springs, California; Gigi Castiller, Delta, British Columbia; Ronald P. D'Agostino, L'Anse, Michigan; Millard Delampierre, Nashua, New Hampshire; Andy Dumont, Repentigny, Quebec; Susan J. Locke,

Better than Flush Ears

We blew an impeller on an outboard engine when the flushing attachment failed to seal the water intake and more water splashed on the ground than flowed into the engine. As the engine overheat alarm didn't sound, we were not aware of the damage until the water pressure gauge registered a low reading when running at idle and at WOT. A better solution when servicing outboards, is a humungous plastic tub filled with water. This one fits the lower unit on a 150hp outboard with plenty of room to spare.

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St. Petersburg, Florida; Jerry Madonia, Long Branch, New Jersey; R. Marsh, Prince Albert, Ontario; Dr. Robert Mathieson, Sydney, Nova Scotia; S.E. Redshaw, Duncan, British Columbia; Tom Wescott, Belle Haven, Virginia.

Liner Caps Whereabouts

After publishing the article on installing deck hardware when a cabin liner is in place ("Installing Deck Hardware," DIY 2001-#1 issue), we had numerous calls from readers inquiring as to where to purchase the liner caps used to seal the liner and hide the nuts. Any marine retailer with a well-stocked fastener section should sell liner caps.

A Technical Boost

I have been busy and did not acknowledge the receipt of your DIY CDs, which you have contributed as a gift to the boatyards of Chaguaramas, Trinidad. I know that they will be very appreciated and I thank you personally.
Dr. Barry Glickman, Diversa Corporation, San Diego, California

DIY donated six CDs, representing the six years of back volumes from 1995 to 2000, to the port manager of Chaguaramas who is in the process of developing a marine apprentice-training program. This area is a fast developing marine center, and is popular as a hurricane hole for cruisers.

DIY is pleased to contribute to this worthwhile program.

Article Search

I wish to find and printout the DIY article on rebuilding the Atomic Four engine in DIY 1997 #4, and the article with a complete list of technical bulletins from your 1998-#2 issue. How do I do this?
Robert Bell, "Casper," Anacortes, Washington

In the web version, DIY EZINE, only the current issue and three most recent back issues are available. The Atomic 4 two-article series is available either on the 1997 CD or 1998 CD or printed back issues (1997-#4, 1998-#1).

Cruising 101 Revisited

Eric and Susan Hiscock were mentors for many cruisers in the '60s and '70s. Their books were the gospel truth for sailors contemplating an offshore voyage. You followed their advice, similarly outfitted your boat, and hopefully, cruised the oceans without any mishaps (as they apparently did). Then along came Donald Street, Lin and Larry Pardey with their "go simple, go now" philosophy, and a host of other distin-

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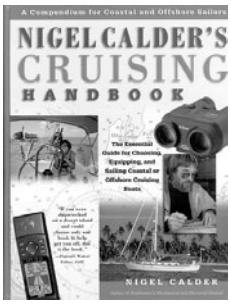
guished blue-water cruisers who published volumes of advice and how-to information. But aside from basic piloting, boat handling, seamanship skills and other issues, much of what was written then doesn't apply to today's contemporary cruisers outfitted with modern gear, sophisticated electrical systems and abundant amenities.



Nigel Calder, renowned author of the "Boatowner's Mechanical and Electrical Manual," and other technical and cruising books, has added another accomplishment to his library. "Nigel Calder's Cruising Handbook" (International Marine Publishing, 588 pages), is surely to become the bible for anyone contemplating cruising under sail in a modern sailboat. Divided into two sections, the first half of this book focuses on boat design, construction materials, rigs and rigging, interior layouts and boat systems. Number crunchers will especially enjoy the numerous specifications, formulas and worksheets used to compare a boat's performance and cruising qualifications. The second half looks at boat-handling skills, weather theory and sample forecasting, heavy-weather sailing, and long-term cruising guidelines. It's loaded with boat-tested tips and anecdotes from the Calder family's many years of cruising. There's something in this book for every veteran, novice or armchair sailor, compiled all into one unparalleled book. A must-read.

Spare Parts

If your boat has a vintage Graymarine gas engine and is in need of parts, contact Ken Spars, 1402 Mount Vernon St., Oshkosh, WI 54901; Tel: 414/231-7909, Fax: 414/231-7834.

From the Bridge

Oops, we goofed. The illustration in DIY 2001-#2 issue, on page 3, should have been credited to the top-notch illustration work of the design staff at Gougeon Brothers, Bay City, Michigan, as published in "Fiberglass Boat Repair & Maintenance Manual."

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Talkback Q+A

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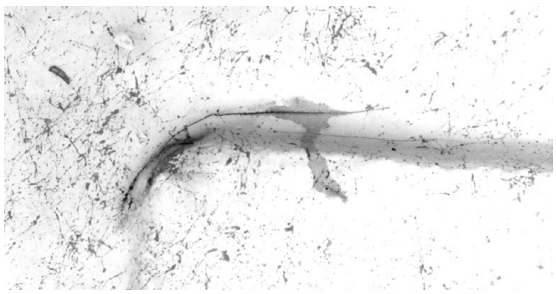
Evidence of Core Wetting

Q: After a rainstorm, a brownish liquid seeps from the flybridge aft drain holes on my 1986 Ocean Alexander 40 DC trawler, and stains the topsides. These drain holes are located in the side cavity that surrounds the bridge. Inside an inspection plate, the area is wet. I assumed the drain holes were plugged, so I drilled them, this liquid poured out, and it's been raining brown ever since. Any suggestions?
Al Shuhart, "Sundial," Punta Gorda, Florida

A: I suspect this is a case of a saturated core. Water is probably migrating into the laminate from hardware not properly sealed, and the balsa or plywood core has become water soaked. After a rain, the leak source lets in more water, which runs through the wood, oozing the brown fluid at the lowest point, the flybridge drain holes. You must locate the source of the leak and seal it or water will continue to break down the laminate's core and eventually affect the structural integrity of the flybridge. You should engage a competent marine surveyor to assess the extent of the problem and its source.
— Jan Mundy



Corrosion Removal

Q: What do you recommend for removing corrosion from RCA jacks or other electrical connections?
Timothy Stark, "Selene," Falmouth, Massachusetts

A: An RCA jack is often a very cheaply made electrical connector. If the corrosion is mild, using a commercially available (from an electronic store) contact cleaner usually solves the problem. Be careful not to dissolve the phenolic composition material that insulates the plug's two contacts from each other. Sometimes it takes multiple passes and a nylon brush (a soft toothbrush works), but the corrosion residue eventually comes off. If it's severely corroded, the effort needed to remove it sufficiently to restore noise-free operation could easily destroy the plating and/or the jack itself. If it needs to be replaced, purchase one that is plated with nickel, gold, or silver. I have occasionally replaced the RCA-type jack with either a BNC coaxial fitting or a miniature phone jack. Some corrosion removal chemical sprays dissolve plastics and others are moderately toxic. Read the instructions and cautions on the can before using, and always use these products in a well-ventilated area.
— Larry Douglas

Gelcoat Refresher

Q: Please advise if I can paint over freshly applied gelcoat.
Ron Barker, Vancouver, British Columbia

A: The most successful paints for over coating gelcoat are linear polyurethanes (catalyzed polyurethanes). If it's freshly applied gelcoat, Jim Seidel of Interlux recommends a cure time of four days in moderate temperatures prior to overcoating. It could be accelerated if the boat was post-cured (perhaps by putting in the sun for a day or so). After that, wipe with a fiberglass solvent wash to remove the antioxidant layer or blush, mold release, wax, etc. Spray water over the surface to be sure all wax, etc., has been removed. (If it beads, solvent wipe until there is no beading.) Follow paint manufacturer's recommendations for painting over gel surfaces to the detail with regard to mixing, sanding, cleaning, coverage, thickness (wet) and so on. A sanding with 80- to 120-grit paper typically follows the solvent wash, washing again to remove sanding residue, then paint. Apply a primer to improve topside aesthetics and coverage, and below the waterline, prime with a barrier coating.
— Wayne Redditt

Manifold Replacement Made Easier

Q: The Chevy 350, 260hp, seawater cooled, V8 engine in my 1989 Bayliner 2855 has a hairline crack in the port exhaust manifold. It needs replacing, a job I would like to do myself. It appears that I would have to remove the six bolts holding the manifold in place to the block, as well as the two bolts holding the riser to the manifold. Can you tell me the necessary steps and whether there are any articles with good text and pictures showing

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how this is done? If I leave the exhaust hose (that follows the exhaust riser) connected to the sterndrive outdrive at the transom, but disconnected to the riser, do I need to take the boat out of the water to do this task?
Steve Presley, Westminster, California

A: Corrosion commonly causes exhaust manifolds to develop a leak. Using the proper tools and a few tricks of the trade from Mercury Marine, replacement is not difficult. First, drain the water out of the engine via the two drain holes. Place suitable containers under these drains so water doesn't spill into the bilge. It's common to insert a piece of wire into the drains to ensure dirt isn't blocking the hole. Disconnect the exhaust hose and water hoses that attach to the manifold. Tie the exhaust hose to something so it doesn't fall below the waterline and cork the end, or use a tapered soft wood thru-hull plug to prevent water from back washing though these openings and into the boat, which could flood and sink the boat. Remove all components that attach to the manifold. Disconnect the positive battery terminal before disconnecting any electrical components. Unbolt the exhaust elbow. Since the manifold is heavy, after removing the bolts, it can drop on your toes. Here's the trick: use threaded "dowels" to support the manifold during removal and reinstallation, if there is access in the engine compartment. To do this, cut a piece of 3/8" threaded rod into short lengths, or use long 3/8" bolts and saw off the heads. Remove two bolts, and then screw a rod into each hole. Now, remove the other bolts, and the manifold easily slides off on the dowels. Clean the gasket material from the mating surface on the cylinder head. Place a new gasket on the cylinder head. Your engine uses a Chevy header gasket, available from a GM dealer, or MerCruiser dealer, part #27-33395 ($10). Using a gasket, rather than sealant, eliminates any possibility of deadly carbon monoxide-laced exhaust gases from leaking into the compartment. Carefully slide the new manifold on the two dowels, install the bolts and tighten them securely and evenly. Attach any components that were removed, and install the hoses with double clamps. Before doing any engine work, I strongly recommend you obtain a service manual for your engine.
— Jan Mundy

When Fuel Jells

Q: My boat has been out of service for four years and the gasoline fuel has jelled. Is there a chemical or solvent that I can add to the tank to liquefy the fuel? I can take care of the ventilation issues and disposing of the hazardous waste. It's a 265L (70gal) tank and I don't want to replace it.
John FitzSimons, "Sunshine." Coon Rapids, Minnesota

A: Today's gasolines contain 10% methanol alcohol by law, with concentrations as high as 33%. What remains when the alcohol evaporates, is a petroleum-based fuel containing large amounts of semi-solid disbursements, mostly additives and cleaners that are also mandated by law. This hardens to like a shellac-like substance; mechanics refer to as "Orange Goo." This goo must be removed before engine operation. Any residual disbursements in the tank can gum up the carburetors, or glue the float to the bottom of the float bowl, even weld close the check valve in a standard fuel pump. Adding high concentrations of a fuel stabilizer can prevent fuel jelling. According to Exxon, solvents, such as Varsol, won't do the job. You must clean the tank with an industrial strength heavy aromatic naphtha (HAN) that contains toluene and zylene. Available from chemical companies (check the yellow pages), it's sold under the brand names SolvEsso 100 and SolvEsso 150. Shell recommends A100, an aromatic solvent, followed by a steam cleaning. A potentially dangerous job, the explosion risk is high. As solvent and gasoline vapors are heavier than air, fumes collect in the bilge. Start pumping fuel and you create static electricity, and an invitation for fireworks. It's a job better left to professionals.
— Jan Mundy

Bilge Checkup

Q: I'm looking for a schematic for wiring a counter into a bilge pump circuit to record pump cycles.
Charles Monroe, Saugerties, New York

A: There are available some aftermarket cycle counters or you can substitute an engine hourmeter. A rather coarse indicator, most hourmeters read in hours and tenths, then click over, so you won't notice any reading change until operating the bilge pump for about six minutes.
— Nick Bailey

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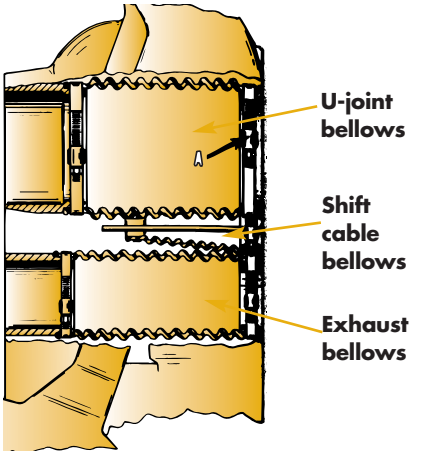
Bellows Service

Q: I am having a problem with water leaking into my boat. It has something to do with the MerCruiser 140 hp cooling system or the Alpha One outdrive. Water leaks into the boat through the outdrive when it is down. Flow slows or stops when raising the outdrive to its highest point. Is there a manual that details this system and how to fix it?
Gary White, Toronto, Ontario

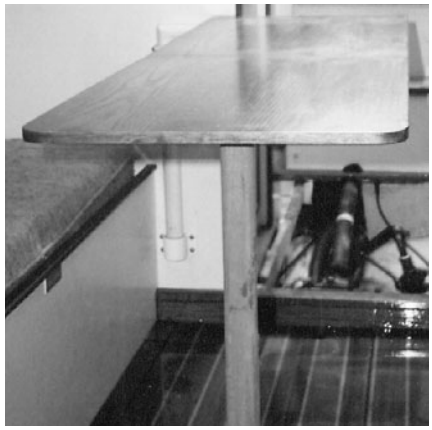
A: It's common for the universal joint bellows or the seal around the transom assembly to leak on engines that are long on the tooth. The crack is probably in the top of the bellows. Tilting the drive down, exposes the crack. Trim up and it compresses the bellows, closing the crack. If you want to do repair it yourself, you'll need to purchase a transom assembly reseal kit and depending on the engine's vintage, about $300 in specialized tools. The engine serial number is required when ordering the reseal kit and service manual. You need to remove the bell housing, which often has corroded fasteners. It's a long, fidgety job but not undoable if you have the time and patience, the service manual, mechanical skill and proper tools. An experienced marine mechanic would take about eight to 10 hours, at an average $100 per hour.
— Jan Mundy

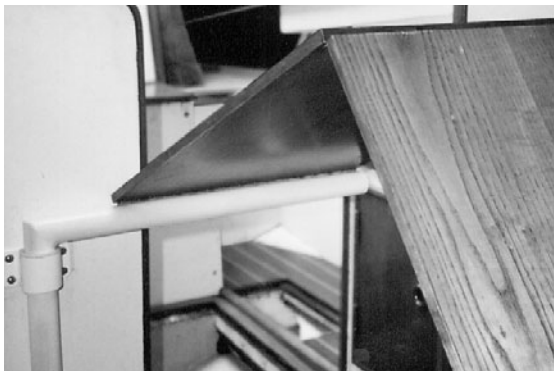


Need to Customize

Q: Do you have a diagram of the aluminum bracket and fittings as shown in the photo for the Decolite Fold and Turn Table in DIY Projects, 1998-#4 issue.
Warren Matthews, Western Australia, via email.

A: Sorry, we don't have a schematic of the bracket. Briefly, the round base has a flat mounting surface and is held with four screws. The 90° tubing fits into the base and swivels. A collar mounts to the bulkhead and holds the tube at the elbow joint. Both the base and collar are made so the tube is offset from the bulkhead about 6mm to 12mm (1/4" to 1/2"), so it doesn't hit the bulkhead when it swivels. The piano hinge mounts to the tube and the side of the table. In the up position, the bracket swings out to position the table between the two berths. In the folded position, brackets swing in to position the table against the bulkhead above the starboard berth. You may be able to substitute stanchion bases and tubing.
— Jan Mundy





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Tech Tips ✓

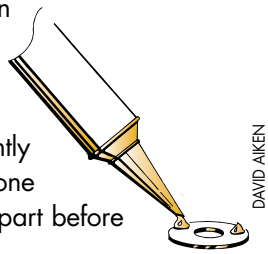
HARM-LESS CLEANSING: Add a high-pressure washer to your clean-up kit and blast away dirt and grime, rust, old coatings. No toxic cleaners to pollute the environment, no more scraping, sanding or wire brushing. Works great on weathered teak!

GELCOAT RUST REMOVER: Contrary to your "Dockside" article on page 48 in DIY 2001-#2, we have found a good solution to the problem of removing rust stains from fiberglass. Mix several spoonfuls of oxalic acid crystals, available from chemical supply companies or some pharmacies, with a cup of water. Stir until completely dissolved, and then brush onto the rust stains. Wait a few minutes, rub vigorously with a cloth and the stains disappear. [Ed: Acid is highly toxic. Wear gloves and don't breathe the fumes.] *Alan Porter, "Te Tiaroa," Victoria, British Columbia*

FRIDGE BOUQUET: To help eliminate odors in your boat's refrigerator, fill some paper coffee filters with 1/2 cup of baking soda, tie securely with string, and place one on each shelf.

SOUND MAPPING: It's a good idea to test the engine's sound level measurements after repowering, purchasing a new-old boat, or if you are wondering whether to add additional soundproofing to reduce noise levels. You can use your ear, but it's not very accurate. Radio Shack sells a useful meter for about US$30. Take measurements at the helm station, in the cockpit and in the cabin below decks, noting engine rpm and boat speed. *Charles Husick, Tierra Verde, Florida*

A HELPING HANDHOLD: A neat trick to hold parts in place when gluing, or attaching nuts and washers, especially when working overhead or in other awkward areas, is to lightly dab some silicone sealant on the part before assembling.



DAVID AIKEN

EASY PUMP STORAGE: To winterize a bilge pump, fill a tray with plumbing antifreeze, place under pump and let it run until it exits the thru-hull. Place a collection container under the thru-hull outfall to prevent the antifreeze from entering and contaminating the environment.

TAPELESS MASKING: Prior to painting, varnishing or oiling, brush molten wax around the base of handrails to protect surfaces from spills and runs. Apply in an inconspicuous place first to ensure the warm wax won't damage the surface.

SHRINKWRAP GUARD: *A cost-effective solution to prevent punctures and tears where shrinkwrap stretches across stanchion tops, windshields, and other peaked corners, is to cover with pieces of foam water pipe insulation or pool noodles, secured with wraps of PVC tape. Christopher Harcourt-Vernon, "QuickStep," Toronto, Ontario*

TARNISH-FREE METAL: Salt air tarnishes brass, bronze, copper and silver quickly. 3M Tarni-Shield is a one-season or longer protective polish that requires no buffing. Just dab on, rub and wipe off. Instructions say to rinse after cleaning, but Rita never does, unless she's planning to eat with or from it. *Rita Maersch, Annapolis Polish & Plating, Annapolis, Maryland.*

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ShopTalk

METAL FACTORS

It helps to know the compositions (alloys), corrosion characteristics and installation factors when you're choosing a metal for your boat.

By Wayne Redditt

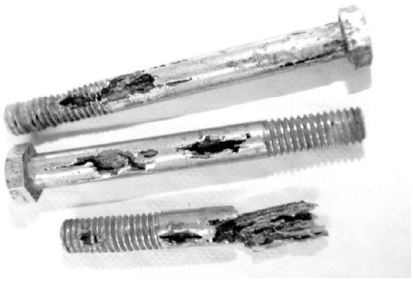
All aluminum, brass, bronze or stainless steel available today are mixed with one or more other metals, sometimes for hardness or strength, or corrosion resistance, to form an alloy. Knowing which one to use for a specific application on your boat is important to delay or prevent corrosion and ensure strength.

Marine grades of stainless steel, for example, are predominately iron alloyed with smaller quantities of chromium, nickel, silicon, molybdenum and manganese. Aluminum alloys are series designated in groupings, according to the major element in their composition. The 5000 and 6000 series alloys are of the most interest to boaters. The major alloy in the 5000 series is magnesium. The 6000 series mixes magnesium and silicon. Additional digits often append these major designations. A complete alloy identification may appear as 6061-T6, which signifies a 6061 alloy solution heat-treated and furnace age hardened. Another common alloy is 5054-H32, a 5054 alloy that is strain hardened and stabilized by low-temperature thermal treatments. For most applications, useful marine aluminum alloys include: 5083, 5086, 5054, 5456 and 6061 in various states of hardness and tempers.

One exception is water tanks. The 1000 series alloys are almost pure (99%) aluminum. They are the most corrosion resistant, are completely non-toxic and bend easily, a big advantage since it decreases the amount of welding required.

Stainless steel of the type commonly used aboard boats is of the austenitic type. Chrome and nickel are the main alloys in these steels. They are non-magnetic, or only very weakly magnetic. Other stainless types (ferric or martensitic) display magnetism similar to steel. [Ed: Refer to DIY 2001-#1 for a complete discussion on stainless steel alloys including correct drilling techniques.]

Stainless steel rigging is susceptible to crevice corrosion that occurs around areas of pooled or stagnant water. The "stainless" nature is created by a phenomenon known as passivity. In the presence of oxygen, chromium in the alloy creates an impervious oxide layer. Where water (an electrolyte) collects and stagnates, reduced oxygen deprives the stainless of its passivity, and the alloy becomes active (electro-negativity increases). Wherever stainless steel is starved for oxygen exists a potential for crevice corrosion, such as wire rigging swages, bolts under nuts or where bolts are passing through wet wood, or in out of sight areas, such as beneath shaft couplers or struts, or rudder posts embedded in fiberglass. Other areas of concern are plastic-coated stainless-steel lifeline wire, swaged fittings and turnbuckles. Here water migrates under the coating, or enters the fitting and stagnates, depriving the metal of oxygen. Interestingly,



JAN MUNDY

Extreme crevice corrosion in stainless steel bolts, due to lack of oxygen in a damp environment, likely caused by water leaking through an improperly sealed bolt head.

corrosion can be very localized and difficult to detect.

Type 316L, the preferred choice for most applications, and 304 are the two common austenitic stainless steels commonly used onboard. The addition of molybdenum to the 316L alloy increases its resistance to corrosion significantly over the type 304. The "L" signifies an extra low carbon content. This is significant if the metal is welded. Carbon precipitates into carbides in the weld zone, altering the corrosion resistance and

Without properly isolating these dissimilar metals, the stainless-steel fastener has corroded to the aluminum tang, making extraction very difficult.

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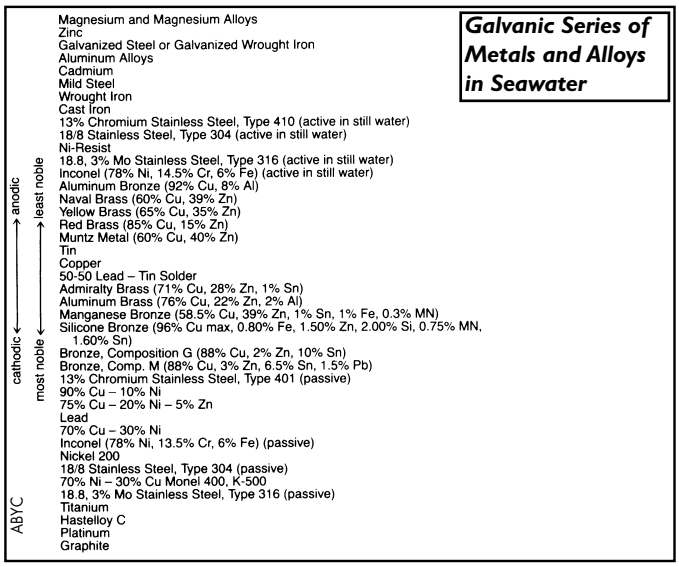
Figure 1

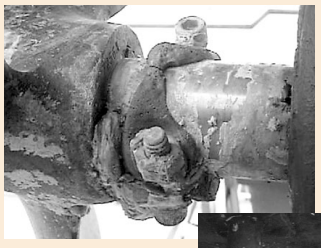


strength characteristics. All welding of either 304 or 316 types should be done using 316L filler rods to ensure no carbon is added to the weld zone.

Shafts are a common application for stainless steel. The most famous stainless for this purpose is a proprietary alloy referred to as Aquamet 22. This alloy, and others similar to it, are composed of higher chromium percentages than 304 or 316, and include manganese and molybdenum in the mix. Aquamet is particularly strong and corrosion resistant, although sacrificial zinc anodes are still recommended to protect the stainless steel.

Copper-based bronze alloy propellers, turnbuckles, winches and other deck hardware, decorative items and other gear are popular on boats. While marine quality bronze is less noble than passive stainless steel, it does not exhibit the active states that are possible with stain-

-Tip- Anode Notes



PAUL & SHERYL SHARD

Never paint a zinc anode. It can only provide sacrificial protection when clean and directly in contact with water. Over time, it will corrode to the point of losing 50% its weight or original surface area. When this happens, it's time to replace it to ensure maximum corrosion control.

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Milling Aluminum

Fabricating with aluminum alloys is fairly easy. Any tool used to mill wood, also works on aluminum. Use a circular saw with a carbide blade for straight cuts. A band saw with 1/2" x 6 tpi wood blade cuts aluminum quickly, and turns tight corners with ease. Routers, jointers, table saws, hand planers, drills, rasps and everything else in the carpenters' toolkit will work on aluminum. Even more so than when used with hardwoods, the tools must be sharp for best results.

Aluminum is easily welded using either TIG or MIG (shielded gas) apparatus (as are stainless steel and copper alloys). Welding success with aluminum requires precleaning. It's good practice to use a stainless steel brush to remove the surface oxide in the weld zone immediately prior to welding. (Sophisticated square-wave TIG welders remove this oxide automatically.) I always use a stainless cup wheel on an 18cm (7") angle grinder for this job. This tool is pricey, but indispensable. Don't be tempted to use a steel wire wheel. This will contaminate the weld zone and failure will surely follow.

It's unwise to weld fittings onto aluminum spars and masts. Mast extrusions are generally 6061-T6, a heat-treated alloy to increase its strength. Welding weakens this metal in the weld zone by as much as 40%. Not surprisingly, most hardware (other than the masthead) is secured with machine screws or bolts, rather than welded.

less. In other words, if absolute corrosion resistance is required, it's difficult to beat bronze alloys. Turnbuckles for instance, will not succumb to crevice corrosion or pitting as their stainless counterparts might. Having said that, it's important to protect bronze props on a stainless shaft with zinc anodes. The difference is that the underwater gear is submerged in an electrolyte, and the dissimilar metals are electrically connected (they contact one another).

Brass is a copper-based alloy that should not see service anywhere aboard a boat other than a little decorative sign that identifies the head, or as a light fixture. The problem is that brass is largely alloyed with zinc. Underwater, brass destroys itself in short order. Brass gate valves meant for land-based uses (household hose bibs) should never be substituted for seacocks made of bronze, stainless steel or marine grade fiberglass reinforced plastic valves (i.e. Marelon).

Joining Dissimilar Metals

Galvanic corrosion occurs when three conditions are met: two or more dissimilar metals are involved; an electrolyte (seawater) is present; or the metals are electrically connected (the transfer of charged electrons).

Generally, the relative position of the metal on a scale of electric potential (or galvanic scale) is similar regardless of the electrolyte (**Figure 1**). Consequently, we can state that aluminum is always more electrically negative than bronze, zinc more negative than stainless and so forth. Electro-negativity is important because when dissimilar metals are immersed in an electrolyte and are otherwise electrically (or mechanically) connected, the metal with the more negative rating will give up electrons into the electrolyte and current will flow between the metals. That metal will eventually corrode due to this activity.

What you need to know, without involving an in-depth discussion on corrosion, is how to protect the metals on your boat. There will always be dissimilar metals underwater. The usual practice is to bond all underwater fittings together into a common ground system, and install a sacrificial anode (a most electro-negative metal) to corrode on behalf of the whole system. Sacrificial anodes are usually a quantity of zinc metal bolted somewhere onto the hull or attached to a shaft or rudder, and wired to the common bonding system. [Ed: Typical grounding installations appear on page 52.]

Stainless is the metal of choice when fastening hardware to aluminum (i.e. spars). Never fasten bronze on aluminum, as it will "eat" at the aluminum. Since aluminum and stainless are well separated on the galvanic chart, they eventually create an oxide barrier between themselves, inhibiting further corrosion. It's this oxide that makes it virtually impossible to remove stainless fittings that have "corroded" in place on an aluminum spar. To prevent seizing of threaded fasteners in dissimilar metals, apply an electrical barrier, or "gasket" of polyurethane sealant (i.e. 3M 4200 or 5200), thread compound (i.e. Lubriplate, Tef-Gel or other anti-seize corrosion eliminator), or a neoprene or PVC washer.

About the author: Wayne Redditt has 20-years experience in design, construction and repair of small craft built of wood, composites and metals.

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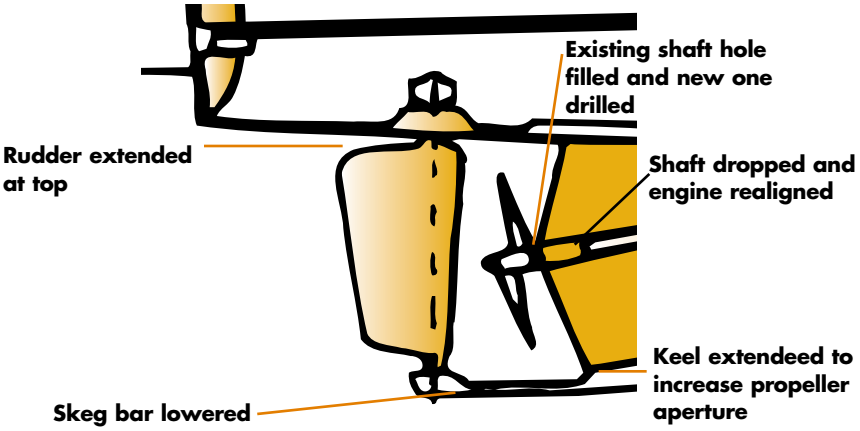
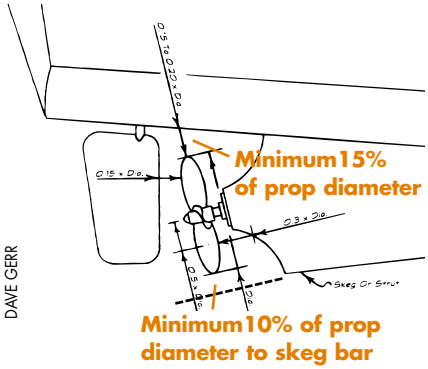
Projects

CURE FOR PROP NOISE



My 10.6m (35') fiberglass lobster boat (used as a cruiser only), equipped with a Perkins 145-hp diesel, propped with a 56cm x 45cm (22" x 18") four blade, a 2:1 reduction gear, and a clean bottom, would do 14 knots at 2,400 rpm with a normal load. The prop was oversized for the aperture, resulting in restricted water flow and excessive noise and vibration. The propeller blade tips cleared the hull by a mere 4.4cm (1-3/4"), instead of the minimum 15% of overall propeller diameter, or 8.3cm (3.3"), as recommended by designers for optimum water flow and efficiency.



Clearance to the skeg bar below, which runs from the keel to the rudder bearing, was only 2.5cm (1"). This clearance can be as little as 10%, or 5.7cm (2-1/4") for my prop. The prop was starved for water.

To achieve the minimum clearances, I needed to provide a larger aperture. This meant adding to the keel and lowering the skeg bar to make a 70.5cm (27-3/4") aperture, and dropping the shaft to 36.8cm (14-1/2") from its center to the hull. Since the total aperture diameter was 62.8cm (24-3/4"), the skeg bar dropped 7.6cm (3") minimum, and with the shaft 32cm (12-3/4") from the hull, it would drop 4.4cm (1-3/4"). Final measurements were 10cm (4") lower for the skeg, and a 5cm (2") shaft drop.

The keel-skeg addition was built of fiberglass to fit between the existing skeg bar and keel. For this I made a plywood mold, measuring 10cm (4") wide, to match the keel; 11.4cm (4-1/2") high, the desired thickness plus 12mm (1/2"); and 61cm (24") long. This gave 30.4cm (12") for mounting the bar and the remaining length to shape a nice taper on the front to mat with the keel. Strips of 5cm (2") wide clear plastic shipping tape pasted over all surfaces acted as a mold release. A 30.4cm x 7.6cm (12" x 3") piece of 12mm (1/2") plywood laid in the bottom formed a recess for the skeg bar. The mold was filled with mat and roving strips laid up with polyester resin, and then set in the cold outside to slow the cure so as not to create a lot of heat because of the thickness. I then ground the gelcoat off the bottom of the keel and skeg bar recess, using a 20cm (8") grinder and 36-grit disk. Tip: Use a leaf blower after grinding to clean off the dust.

When fully cured, the new keel shim was removed from the mold, and rough fitted to the keel. The three holes for the skeg bar bolts were extended through the shim working from inside the keel with an extension on a 16mm (5/8") paddle bit. With a friend holding the shim in position, it was bonded using epoxy resin thickened with colloidal silica, and bolted to the existing keel. New longer bolts fastened the bar and shim to the keel through the original holes using caulking. All was ground smooth, primed and painted.

Original skeg placement showing shaft and cutlass bearing removed.

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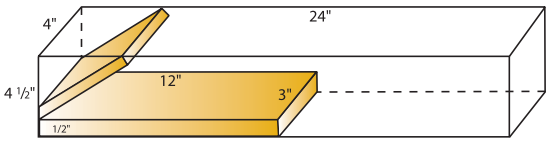


Schematic of Shim Mold (Not to scale).

Lowering the shaft involved removing it and the cutlass bearing. The hollow fiberglass keel was ground out around the original shaft hole and cutlass bearing mounting bolts. The hole was then filled with small circular pieces of mat, of progressively larger diameters, set in epoxy resin thickened with colloidal silica. When cured, a new hole was drilled and cut with a holesaw, 5cm (2") below the original one. All was ground, then filed flat. Shaft and bearing were dry fit to determine if I would need to lower the rear engine mounts or raise the front ones the required 12mm (1/2") to align the shaft. I decided to raise the front mounts, placing metal spacers underneath, as access was better and this gained additional clearance under the engine. After a final alignment check, the cutlass bearing was fine tuned with the keel, caulked and bolted in place.

Attaching new stuffing box hose and clamps, adjusting the center shaft bearing to the shaft, and realigning the shaft to the engine coupling completed the shaft reinstallation.

The rudder was placed on the skeg bar. The new lower mounting would yield a taller rudder with slightly more surface area as a bonus. Luckily, the rudderstock had the required extra 10cm (4") of height needed. Filling the gap between the hull and rudder top was easily done with polyester resin putty. Otherwise, the job would require adding to the rudder bottom by welding a piece to the original shaft then extending the lower end.

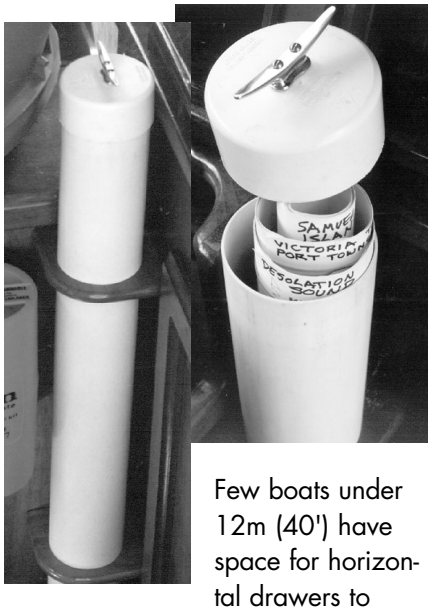
Molded fiberglass shim bolted to the bottom of the skeg lowers the aperture 10cm (4"). Note recess in bottom of shim for skeg bar. Original shaft hole filled and a new one drilled 5cm (2") below.

Top of rudder filled with 10cm (4") of polyester putty.

Performance results achieved were more than worth the time and effort. The boat gained almost a full knot, propeller tip noise and vibration all but ceased, and steering seemed to improve slightly as well. If I were building a new boat, you can bet I would stick to the recommended clearances.

— John Brooke, Centerville, Massachusetts

CHART STORAGE IN SMALL SPACES



Few boats under 12m (40') have space for horizontal drawers to stow navigation charts. If you're in this category, a vertical spot in an unused corner will do the job.

I used 10cm (4") PVC pipe, cut to length to comfortably fit my rolled up charts, and sealed with end caps, one glued to the bottom and the other doubling as a lid. If the PVC is dirty, lightly hand sand until pure white. This also removes the hard shine and gives them a classier look. Two teak corner brackets secure the tube in place, and the addition of a brass cleat makes a decorative handle for easy removal of the top cap. If the lid is too tight, just sand the inside edge until a comfortable fit results.

I roll the charts to different circumferences and secure them with elastics, so they nest inside of each other and are easily removed. A notation on the top edge identifies each chart.

— Bert Small, Salt Spring Island, British Columbia

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Upgrade

Spotlight on Lighting

Modern lighting systems for boat interiors and decks have advanced significantly in energy efficiency, illumination output and longevity.

Story and photos by Jan Mundy

As lighting accounts for a large portion of your boat's total electrical load, it pays to look carefully at the power requirements of existing fixtures. Incandescent fixtures, the standard light source on older boats, produce a natural, warm light that most closely mimics daylight, but these lamps also consume the most power. Should you decide to refit, you can reduce this load by installing fixtures with energy-efficient fluorescent and halogen bulbs, and LEDs.

Lighting efficiency is measured in lumens per watt, or a measurement of the light output versus the energy consumed. For example: a 40-watt incandescent bulb that produces 12 lumens per watt has the same light output as an 8-watt fluorescent bulb delivering 60 lumens per watt.

Fluorescent fixtures produce the most light for the lowest cost. A typical fluorescent tube produces two to four times as much light per watt as a standard incandescent bulb and can last up to 10 times as long. Newer designs light at temperatures as low as -15°C (5°F), don't flicker due to voltage variations, have longer bulb life and suppress EMI and RFI noise for zero-free interference. [For a complete discussion on electronics interference, see "Noise and Interference" on page 50.] Improvements in tube colors now shed a natural yellow, warm light, compared to the harsh, bluish-white light on older lamps. Though fluorescent lights cut power consumption, they do require a large surge to start them, so frequent switching on and off can diminish the advantages.

A new generation of cold cathode fluorescent (CCF) lights from TaylorBrite produce up to 80 lumens per watt, has a service life of

Cabins: ***(1) Adjustable spotlight with efficient reflector lamp reduces both glare and shadow, and lessens eyestrain. Light coming from several balanced sources makes the best reading light. (2) Lighting scheme in a new trawler provides the needed illumination and enhances the decorative design of the cabin. Accent lighting of equal wattage, in this case a table lamp, eliminates shadows to reduce eyestrain and adds secondary lighting to the corner. (3) Meta bulkhead light with rocker switch has a white translucent "shade" that projects a soft white glow. (4) Flood a wall or bulkhead with bright or dimmed light with this solid brass halogen clamshell fixture from ABI. (5) Classic brass combines with European design in the Cantalupi Astor, a dual halogen spotlight with shield that orients the light downwards.***

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-Tip-

Bulb Extender

A Cantalupi voltage stabilizer, available in 12 and 24 volt, installed inline 10cm (4") or longer from the light fixture with an incandescent light or halogen bulb, can eliminate voltage fluctuations and prevent frequent bulb burnout. When voltage exceeds the unit's operating peak, it trips an electronic circuit breaker. When voltage returns to the stabilizer's operating levels, the circuit is restored.

25,000 hours and are available in four colors: warm white for living areas; bright white for more illumination; daylight white for task areas; and red for night vision. Unlike hot cathode (the standard) fluorescent fixtures, CCF ones can be dimmed.

High brightness and low energy consumption make the halogen light the ideal light source. Halogens typically produce 10 to 15 lumens per watt and illumination is brilliant. On the downside, these high-intensity bulbs burn much too hot to be practical for reading lights and other task lighting applications. Lens temperature with a 10-watt bulb averages 100°C (212°F), and as hot as 160°C (320°F). Temperatures with a 5-watt bulb drop about 20°C (68°F). One exception and a better choice is Meta halogen bulbs that replace the standard G4 halogens, and claim to produce a cooler 32°C (90°F) operating temperature. Dome and recessed halogen lights should have a safety glass lens as standard.

For minimum energy consumption, light emitting diode lights (LEDs) introduced in the late '90s, make perfect courtesy lights for the cockpit, nav station, passageways, steps, storage areas and other areas needing low illumination. Light output of one LED "bulb" compares to a 10-watt incandescent bulb with very low power draw — a mere 10 milliamps per hour for each white LED, less for colored LEDs, or 1/10 the power consumption. About 18 LEDs roughly equate to one 10-watt halogen bulb. Battery drain is just 1 amp hour per 15 hours of use. LED Clusters from Davis Instruments consist of six LEDs in clear, amber or red for night vision, in a single penny size fixture. Providing more than 100,000 hours of continuous use, these lights last 100 times longer than an incandescent bulb. LEDs don't generate heat, making them ideal for cluster mounting over bunks or a chart table. Flexible, bendable and waterproof, low voltage LED string lights emit 3 to 12 lumens per watt. ITC Sof-Touch PVC LED light string provides a cool, diffused clear or red light. A 2-volt bulb spaced every 2.5cm (1") consumes 3.36 watts per foot.

Lightweight fiber optic lighting is seldom seen on boats, except maybe as continuous string lights.

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Upgrade

Planning the Lighting Layout

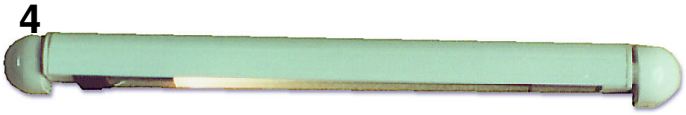
Before purchasing additional light fixtures, you should map out the lighting systems for the entire boat. Lighting refits start with an evaluation of usage, safety and energy conservation. First, draw a graph paper plan showing the configuration of the boat's interior. Include locations of existing lighting (if they are to remain), furniture, bulkheads, doors, etc. Assign a probable use to each area. Decide how much light is needed (brightness), what kind of light is needed (direct or indirect) and which type of light source is best. The lighting scheme should provide a combination of general, task and accent lighting, controlled to suit the activity and to reduce eyestrain. Determine circuit routing; decide which lights should operate together, and the location of dimmer switches. On trawlers and large cabin cruisers, you'll need multiset controls to set the lighting at any entranceway.

Downlighting provides ample general lighting for most salons and living areas. Use large dome lights with a 20-watt fluorescent or halogen bulb to light up a large table. Adding a few spotlights supplies concentrated beams for reading, work, playing games, etc., and adjustable ones let you direct the light where needed. Fixtures equipped with dimmers, or clear and red bulbs with a three-way switch, provide more flexibility. Uplights can highlight a corner niche or wash cabin sides with soft light to make the salon seem more spacious and open. Since an illuminated area varies with fixture height, a light, when mounted higher, illuminates a wider area.

Because head compartments are so small, function is more important than design. Natural light from a portlight for daytime use complemented by bright light from a fluorescent or halogen fixture is the best arrangement.

Low-level LEDs, low-voltage string lights and wall washers, equipped with either clear or red bulbs, provide ample general lighting for the safe use of companionways, passageways and stairs.

Moderate brightness coming from several light



Salon Lighting: ***(1) ICM's sleek, modern design Opal task light adjusts vertically to direct the light as needed. Frosted white glass lens reduces glare from the 10-watt halogen bulb. (2) Euro-designed Cantalupi Time solid brass reading light. (3) Recessed halogens flood the area with soft lighting. Frosted lenses diffuse the light to eliminate bright spots and hard shadows. You can easily change a well-lit salon into a softly lit area by adding a dimmer switch (not suitable for hot cathode fluorescent lamps). Task lighting as shown in #2 often required for reading at the dinette table, is missing from this layout. (4) ABI halogen light rail with frosted lens and white powder-coated aluminum housing that pivots 170° to direct light upward or downward. (5) A contemporary design from Meta housed in unbreakable plastic that never gets hot to the touch. (6) Wall washers consist of ITC Sof-Touch string lights mounted behind a baffle.***

-Tip- Easy Converts

If you want to replace your incandescent fixture with a halogen one, there's no need to purchase a new lamp. Instead, adapters are available with a double or single contact bayonet base, or screw base to convert existing lights to fit 5-, 10- or 20-watt halogen bulbs.

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Galley Lighting: ***(1) Danish made Cabin multi-directional spotlight with 10-watt halogen bulb provides task lighting in the galley. To prevent shadows, mount the light in front of the work area. (2) Concentrated beam from a recessed downlight supplies task lighting only directly above the sink. (3) A fixture mounted behind a baffle sheds ample light to a galley countertop. (4) Practical illumination in the galley includes overhead general lighting, adjustable spot and under-coaming dome lights for task lighting.***

sources makes the best work light at the nav station. Task lighting sheds direct light on the chart table, while downlight from fluorescent or halogen fixtures reduces glare and adds brightness. For nighttime use, consider installing a dome light with two halogen bulbs, a low-volt-

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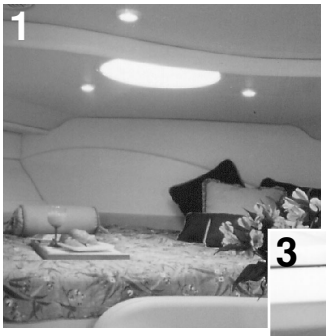
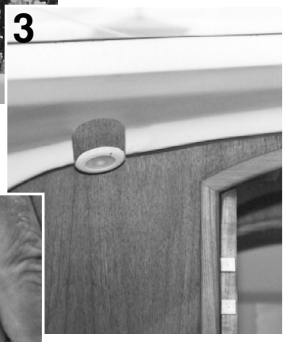
Upgrade





Installation Tips: ***(1) No head bangers: mount recessed overhead lights in the vee-berth and other areas with limited headroom. (2) Fully expandable, one modular master dimmer controls one or more push button controls. Remote units connect with one wire to the master when more controls are needed. (3) Where an overhead light is desired and you don't have the recess depth, typically 12mm (1/2"), mount the light in an attractive wooden trim ring or install a surface mounted downlight. (4) Bulb changes are easy — just unscrew the lens — with the Cantalupi Patty. Halogen reading light has a prismatic reflector for wide-angle illumination and frosted lens to diffuse the light (5) Cantalupi Disco halogen dome light with massive aluminum reflector. (6) On the Cantalupi Tebe (right) retaining clips hold onto headliner without screws. Needs 5cm (2") recess depth to allow for multi-directional swivel lamp. (left) Meta Turn and Tilt with low-heat Xelogen bulb, mounts flush with clips that snap onto the headliner (needs 19mm/3/4" gap) eliminating unsightly screws.***

age red one for chart work and a clear bulb for a bright working light, all operated on a three-way switch. A red hand-held Davis LED Cluster is ideal for nighttime chart reading.

Food preparation requires the brightest light. General light is needed to see into cabinets, lockers and drawers. To reduce eyestrain, numerous single, close-mounted lights can provide general overall lighting. Use under-cabinet florescent or halogen lights to bright illuminate work areas. Task lighting floods the sink and stovetop and pivoting types let you aim the light where needed most. Lights must be mounted to avoid blinding persons sitting at the dinette or in the salon. Fixtures mounted over the stove and sink with removable lenses allow easy cleaning. When connected to a dimmer switch, illumination (incandescent or halogen only) is set for food preparation or a late night snack. Another option is a dual purpose light, such as those offered by Alpenglow, that feature a dual power switch to select between a bright light or lower voltage soft glow.

-Tip- Waterproof your Wiring

When wiring water-resistant lights in the cockpit, bridgedeck or other exposed area, use heat-shrink tubing to seal the connection.

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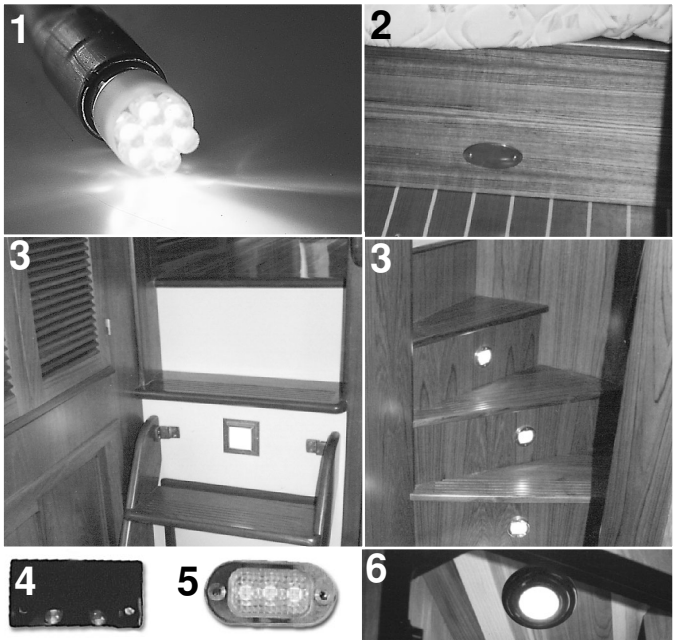

Courtesy Lighting: ***(1) Low-energy, long lasting sealed Davis LED Clusters are ideal where totally waterproof lighting is desired, such as a swim platform, coolers, livewells, docks, rod lockers, under steps and storage lockers. (2) Red footwell light below berth preserves night vision. (3) Downlighters provide direct lighting over stair treads. Polycarbonate diffusers protect the bulb and soften the light. (4) Aqua Signal LED Handy Light available with white, red or amber lamp, draws less than .1 amp. (5) Inexpensive, plastic utility light measuring just 4.4cm (1-2/4") wide has three amber LEDs (Sea Dog #401410). (6) Brightly light a closet with an ITC surface mount halogen with integral switch. (7) Shed some white or red light on your cockpit with a bimini-mounted light (Aqua Signal #16210) that mounts on 2.5cm (1") tubing.***

Doing intricate work in the engine room, or like spaces, requires a bright light. One or more fluorescent or halogen rail lights provide general illumination. A small adjustable spotlight is a great help for detail work.

Lighting the cockpit requires three levels of brightness: a general light that floods the entire cockpit; task lighting (preferably red or amber) to light up instrumentation and inside lockers; and downlights or string lights around footwells, bridge ladders, boarding areas and transom gates for safety. A waterproof light mounted on the radar arch or bimini frame makes an ideal general light. Low-level downlights must have a reflector pointing downwards or the top half shielded to direct the light output and eliminate glare. String lights are nice to have on toe rails or handrails, but they must never be illuminated when the boat is underway at night. They can and will make discerning navigation lights difficult for other boats in the area.

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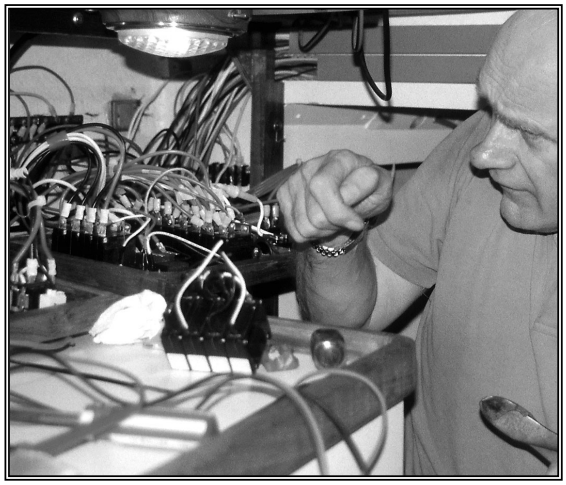
Electrical

ALL ABOUT ELECTRICAL PANELS

Modern electrical panels blend form with function so you can tailor your boat's electrical power distribution to your present and future requirements. Spend the time to choose the right panel and understand its configuration.



PAUL SHARD

By Kevin Jeffrey

Marine electrical panels are at the heart of a boat's electrical power distribution. They offer safety, convenience, control and monitoring in one convenient package. Electrical panels are principally used to distribute electricity from a primary power source — house battery banks for DC power; and shorepower, gen-set or inverter for AC power — to the various loads on board. Planning for and selecting the appropriate panels for your boat helps you organize and understand the distribution side of your electrical system. Even if your existing panels meet your present needs, studying their configuration can tell you a lot about your electrical power system.

Electrical panels serve a variety of functions. They provide convenient connection points for all wires leading to various electrical loads on board. This makes it easy to troubleshoot and service these circuits. They also provide switching and circuit protection for all branch load circuits, and often for main power supply circuits as well. Panels also serve to indicate circuit status, either through simple LEDs or more sophisticated analog or digital electrical meters.

Conventional panel with glass tube fuses comes with 60 interchangeable, self-adhesive nameplates.

Panel Types

Standard panels available from marine chandleries are flexible enough to satisfy simple installations. When you needed added features or design flexibility, or a set color-coordinated to your boat's interior, there are manufacturers who offer custom panels built to your specifications. Paneltronics, for example, offers 150 different panels designs in black, gray or white, or three faux wood finishes.

The two basic categories of electrical panels are main distribution panels and sub panels. Main panels contain the standard house load circuits. Many boats only require a main panel. Sub panels are used for special circuits, such as large DC loads, emergency paralleling of battery banks, AC loads supplied only by shorepower or a gen-set, or for special functions such as metering or primary switching (i.e. switching between battery banks or between shorepower and gen-set AC power). On larger craft sub panels are common.

There are subtle differences between a simple main panel and sub panel. They both likely have branch circuits. Since a main panel, in most installations, receives the main feed direct from the power source (AC or DC), it normally provides an overall disconnect of some type and circuit protection to protect the electrical power feed. Main panels may offer general monitoring of system voltage, load amperage, and for AC panels, reverse polarity of the AC feed. A sub panel receives power from the main panel and distributes it to special branch circuits, such as sub panels for heavy-duty DC loads. Or it controls the power feed before

FIGURE 1

A single electrical panel on a Cabo Rico sailing yacht combines DC and AC circuits, circuit breakers, analog DC and AC voltage and amperage monitors, three-position switching to monitor multiple battery banks, and LEDs. Note the AC source selection panel (bottom left) with circuit breakers for switching between the gen-set and inverter.

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it reaches the main panel, as is the case with AC source selector panels that provide switching between shorepower and another AC power source, such as gen-set or inverter.

Electrical panels designed for AC circuits are very similar to those designed for DC circuits. General layout and overall appearance are the same; the differences are in the panel components and the wiring. DC and AC circuits can be integrated into one large main electrical panel (**Figure 1**). If space is available for a larger panel, and you know what your DC and AC present and future needs will be, a single panel may be the best choice. For integrated DC and AC panels, marine electrical standards require that a physical, non-conductive barrier, be provided by the manufacturer between the DC wiring and the AC wiring to prevent accidental crossover of the two power sources, or contact with high voltage supply or connections. DC and AC circuits can also be handled by matching, yet separate, main electrical panels (**Figure 2**).

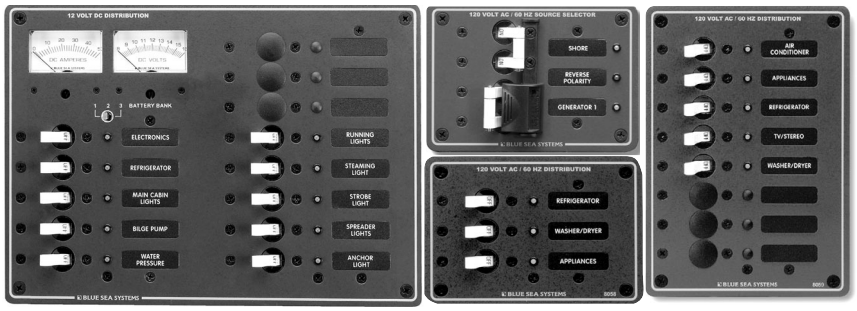
Components

Getting familiar with the individual components of an electrical panel will help you during installation and servicing.

Backlight switches for easy nighttime viewing.

FIGURE 2

Separate DC panel is practical where you have limited space.



Premium panels with standardize height and widths allow either vertical or horizontal arrangements to create one large panel assembly. Three-position switch allows volt and amp readings of multiple battery banks.

Faceplate: A faceplate made of aluminum or plastic provides a structural housing and allows the panel to be flush-mounted against a bulkhead. Faceplates have cutouts for various switches, circuit protection devices, indicator lights and monitors.

Busbars: On the backside of an electrical panel are a series of busbars, rigid copper (good) or tin-plated copper (better)) conductors. Busbars are simply common distribution points configured to easily allow for a number of individual electrical contacts. On a DC panel, there are typically three busbars, one for DC positive, one for DC negative, and one connected to the DC grounding system (**Figure 3**). The positive busbar is usually bolted directly to contacts on the backside of the circuit protection devices that are conveniently arranged in a straight line. Multiple positive busbars, used when there is more than one line of circuits on a panel, are joined by a heavy-duty jumper bar or cable. Negative and ground busbars fasten to the backside of the faceplate, held off the plate with non-conducting material. Screws inserted into tapped holes in the busbars provide a series of contact points for the individual load negative wires and load ground wires.

On an AC panel the layout is similar, except there is an AC hot busbar connected to the circuit protection devices, an AC neutral busbar, and an AC grounding busbar (**Figure 4**). Some AC circuit breakers are double pole, double toggle switches that break both the hot and neutral legs of the circuit simultaneously. This type of breaker offers a greater level of safety, and is recommended if no isolation transformer is installed in the system.

Circuit Protection: Modern electrical panels now use circuit breakers as the preferred circuit protection device. They are convenient to use, and provide switching and circuit protection in one single device. You'll still find electrical panels with the old glass tube fuses, and Vetus makes an 8-circuit DC panel that incorporates new high-tech electronic fuses (**Figure 5**). Vetus fuses

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have the same function as a circuit breaker, but operate in an electronic instead of an electro-magnetic manner. They also have a "slow blow" characteristic, which means that loads with high surge power (and therefore current) will operate without any problem. In the case of continuous overload or an extreme peak current (short circuit), the fuse automatically disconnects the switch. Remove the cause of the overload and, after a time lapse of about 20 seconds, the switch is set in the "on" position again, making the circuit operational again.

Switching: Circuit breakers have largely replaced standard fuses, though when fuses are used as the circuit protection device, separate disconnect switches are needed, typically simple on-off toggle switches rated for the maximum amount of current in the circuit. Circuit breakers satisfy the switching requirements for both main and branch circuit disconnects, and can even be used to control AC power source selection. But some auxiliary switching may also be included on the panel even when circuit breakers are present. On some panels a heavy-duty battery disconnect switch (On-Off or 1-2-Both-Off) is incorporated, although it's common for this to be mounted separately, usually as close to the battery bank as possible. Another common type of auxiliary switch found on DC electrical panels is a two, three or four position selector switch; this allows voltage monitoring of multiple banks of batteries with a single meter.

Status Indication: LEDs indicate when power is supplied to an individual circuit. When lit the user knows that power is available to the load. Some loads, such as run-

Combination AC/DC panel. More is better when purchasing new panels — spare circuits allow for future expansion as needed. (inset) Digital voltmeter provides an accurate precise reading with intense red LED numbers easily viewed from a distance.

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FIGURE 3

Typical DC Wiring Schematic

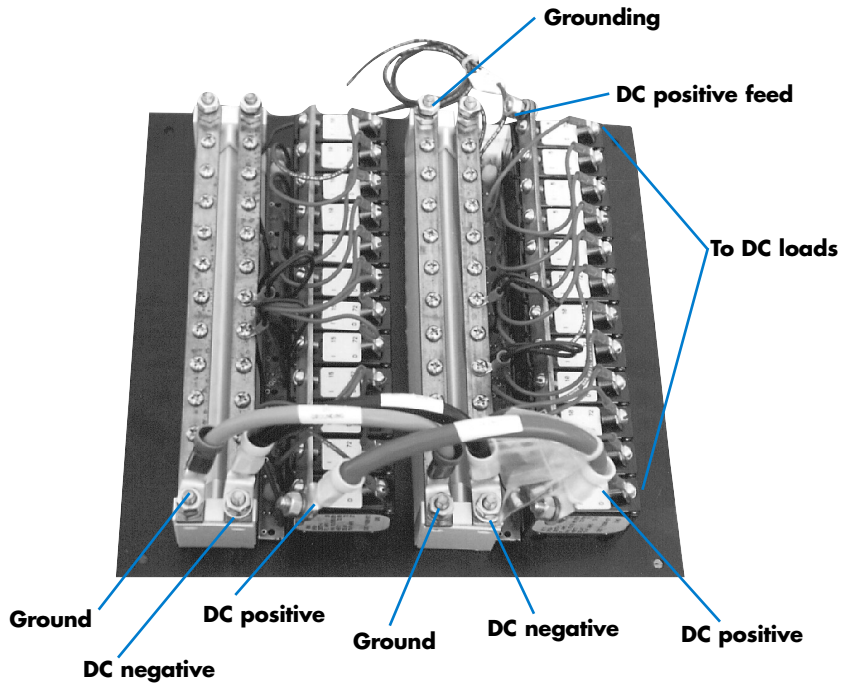
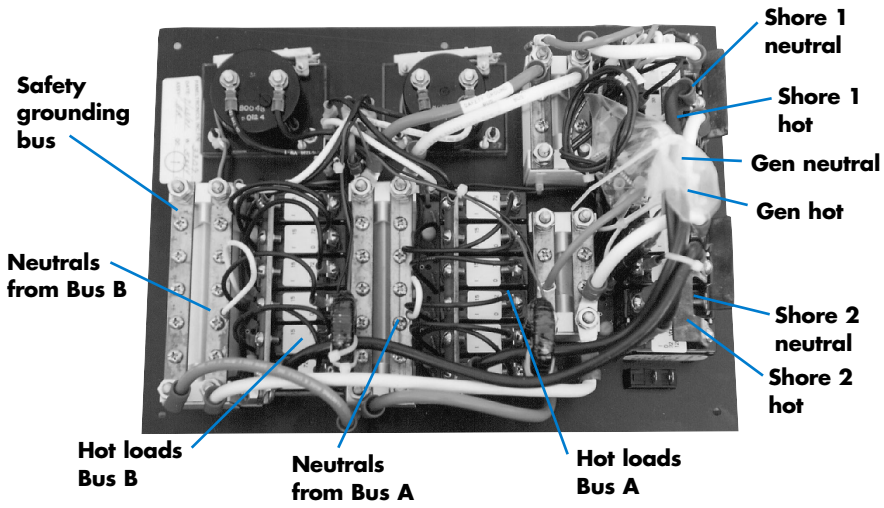


FIGURE 4

Typical AC Wiring Schematic



ning and anchor lights, have no other switching and are thus on and consuming power when turning on the breaker switch. AC main panels, or sub panels that include main circuit disconnects, typically have a reverse polarity indicator to indicate a problem with incoming shore-power.

Circuit Labeling: When purchasing a new panel, it is best to choose one that has replaceable circuit labels. Your electrical power system can change, so give yourself built in flexibility as to what type of circuits you have and where they are located. New panels are sold with an assortment of labels in either stick-on or screw-on format, and many chandleries sell replacement labels.

5 Steps to Panel Selection

Here's a step-by-step selection procedure to determine your electrical panel needs that works.

1 Decide how many individual circuits you require. Each distinct type of load, such as an anchor light, cabin lights, running lights, instruments, etc., should be on a separate circuit. The number of circuits relates to how you want to group loads and control them. For instance, on smaller boats all cabin lights are on a single circuit, whereas on larger boats they might be divided into multiple circuits, perhaps one each for fore and aft, or port and starboard lights. Be careful not to exceed the load carrying ability of the panel. When wiring, use conductors sized for a voltage drop not to exceed 3%. [Ed: Tables for determining conductor sizes based on length of run and voltage drop appear in "DC Wiring Handbook," DIY 1998-#4 issue.]

2 Determine what your DC and AC requirements are. If you have both power systems on board, consider what works best for you, either integrate DC and AC circuits into one panel or keeping them on separate panels. Space and panel availability are probably the determining factors. According to the American Boat and Yacht Council (ABYC), panels must be installed in a readily accessible location, shall be weatherproof or protected from the weather and splash. Select a DC panel that suits your sense of aesthetics and offers enough circuit flexibility for present and future

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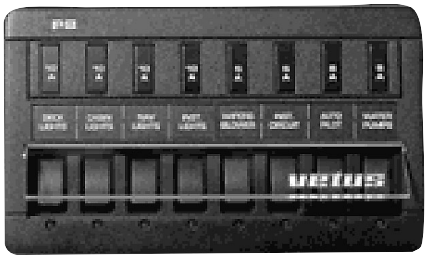
FIGURE 5



Vetus 8 circuit DC panel incorporates new "smart" electronic fuses and LED indicators. Compact design, postcard size and horizontal layout fits into dashboards and other confined areas.

needs. Then choose your AC panel, preferably one that matches or is integrated into your DC panel. If your AC power requirements are modest, a main circuit and a few branch circuits could be sufficient.

3 Select sub panels that compliment your main panel(s). On the AC side, you'll need a separate main breaker sub panel if the main AC panel is more than 3m (10') away from the shorepower inlet. An AC source selector sub panel is necessary if you have multiple sources of power (i.e. shorepower, gen-set and/or inverter) feeding the same AC distribution panel. Loads that you only want supplied by a designated AC power source such as shorepower can be put on an AC load sub panel; several AC loads that you definitely wouldn't want to be supplied by an inverter are a battery charger and water heater.

4 Decide if you want monitoring of DC or AC voltage and amperage on the panel(s). Most panel meters are analog (moving needle), which are fine for many applications, but they lack a high degree of accuracy. With analog meters, you need a separate meter for each function (voltage, load current, charging current, etc.) I prefer a single digital system monitor that displays volts, amps, amp-hours and percent of charge all in a single, accurate device. [Ed: For how to select and install a system monitor, refer to DIY 2001-#4 "Electrical" column.] If you do choose to include metering on your electrical panel, decide if you want to include this function on your main panel or make it a separate sub panel.

5 Choose panel options such as backlighting systems for easy viewing at night, or color coding collars that, at a glance, allow you to distinguish groupings of circuits, such as DC from AC.

About the author: Kevin Jeffrey works as an independent electrical power consultant and is the author of the "Independent Energy Guide" and publisher of "Sailor's Multihull Guide," now in its second edition.

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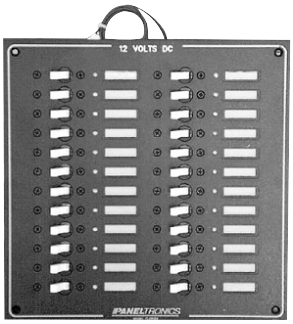
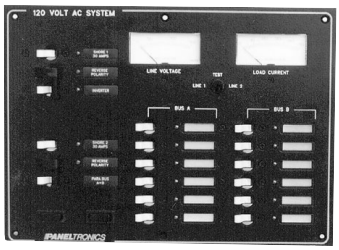
Classic Egg Born Again

The next step in renovating this vintage cruiser is to reconfigure and rebuild its antiquated power system.

By Dwight Powell

A seven-year refit of our wooden Chris-Craft 30-footer, which included adding a foredeck seat and cockpit hardtop, installing new windows, and building a custom swim platform, closed with its sale and subsequent purchase of another "golden girl," a 1968 Egg Harbor Double Cabin 37. [Ed: Some of Dwight's extensive renovations are documented in past articles of DIY.]



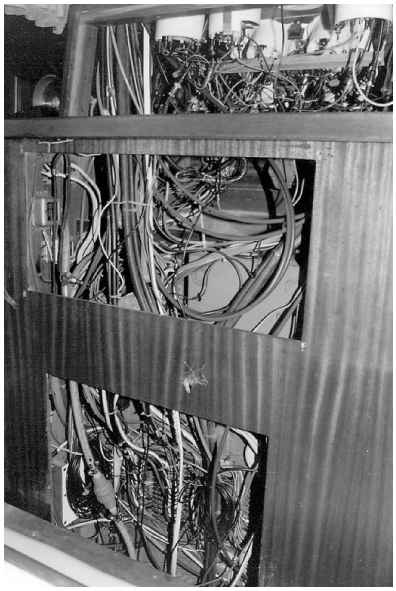


Custom panels built to author's specs await installation: DC panel has 24 breakers; AC features 12 breakers, volt and amp meters, one 30amp inverter main and two 30amp shore-power mains.

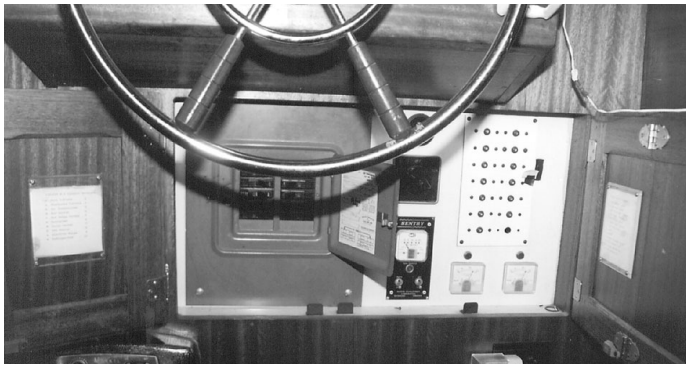
A poor man's "trawler," the "Egg" has a semi-displacement hull of carvel plank construction (the Chris had a lapstrake plywood hull) with a massive keel. This would be our last boat, as our intention is to refit it for our retirement. Since purchasing the boat last year, a local wooden boat repairer fixed several problems, and a mechanic rebuilt the twin Crusader inboards, both tasks best left to the experts. Now, I needed to put the DC and AC electrical power systems under the microscope.

The Egg's current systems work fine and have caused no problems in our short tenure. The 7.2kW Westerbeke genset energizes everything at once, with plenty of power to spare. But it is noisy, and sitting lazily at anchor in some secluded paradise, with a 3,600 rpm genset running is not my idea of happiness. While the boat was wired for DC and AC power, the panels had few circuits, and with add-ons over the years, tracing any wiring was impossible. Also, safer, marine hardy distribution panels have long since surpassed the safety technology of the existing household-type AC panel.

My refit plan starts with selling the genset and running all AC loads off a 2.5kW inverter. It's quiet, and can operate everything onboard but the most demanding loads. This strategy necessitates increasing battery bank capacity; adding at least one high-output engine alternator; replacing all suspect wiring and connections, especially that which is the effect of shady electrical work. I purchased two custom-made electrical panels from Paneltronics, based in Hialeah Gardens, Florida, and the installation required a new panel cutout. On the AC side, ground fault circuit interrupter (GFCI) protection must be provided at existing outlets. Because of the anomalies and myriad options in batteries and battery charging systems, as well as alternator and voltage regulator configurations, I decided to consult an expert, and I'm working with Dick Rogers of Arbrux (905/852-5417).



The author's ambitious refit plan involves replacing and coding the "spaghetti" behind the existing panel, and installing new AC and DC electrical panels.



1960s style AC panel (left), a descendant of the housing industry; antiquated DC panel (right). Circuits are identified on typed sheets mounted behind Plexiglas panels on the inside of the doors.

Scheduled to begin this winter with completion planned in time for spring launch, my plan is ambitious and challenging. Yet, given the proper tools and knowledge, it's a fully workable undertaking. [Ed: A full account of Dwight's electrical refit complete with a materials lists, review of costs and labor, will appear in DIY 2002-#3 issue.]

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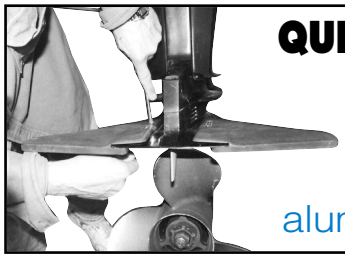
Powerboat Rigging



QUICK FIX

Here's a simple method to repair an outboard engine's anti-ventilation plate , or most any holes, cracks or dings in aluminum.

By Jan Mundy

Removing the hydrofoil on DIY's 6.7m (22') test boat to install Smart trim tabs (see "A Smarter Way to Better Handling," DIY 2001-#2 issue) left the anti-ventilation plate with four drilled holes. As the hydrofoil was no longer needed, we needed to fill the mounting holes.

Repairing the anti-ventilation plate was an easy 20-minute job using SeaRepair Aluminox, an epoxy-based putty with aluminum fillers. (QuikAluminium is a comparable product.) It's strong enough to fabricate, rebuild or repair most aluminum components, including engine parts, and it's a quick, permanent fix for sealing leaking rivets on an aluminum boat. It cures steel hard, is solvent-free so it doesn't shrink, yet is sandable and paintable, and ready for splashdown in one hour.

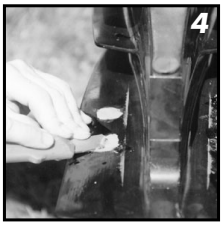
Before applying, clean to remove all dirt, grease and oil, and lightly sand the surface to ensure a good bond. To fill, repair or seal aluminum, follow these six easy steps.

Step 1: Cut off a small piece of the plastic-wrapped epoxy putty from the tube. A little goes a long way; half of this amount would have filled the four 6mm (1/4") holes.

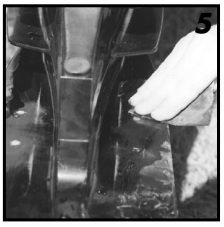
Step 2: Knead the putty until well mixed and a uniform gray color.

Step 3: Press the putty into the hole from the top and the underside, leaving a slight excess above the plate surface so it can be trimmed and sanded flush. Fill any dents in the plate as well.

Step 4: Wait a few minutes and slice off excess with a sharp utility knife dipped in water.



Step 5: Before it fully cures, about 5 to 7 minutes, wet sand with 320-grit paper. Check for imperfections, and reapply if needed.



Step 6: Repair completed. Just need to sand the plate, degrease with solvent, and apply a primer followed by several coats of black spray paint.

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Engines

MECHANIC IN A BOTTLE

Fuel additives can never replace proper engine maintenance, but they can boost your engine's performance. Here's a skeptic's look at what brews are available and when to use them.

By Robert Hess

A discussion of the pros and cons of fuel additives often results in a heated debate over whether they are reconstituted snake oil and a complete waste of money, useful and not-so-useful products that work well when used as intended, or magic chemicals that perform miracles.

Fuel additives are suspect mostly because advertising often obliquely implies a cheap quick fix for problems caused by abuse and/or poor maintenance. The promise of improved performance is another attraction. Who can resist a cure for the cost of a container of additive, versus the expensive alternative of repairing or modifying the engine? Advertising aimed at repair shop owners is also suspect. Many ads emphasize the profit such products generate compared to the relatively miniscule profits realized from the sale of fuel, instead of discussing the actual benefits to be gained from the use of these products.

Adding these potions, some consisting only of alcohol, light oil or solvents, is really misplaced faith in modern science. In addition, some formulas are potentially damaging to the environment, since additives are burned with the fuel and exhaust into the water. (For a listing of additive blends, see "What's in a Name" on page 36.) Mechanics may scoff at the notion of a "mechanic in a bottle" that can repair worn parts or clean fuel system components, but often suggest using some additives to help reduce any harmful effects.

Degraded Fuel

The fuel refinery adds all the additives that modern fuels need to function properly in an "ideal" environment. Specific additives are legislated by government to keep machinery performing, but at minimum emission levels. Diesel contains N-hexyl and octyl nitrate, paraffin and other hydrocarbon molecules. Gasoline contains anti-knock agents, scavengers, phosphorus additives, antioxidants, metal deactivators, surface-active agents, deposit control additives, deicing agents, dyes, and octane boosters, plus 43 other additives. Such fuels perform well in automotive engines, but can spell trouble for marine engines.

Water in fuel is the most common cause of mysterious engine problems. Water blocks jets in carburetors and injectors in fuel injection systems, and it corrodes fuel system components such as carburetors, injectors, fuel pumps, filter housings, and fuel lines, causing intermittent engine fuel starvation problems that lead to stalling, high fuel consumption and hard-starting, and fuel lines blocked with ice in cold weather.

Low octane levels affect engine fuel economy and performance. For many marine engines (check with the engine manufacturer before using), adding an octane booster to aged fuel makes good sense.

Water Causes and Cures

Water enters a boat's fuel tanks from condensate that forms in the tank. Rain and seawater can enter the tank via a leaky fuel tank filler cap seal. Gasoline from the fuel dock can be contaminated with water. Since water is heavier than fuel, it will gradually separate and settle on the tank bottom.

When a boat is at rest, or underway in a calm sea, the water, sediment, dirt, bacteria and fungi in the tank separates and settles undisturbed in the tank bottom. Any "soup" that rises to the level of the fuel pickup tube is gradually sucked into the fuel line and stopped by the fuel-water separator filter. When the boat encounters rough seas, the increased movement agitates the fuel, lifting the water and other contaminants from the tank bottom where it's quickly sucked up into the fuel pickup. It doesn't take long for the fuel-water separator filter to become plugged, and the engine fails.

To minimize water in your fuel, keep the tank filled to reduce condensation, replace leaking filler cap seals, and buy your fuel from a reliable source. Install a quality fuel-water separating filter between the tank and the engine, with a petcock

Continued on page 32

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Premier Protection, a unique package designed for boats over $100,000, gives big boats over $700 worth of policy extras for an additional premium of only $75. All BoatU.S. yacht policies include low cost, agreed value coverage and claims service from boating experts, but the Premier Protection package includes these valuable extras:

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Diesel Fuel Polishing

Filters and centrifuges remove particles and water in fuel. Biocides are chemicals added to control microbes (bugs). Provided fuel-water separating filters are changed frequently, and additives can overpower the microbial activity, your engine should run problem free. Sludge (organic debris) accumulating in the tank, dark-colored or foul-smelling fuel, clogged filters, carbon build-up, excessive smoke and loss of power may indicate bad fuel.

In every fuel tank there is always oxygen, and therefore always moisture. Fuel absorbs this moisture, resulting in microbial contamination. Comprised of bacteria, enzymes, fungus, yeast and molds, these micro "bugs" only grow in the presence of water. As they mature, they join together to form clusters of what we call algae. Eventually, this algae collects to form sludge in the tank. If the sludge-fuel ratio compares to putting a few teaspoons of sugar in a cup of coffee, a biocide will likely dissolve it. But when the sludge exceeds saturation levels, it makes sense to pump out the fuel.

There are several methods that claim to remove contaminates by "polishing" the fuel, using a filtration-recirculation system, such as RCI, or magnetic fluid treatment, such as Algae-X. Boatbuilders and service yards that have had satisfying results install such units as standard equipment. Most devices are easily retrofitted by the do-it-yourselfer.

Algae-X installs on the intake line, between the fuel tank and fuel-water separating filter. A passive device, it operates on induction: moving a charged particle (microbes) through a magnetic field to affect the electron behavior of that particle and break up the solids so they pass through the fuel system without clogging filters or affecting engine performance.

There is a lot about fuel that engine experts don't know, even fuel experts don't know. If you're considering a fuel-polishing device, ask the manufacturer for specifications and testimonials. Discuss its application with the engine manufacturer, then the boatbuilder. Get opinions from qualified mechanics, service yards, other boaters, even petroleum companies.

While additives provide relief, filtering diesel fuel is your most effective method to eliminate contaminates before they reach the engine. An inline fuel-water separator, frequent filter changes, and fuel-polishing devices all work towards cleaner fuel.

— Jan Mundy

Put Lead in Your Tank

Unfortunately, the quality of gasoline and diesel fuel in recent years has generally declined. These changes, caused by refining of lower grades of crude oil and EPA mandates, have led to an increase in fuel-related problems in marine engines. Many of these fuel problems can be reduced or eliminated with the use of fuel additives.

Marine engines are especially susceptible to premature wear because of the heavy loads and high rpm under which they operate. Once valve seats begin to wear, engine failure can quickly occur. Newer gasoline engines were built with "hardened" valve seats that are more likely to resist wear under normal conditions. Older gasoline engines that still have "soft" valve seats must use a lead substitute, such as ValvTect Protective Lead Substitute, to protect valve seats from premature wear. In addition, any 4-cycle gasoline engine with the newer hardened valve seats that run at high rpm and/or under heavy loads can also experience premature valve seat wear, and benefit from the use of a protective lead substitute additive.

— Michael J. Giannini, ValvTect Petroleum Products

(Continued from page 32)

on the bottom so it can easily be drained regularly. This device halts water at the filter before it reaches the engine. Any water that rests below the fuel line pickup (the pickup is located slightly above the bottom of the tank) may cause tank corrosion that can eventually lead to a corroded tank and a fuel leak. [Ed: Details on repairing and replacing a leaking fuel tank appears in DIY 2000-#1 issue.] In the case of diesel fuel, water in the tank may also allow growth of bacteria and fungi that can foul fuel-water separating filters and injectors.

Treat small amounts of water in a gasoline tank with "dry gas," or gas-line antifreeze that absorbs water so both are burnt with the fuel without causing engine failure. Use a diesel fuel conditioner and treat diesel fuel with a diesel biocide to stop the growth of bacteria and fungi.

About the author: Robert Hess operates Atomic Four Engine Service in Vancouver, and specializes in rebuilding Universal gas & diesel marine engines.

-Tip- Recipe for Smooth Running

Two additives added to the fuel tank on a DIY test boat have its outboards running better this season and starting every time on the first crank. To eliminate water formed by condensation, we add a maintenance dose of methyl hydrate or methyl alcohol (Gasline Antifreeze) every month. At the beginning of the season and with every refueling, we add the recommended dosage (per the label) of octane booster, such as Valvtect Octane Performance Improver. Note: Some manufacturers advise not to add an octane booster to gasoline because it can cause plug deposits and misfiring. Best to check with the engine manufacturer before using. — Jan Mundy

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Fuel Testing

By Robert Hess

One way to consider the pros and cons of different brands of fuel additives designed to remove water from fuel tanks is to actually test them by mixing them with fuel and water in a clear glass container meant to simulate the fuel tank. I decided to conduct some water removal tests on gasoline mixed with measured concentrations of methyl hydrate alcohol, and diesel with fuel stabilizer added. All samples were well stirred then let settle for 5 minutes.

I always assumed that additives emulsified with the fuel and water, and together were gradually burned by the engine. My test results were very surprising. The gasoline and diesel fuel additives mixed with water, but mixed with the fuel for only a short time, then returned to a separate state on the bottom of the fuel. The diesel fuel conditioner reacted exactly like the gasoline antifreeze. If this additive-water mixture indeed doesn't stay mixed with the fuel, and its volume accumulates to where it rises above the fuel line pickup, the engine is sucking only water and additive, and may not run. This also emphasizes the need to have a good fuel filtering system.

[Ed: Engine winterizing procedures specify adding the fuel stabilizer to the tank then going for a boat ride, obviously to mix up the "soup." Difficulties arise when starting the engine for the first time after storage or after a long absence. For the DIY test boats, in the spring after storage, we first start the engines from a jerry can of fuel mixed with the recommended additives. Similar additives are added to the inboard tanks, and the engine is run on the "soup" to blend the fuel before switching to the these tanks.]

Gasoline

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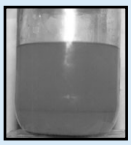
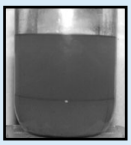
3 

4 

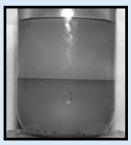
5 

Photo	Mixture	Results
1	2 cups gasoline	Clear
2	2 cups gasoline + 1 cup water	Water separated to bottom of container
3	2 cups gasoline + 1 cup water + 1/2 cup methyl hydrate alcohol	Alcohol joined with water and increased volume of liquid in bottom section of container. Milky looking top section and very milky bottom section
4	2 cups gasoline + 1 cup water + 1 cup methyl hydrate alcohol	Milky top section and milky bottom section.
5	Stirred above mixture again	Clear top, semi-clear bottom

Diesel

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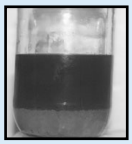
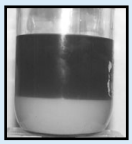
2 

3 

4 

Photo	Mixture	Results
1	2 cups diesel	Clear
2	2 cups diesel + 1 cup water	Water separated to bottom of container.
3	2 cups diesel + 1 cup water + 1/2 cup diesel fuel conditioner	Diesel fuel conditioner joined with water and increased volume of liquid in bottom section of container. Semi-clear top section and very milky bottom section.
4	2 cups diesel + 1 cup water + 1 cup diesel fuel conditioner	Semi-clear top section and milky bottom section.
	Stirred above mixture again	No change

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Octane Physics

Q: Is marina gas of a higher octane than road standard 87?

A: For the most part, the fuel that has been determined for automobile use is the same stuff that is shipped to marine facilities. Common grades available are regular, with a minimum octane rating of 87 when delivered, and premium fuel with a minimum octane rating of 91. Premium contains a higher percentage of alcohol so it burns more slowly, but it's not necessarily better quality. Most marine engines operate satisfactory using unleaded gasoline having a posted minimum pump octane rating of 87 (90 RON minimum outside USA and Canada). Since octane readings are "when delivered," after 2 weeks or so in your boat's tank, the fuel starts to degrade. Hence, the only advantage of burning premium fuel in marine engines is to ensure that a month after purchasing it's at least 87 octane. When octane levels drop below 87, you'll surely detect poor fuel economy and performance as the engine requires more throttle to achieve the same speed. It's best to buy fuel at a heavily trafficked facility, but even then there's no guarantee you won't pump some water and cause related engine problems.

— Jan Mundy

Most fuel additives can be assigned to one of 10 categories:

1 Gasoline and diesel microbiocide-bioguards control and/or stop the growth of bacteria and fungi in diesel fuel and gasoline. Recommended in small quantities as required.

2 Diesel cetane booster claims to raise the cetane (power) rating of diesel fuel to improve engine performance. If your engine is experiencing rough cold starts, this could be due to a low cetane fuel (minimum is 45 cetane rating). Recommended only on the advice of the engine manufacturer.

3 Diesel fuel modifiers, cleaners, conditioners and treatments profess to clean diesel fuel system components and extend fuel storage life. They mix with water in the fuel, allowing it to be gradually burned with the fuel, and protect against internal fuel system corrosion. Recommended only on the advice of the engine manufacturer.

4 Gasoline stabilizer extends the storage life of gasoline. Recommended when storing gasoline in a full tank for periods over 6 months.

5 Gasoline octane improver alleges to increase the octane rating of gasoline so as to reduce or eliminate detonation and pre-ignition. Recommended only when you cannot buy the correct grade of gasoline.

6 Gasoline lead additives claim to raise the octane rating of gasoline to prevent detonation and pre-ignition, and to protect against valve seat damage in older engines that were originally designed to run on leaded gasoline. Recommended only for use with large high-output older engines without valve seat inserts. Mercury Marine recommends using a lead substitute on all its pre-87 engines and post '87 V-6 engines to extend life of valve train. (Check requirements in owner's manual.)

7 Gasoline fuel conditioner and antifreeze claim to help "clean" the fuel system, protect against corrosion, stabilize stored gasoline, and absorb water in gasoline so it cannot freeze and block fuel lines. Not recommended.

8 Gasoline upper cylinder lubricant is a formula of a small amount of motor oil (1 spoonful per 20L/5gal) mixed with the gasoline fuel that is supposed to lubricate the valves and valve guides. No longer recommended because it causes exhaust smoke and oily emissions that end up in the water.

9 Gasoline fuel injector/carburetor cleaner claims to clean internal gasoline fuel system and injector components. Not recommended. Better to remove the carburetor or fuel injectors and rebuild or replace them.

10 Gasoline gas line antifreeze (methyl hydrate alcohol, etc.) is designed to mix with water in the fuel tank and be burned by the engine. Gasoline sold in the winter usually has an increased amount of antifreeze added at the refinery. Recommended before and after winter storage. Also, add during the boating season, as needed, depending on gas quality.

— Robert Hess

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Rigging Sailboat

REPAIRING A SLOPPY RUDDER

Does moving your boat's rudder require extra force, or turning it causes a grinding sound? A lack of lubrication is a common cause for worn rudder tubes on sailboats. Use these step-by-step instructions to repair the rudder tube using the epoxy resin fill method.

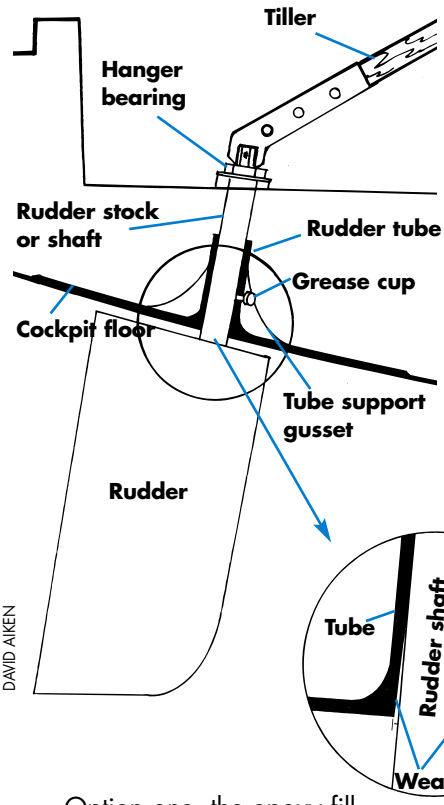
By Nick Bailey

Many fiberglass production boats with inboard spade rudders use a close-tolerance fiberglass rudder tube that also serves as the lower rudder bearing. Usually the tube is lubricated by grease introduced through a reservoir cup or nipple in the side of the tube. This design works well unless periodic lubrication is neglected, resulting in the worn rudder tube.

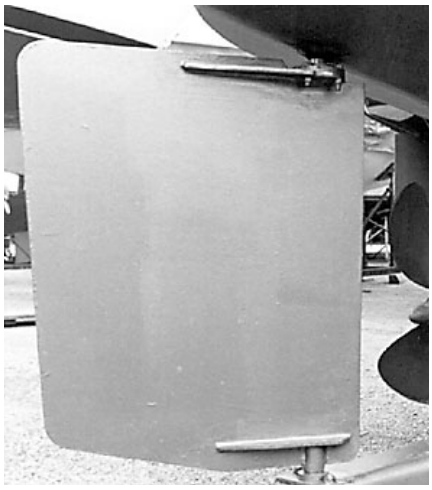
Is this a big problem? A rudder tube can tolerate a lot of wear, but even a small amount of wear in the rudder tube can result in a lot of play at the rudder tip. When excessive play results in annoying noises or problems at the top and hangar bearing, or even just increased steering difficulty, repairs are due. If the rudder tube is so badly worn that you have sprung a leak, repairs are way overdue.

Repair Options

This is not a particularly serviceable part of your boat. Unlike other designs where you simply have to remove and replace a bearing sleeve or bushing, here you have three repair options. Rebuild the worn surface of the tube to the original design dimensions with epoxy resin mixed with graphite filler using the rudder shaft as a mold; or you can change the design, and ream out the tube and retrofit a bearing sleeve; or cut away and grind the existing tube to install a new one.



Option one, the epoxy fill method, is the easiest to carry out, is surprisingly durable, and in my opinion the only viable choice. It's very difficult to get a new sleeve aligned correctly and stiff steering results. This installation may weaken the boat's structure if there is not enough wall thickness in the tube to accommodate a ultra-high molecular weight (UHMW) polyethylene sleeve. Other plastic sleeve materials are available but beware of nylon and Delrin as they absorb water, swell and seize the steering. Replacing a tube may be necessary if it's badly worn. This is a big, dirty



job, requiring demanding glasswork in the cramped confines of a lazarette, and involves major alignment difficulties.

Dropping the Rudder

Removing the rudder is a simple job, but you may have to dig a hole under the rudder or have the boat reblocked to allow clearance below for the rudder shaft to drop out.

Support the rudder with blocking or a tight sling so that the fasteners at the hangar bearing are no longer under load. Besides, you don't want the rudder suddenly falling to the ground when you remove the hangar bearing. Unbolt the tiller head and remove the hangar bearing connected at the top of the rudder. This is the bearing that carries the weight of the rudder. If the boat has wheel steering, loosen the steering cables, and loosen or remove the quadrant from the rudder shaft. The quadrant will usually be a two-piece affair clamped to the rudder shaft but also locked in place on the shaft with grub screws and a key way. Some quadrants may be fastened with a

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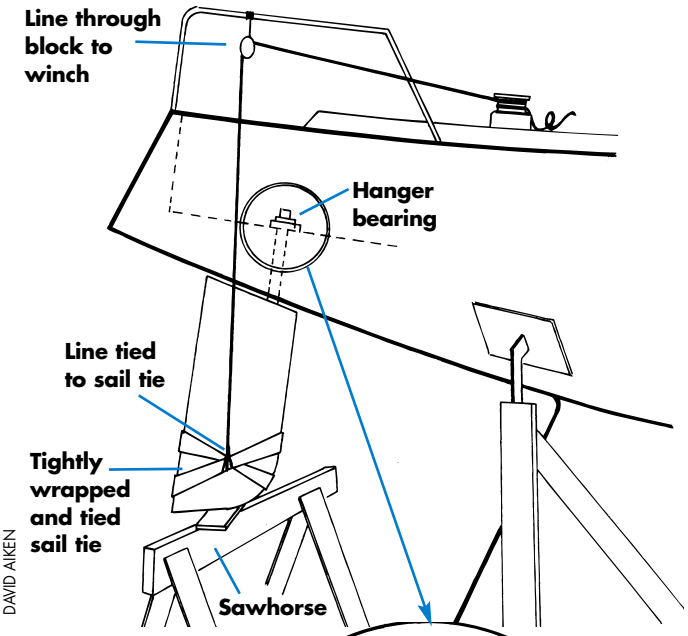
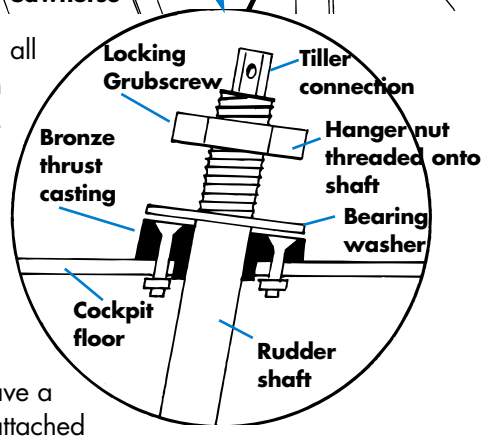


DAVID AIKEN



thru-bolt passing all the way through the rudder shaft. If your boat has hydraulic steering, a push-pull cable system or a direct mechanical steering linkage, you will have a short tiller arm attached to the rudder shaft. Its connection method is similar to the quadrant, but it may be a simple piece, clamp fit. In that

-Tip- Versatile Gear Lube Pump

JAN MUNDY

An elegant, though a bit more expensive approach to applying an epoxy grout is to use a gear lube pump. This hand pump (Mercury Quicksilver part 91-802891q 1 for 1 litre bottles,for 2.5 gal bottles part 91-850730q 1) simplifies oil changes in outboards and stern drives. A threaded 3/8"-13 UNC male nozzle connects to the gearcase fill fitting in the outdrive. To use, tap a matching thread in the lower opening in the rudder tube. Then fill a plastic bottle full of mixed epoxy, screw on the pump fitting, attach the threaded nozzle to the fitting on the rudder, and pump until epoxy exits the upper (vent) opening. Don't count on salvaging the pump, as it's plastic and likely won't survive a solvent cleaning.

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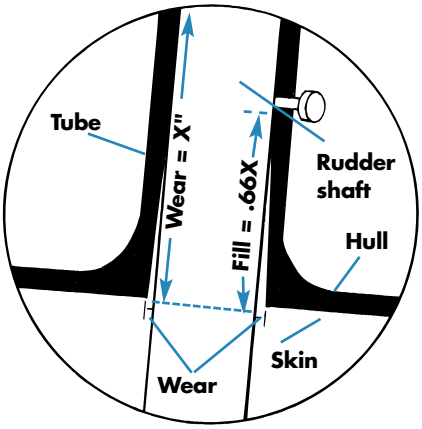
case, it should be loosened and allowed to slip off the top of the rudder shaft when the rudder is dropped. Don't lose the grub screws or key in the bilge!

If the rudder tube is low enough to require a stuffing box or seal on the top end, this should also be loosened. Once everything is released, support the rudder by hand, remove the sling or blocking and slide it out. You may need help as some rudders are very heavy, won't come out without a lot of wiggling and turning. Once out, put the rudder on sawhorses and carefully clean and degrease the shaft. Inspect the rudder molding and the metal stock carefully for wear, cracks, and shaft straightness. Cracks in the molding or around the stock may indicate a water soaked laminate. Bends, corrosion or cracks in the rudder shaft indicate the need to replace it. Going to all this effort to remove the rudder would be shortsighted if the rudder you put back is not in first class condition. The worn portion of the tube will be seen in the lower few inches.

Prep the Rudder Tube

Assuming the rudder tube is rebuildable, you need to prep the repair area so that the epoxy will adhere properly. The repair area must be free of grease, paint or any other contaminates. Remove grease fittings from the tube and, using a heavy-duty bilge cleaner detergent and a large bottle brush, clean and degrease the inside of the tube. Rinse it thoroughly with clean freshwater and let it dry. Since epoxy sticks best to a rough surface, abrade the worn area at the tube bottom with 80-grit sandpaper. Wipe clean with solvent (acetone or laquer thinner).



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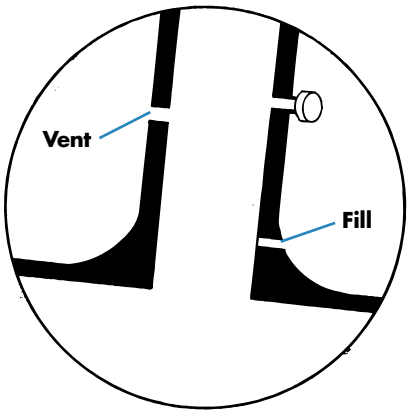

Measure the length of the worn area of the tube. Ideally, the epoxy fill should stop short of the top of the worn area to avoid the risk of overfilling the tube and possibly causing

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-Tip-

Planned Rudder Maintenance

At least once a season or when the steering begins to feel stiff, remove the rudder tube grease cup and apply any waterproof grease (i.e. Mercury Multipurpose Marine Lubricant with Teflon 2-4-C). As most boats have restricted lazarette access, a more effective method is to replace the grease cap with a grease gun nipple, and attach a grease gun.

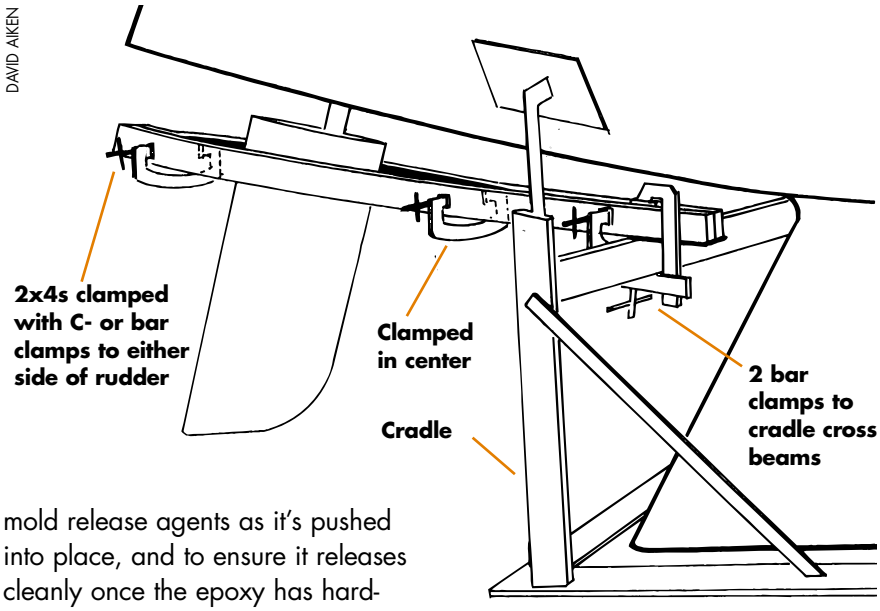
excessive friction. Once you have determined how much of the tube length you intend to repair, you need to drill at least two holes in the rudder tube. One to provide an injection "fill" point near the lower end of the tube, and the other to provide an overflow "vent" for any excess epoxy at the top of your chosen repair area. Holes should ideally be on opposite sides of the tube to ensure 360° epoxy coverage. If the hole for the existing grease fitting is located in a suitable spot, it can also serve as either a fill or vent. Drilled holes are patched or plugged later, or tapped to fit a grease nipple for future lubrication.

It's worth the effort to tap threads into the lower hole (if not using a grease fitting) and install a small hose-barb fitting with a clear 1/4" ID hose attached, or even a gear lube pump (see "Tip" on page 39). Injecting the epoxy this way is simpler than trying to keep a large syringe or caulking cartridge jammed into the hole while hanging upside down in the lazarette.

Readying the Mold

Before it can be reinstalled for use as a mold, the rudder shaft must be prepared to prevent contamination of the work area with grease or

DAVID AIKEN



mold release agents as it's pushed into place, and to ensure it releases cleanly once the epoxy has hardened.

Clean and degrease the upper part of the rudder shaft. Since the lower part of the shaft adjacent to the repair acts as a mold, you need to coat it with a mold release, something epoxy won't stick to. One method is to wrap the shaft very precisely with one layer of waxed paper and secure the seam with tape. Be careful not to damage the paper when pushing the shaft into place. Make sure the seam is leak proof and epoxy doesn't get onto unprotected parts of the shaft. As an alternative, paint PVA (polyvinyl alcohol available at fiberglass supply stores) on the shaft. This green liquid is water-soluble and dries as a thin plastic film. Don't scratch it. Paraffin is another mold release agent. Applied to the shaft, the fit will be a bit tight. This stuff makes me nervous because epoxy has high adhesive strength and may stick to the shaft anyway. With the shaft now prepped, carefully lift the rudder into place. Secure the hanger bearing so alignment is normal. Don't bother reinstalling any steering gear. It would be wise to clamp the rudder so that it can't accidentally rotate during the cure.

After aligning and securing the rudder, you need to dam or seal the gap between the tube and the shaft so the epoxy doesn't run out. The easiest way to do this is with a thick bead of plasticene jammed tightly around the bottom of the tube. Now you are ready to mix and apply the epoxy.

Repacking the Tube

Mix the epoxy resin and hardener (use the slowest hardener temperatures will allow) according to the manufacturer's instructions, stir for one minute, then add enough graphite powder to thicken the resin slightly to a ketchup consistency. Tailor the viscosity to remain thin enough to flow (or pump), but also carry the maximum amount of graphite, which provides a low friction surface to the epoxy. Working quickly, load the mix into the syringe or refillable caulking tube (or a bottle screwed onto the gear lube pump).

Working inside the lazarette, inject or pump the epoxy mix into the hole at the bottom of the tube. Have an assistant keep watch for leaks outside at the seal. Keep pumping until the epoxy comes out the upper overflow hole. Remove the nozzle of whatever epoxy delivery tool you are using, and quickly install a plug or threaded fastener in the lower hole before too much epoxy leaks out. Clean up and leave the whole assembly in place until the epoxy cures.

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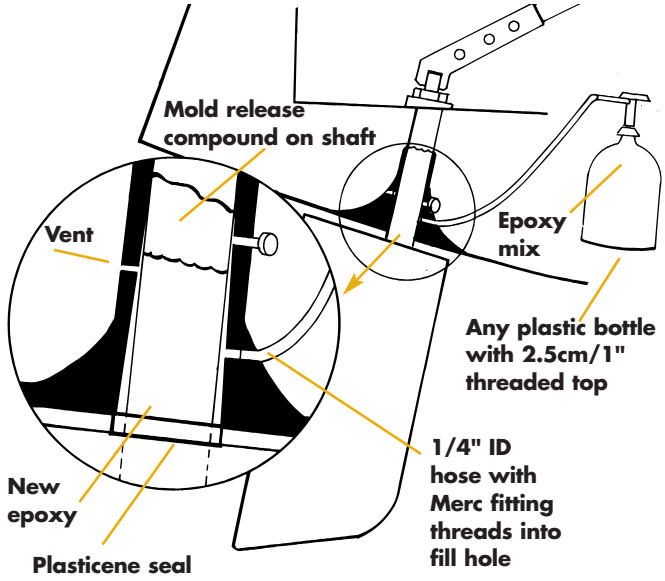

Fine Tuning

When fully cured, remove the plasticene at the tube base, and break the rudder loose with a sharp yank on the back of the blade. With luck, it will drop out easily. Use sandpaper or a sharp chisel to remove any excess epoxy at the bottom of the tube. Remove the mold-release paper or PVA. Clean and reinstall any grease fittings. Lubricate the rudder shaft, install the rudder, and test the amount of resistance as the rudder is moved. If the action is too stiff, lightly sand the filled areas till it feels just right. Once you're satisfied, reinstall the steering gear, launch the boat, and go sailing.

About the author: Nick Bailey is a 25-year veteran of the boat repair business. He is currently service manager of Bristol Marine in Port Credit, Ontario.

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Maintenance HAULOUT TIME

HAULING, LAUNCHING, BLOCKING, CRADLING

Everything you ever wanted to know about boat haulout, blocking and storage, and how to select a competent boatyard…but didn't ask.

By Patricia Kearns

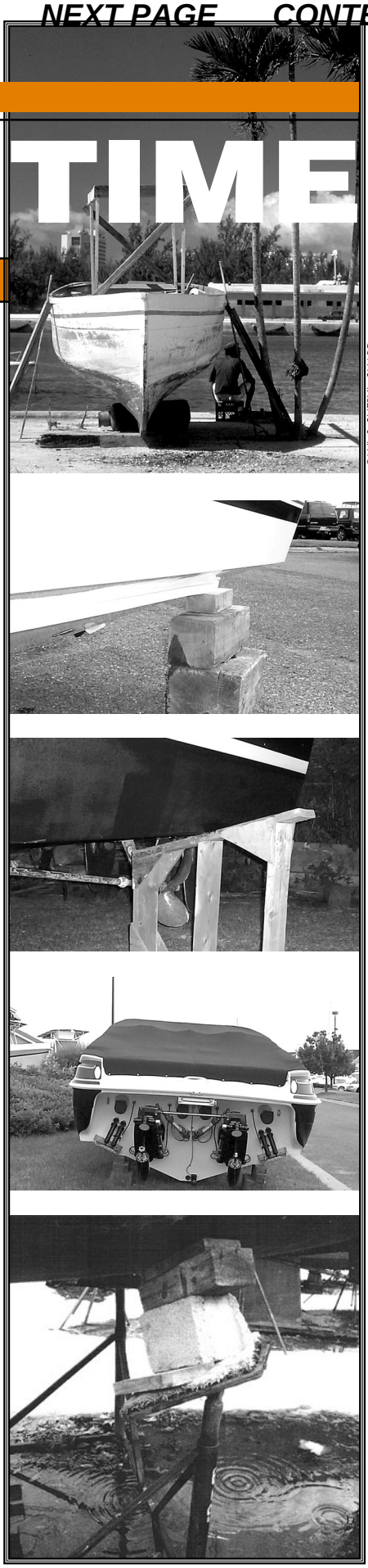
Essential to the process of handling any below-waterline maintenance is getting your boat out of the water. Every year, boat owners and insurance companies learn that wind, ice, floods, mud or other natural disasters, have conspired with inadequate boat lifting, handling or blocking practices to take boats from their lofty positions in boat lifting equipment slings or forks, or from a dryland berth, to the ground, damaging the boat, neighboring boats, and often shattering cruising plans and vacations. There is little the yard owner or anyone else can say that comforts boat owners involved in this scenario. No matter what the yard did right, or wrong, it will have to defend itself on its boat lifting, handling and blocking practices. Knowing what should be done, and the right way to do it, helps to safeguard your boat from any unforeseen incidents.

There are no laws that govern the haulout of a boat by a marina or boatyard. When you take your car to a shop or have your house remodeled, you have some expectations that the mechanic or contractor knows what to do, and is probably certified by some authority. Not so in the boatyard business. With the exceptions of OSHA safety requirements and fire codes, there is little done in a yard that is restricted by mandates of law or regulation. There are some documented guidelines, but they are just that — guidelines. They include equipment manufacturer's manuals and recommendations, and the controversial TY-28, "Boat Lifting and Storage," a little known technical report developed by American Boat and Yacht Council (ABYC).

Boat lifting and storage is rooted in successful and accepted boatyard practices that may vary regionally, and depend on the types of lifting and blocking equipment. "We've always done it that way" is the standard in many yards. That means that you must determine whether the yard you want to use is competent to meet your expectations for a safe haulout and secure blocking of your boat. Can you trust the yard's experience? Does experience always equal expertise? How do you tell the smart yards from the lesser ones?

PAT KEARNS

Sailboat jackstands raise this powerboat high and dry. Since stands are not designed to support a boat's weight, they may collapse, that's if strong winds haven't already launched the boat.



PAUL & SHERYL SHARD

PAT KEARNS

Creative blocking like these are an accident waiting to happen.

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Maintenance

Having a little know-how and yard smarts will help to avoid the potential for a disappointing experience.

It's not a nice, neat black hat, white hat thing. Sometimes it's a "You get what you pay for," and when the price is "Too good to be true," you have to ask why. Being informed will help you rest easy when your boat is out of its element.

One Step Lift, Move, Stack

There are many ways to haul out a boat and move it ashore. Popular equipment in use today includes the straddlelift, forklift truck, hydraulic lift trailers, land-based cranes, and other interesting hybrids including slinged lifts hitched to pickup trucks. (Marine railways, once state-of-the-art devices, are rarely used nowadays.) Straddlelifts and forklifts are the most commonly utilized boat lifting equipment in boatyard service today (other than over-the-road trailers used at launching ramps).

Straddlelift is a generic term for equipment commonly referred to as a Travelift, which is a brand name. Some newer designs can rotate all wheels 360° and are controlled by remote electronic devices like a joystick. The biggest units can handle 800 tons, with smaller ones geared to 15 tons. The behemoths of 100-ton capacity or more are awesome sights when observed shuttling a mega yacht or small ship.

Forklifts (a.k.a. Powered Industrial Truck or PIT) have been adapted for lifting powerboats and moving them about. PITs are the stock-in-trade for skyscraping rack stack storage operations. They're getting bigger and bigger, with some capable of lifting a 10.6m (35') boat.

PAT KEARNS

"All it takes sometimes is a technical fault, usually combined with a bit of bad attitude from Mother Nature, to tip a boat over the edge." Nick Bailey

Blocking 101

To support the boat upright on land, there are two widely accepted methods. One is in a strong, suitably designed and constructed wood or metal cradle. The other is with boat stands. Commonly known as jackstands, those steel tripod contraptions have height adjustable, wood

When an Accident Happens

Your boat fell over, or the yard dropped it. After the fall, what happens? No matter who you think is at fault, call your insurance company immediately. Your insurance company (not the agent) has a right to know what is happening to its "risk." You and your boat are its customer, and it is in business to serve you, the policyholder. This is also the time to engage a marine surveyor on your own behalf, even if the insurance company (yours, the yard's, the yard owner) assigns one to the loss. Once again, you need to take charge, and do what is prudent and necessary to protect your property from further damage. Act promptly on your own behalf.
— PK

-Tip- Coding Aids

If your boat doesn't have the sling placements etched on the hull, the next time you haulout, visually note the locations. Then, afterwards paint "sling" under the rail or have vinyl graphics made. To further assist the yard crew and lift operator, mark the location of knotmeters, transducers, props, struts, fore and aft ends of keel, rudders, etc. This also reduces accidental damage to the underwater gear.
— Jan Mundy

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-Tip- Battening Down

It's awfully tempting to wrap cover tie-downs around the jackstands or a lightweight cradle (top) , but definitely bad practice. Instead use sandbags or jugs half-filled with water (bottom). A loose cover can become a powerful sail in a stiff breeze, causing your boat to take flight from the stands or shake the stands loose from beneath the boat. — *PK*

support pads. However, stands are not just stands. Some are designed to support powerboats, others support sailboats. Stuffing a tall sailboat stand under a powerboat will seat the hull high and dry, but it will be unstable, as the stands support the boat's weight, a job they are not built for. Setting a powerboat stand on top of a drum to raise it to a height needed to brace a sailboat, is just as foolish. And we've all seen yards use steel or plastic drums, foam blocks, various shapes and sizes of lumber in curious placement orientations, concrete (cinder) blocks, and other materials innovatively adapted, sometimes with disastrous results. These are not just "if," but "when" accidents waiting to happen needlessly.

(Continued on page 47)

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Yard Rating Worksheet

In the Yard

• What is the yard's policy, restrictions or environmental requirements on do-it-yourself work once the boat is out of the water?
• Are outside contractors permitted in the yard if your plan is to hire other than yard personnel to work on your boat?
• If a sailboat, does the yard have a mast in-mast out policy?
• Are there adequate disposal provisions for hazardous materials like fuels, lubricants and other maintenance and repair activity byproducts?
• Are water and power supplies handy to the boat storage area? Are you permitted to use it? Do ground fault circuit interrupters protect the power supply? Without them, you could be in for a shocking experience.
• Is the yard generally tidy?
• Is there a disproportionate population of derelict boats in slips or dry stored? These are clues to the yard's demographics, just like in any neighborhood.
• Is the boat land storage area surface dry, level and free of trash, debris and hazardous materials?
• Are there any tall trees that in a windstorm could fall on your boat?
• Will your boat be protected from the effects of other work projects in the yard (painting, grinding, etc.)?
• Are boat blocking materials stored neatly and well organized? Observe the condition of the timbers used for keel blocking. Observe the materials used for the boats that you see ashore.
• Are the boat stands clean and corrosion free? If they are rusted, they might not be trusted.
• Look at the boats in the yard. Are they level? Are they consistently blocked or cradled in the same method? Are the boat stands secured athwartships by chains so they can't part from under the boat in windy, muddy or icy conditions?
• Is the ramp or haul-out slip clean?
• Discuss which equipment will be used to lift your boat. Make sure it's appropriate to your boat's design and construction. An elderly wood boat might not be happy in straddlelift slings. The decision about which machinery is used is based on the type and size of the boat: power, sail, weight, overall length, deep or shallow draft, etc.
• Confirm your boat's weight (or displacement) with the yard to ensure its equipment is capable of lifting the load. Don't assume the yard is familiar with your boat.
• Does the yard have a checklist or written procedure for its hauling and storage operation? Ask for it. Have it with you when you deliver your boat to the haul-out slip and make it clear that you expect it to be followed.

PIT Operation

• Observe the equipment being operated with the boat onboard.
• Is the operator assisted by a ground-based observer, particularly at turns, under and around overhead obstructions, on rough terrain, and when the boat is set down?
• Is the operator's field of view clear with the boat on the PIT?
• There should be no passengers on a PIT.
• A PIT with a boat must never be left unattended when the boat is overhead, not for one second!
• Is it being operated at a safe speed for the conditions? PIT Rules of the Road limit speed to 9.6km (6mph).

Straddlelift

• Look at tires and cables. If you see dripping threads, filthy with oily residue, or rusted cables, or cables with broken strands, or oil and/or fuel dripping from the engine, or you see tire sidewalls that are mostly exposed plies — find another boatyard.
• Check the condition of the slings. Are they clean? Are the edges frayed? Are they ripped or heavily chafed? Then, find another yard. Oils, fuels, bottom cleaners etc., can erode sling material.
• Is there protective material available for the lifting crew to use to protect your boat from damage from cables, cable sheaves, and slings?
• Are the forward and aft slings securely tied together to prevent them from slipping and sliding off?

Equipment Operators

• Are the lifting machinery operators required to be licensed or certified? If so, are they? Are their credentials current? OSHA (Occupational Heath And Safety Act) requires that only trained and authorized operators be permitted to operate a PIT. If there are any irregularities in this department, find another yard. Operating heavy lifting equipment is risky business at best. You don't need to add to that level of assumed risk, and you can't argue this point.
—PK

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PAT KEARNS

Concrete blocks are standard blocking procedure in many yards. These are not just "if" but "when" accidents waiting to happen.

The biggest misconception among boat owners (and some yards) is that boat stands support the weight of the boat. Not! All weight must be supported on the boat's keel, using the stands solely to balance the load and keep the boat level. There are some exceptions that involve specially designed stands or chine blocking instead of keel blocking. It's up to you to know what your boat requires.

Who's In Charge?

Now you're out scouting for the right yard to embrace your "baby," lift and tuck it in for a rest ashore. What can you do to assure yourself that you're in good hands? Albeit there's little you can do to ensure the yard's equipment is up to par, there are some details you can monitor. Use the "Yard Rating Worksheet" on the opposite page as a report card to rate the yard and bolster your own judgment. And, be sure to agree on the ground rules before you give the work order.

With all the yard details in order, you're on your way to the haul-out slip. After securing the boat, confirm the haulout procedures with the equipment operator. Provide the operator with any boat lifting or blocking instructions if documented by the boatbuilder in your owner's manual. Be sure to finalize the pickup points before the boat is lifted. An experienced operator will sling or lift the boat just until the

"We've been doing it this way for many years" doesn't always equal expertise. Before you lift, ask questions.

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PAT KEARNS

Anticipating an untimely launch!

Plugging directly into a power circuit without a GFCI may spark a shocking experience.

Without blocking under the keel to support the boat's weight, it's a shaky foundation destined for a topple.

Sailboat properly tucked away: Boat rests squarely on keel blocks, stands balance the weight. Safety chains couple opposing jackstands to prevent sliding outboard under load.

gear clears the water, then check the positioning for hull obstructions, balance, level, etc., before clearing the slip. Be prepared to stand back and watch the pros in action, or get into your car and go away until the job is finished. When you return, you'll find your boat securely blocked, chocked, and standing proud on its steel mounts, or resting peacefully in its cradle, with a spray washed and clean bottom. Take comfort in the fact that, with all the boats that are handled by yards every season, relatively very few suffer the dreaded drop or fall over.

About the author: Patricia Kearns, a former marine surveyor and assistant technical director of American Boat And Yacht Council, is the executive director of the American Boat Builders & Repairers Association. In 1996, she received the Marine Retailers Association Of America Darlene Briggs Award Of Excellence, the highest industry honor bestowed on a woman in the marine industry. Pat has held a USCG 100 Ton Master's License, and is a qualified senior skipper with the U.S. Naval Academy Sailing Squadron. She's a member of the Kent Island and Corsica River yacht clubs where she teaches adult and peewee sailing programs.

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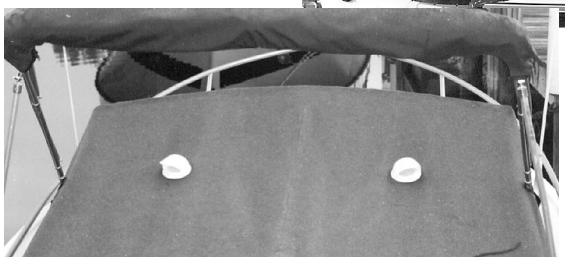
Cover-Up and Ventilate

Covering your boat is the only way to protect it from the elements. And ventilating the cover is the only means to prevent condensation. It's the condensation that builds up excess moisture and the catalyst for mildew growth on carpets, interior walls, berth cushions, etc.

If your tarp or cover doesn't have any vents or you need to add more — you can never have enough vents — an inexpensive solution is to install Airlette vents. Made of durable plastic, they install in minutes without special tools or adhesives in all types of cover materials, including shrinkwrap. They just snap in, stick on or push into the material. Mount a few on the "high" side of your cover and let the air flow.



Boatyard Guidelines

ABYC has developed recommendations for in-yard boat handling and storage. Here's a brief synopsis of what you can do to safeguard your boat when its before, during and after haulout.

To prepare your boat for haulout, empty the bilge of water (excess weight of water can shift the boat in the lifting equipment), and close or secure all hull penetrations.

When the yard lifts your boat, carefully observe the lift points for contact with thru-hull obstructions, such as knotmeters, transducers, splash rails, etc.

Before the lifting/holding equipment is released and the boat is left to rest on stands or in a cradle, be sure the boat sits at an angle (usually stern down) so the cockpit and deck drain. Once safely blocked, secure or remove all canvas, sails, dinghies and any other gear that creates windage. If covering your boat, don't tie it to the stands. Routinely check stands (or cradle) during storage, especially before and after a storm, or thaw.

Never remove a jackstand to paint underneath or to do other maintenance. If it's necessary to move a stand, have the yard position another stand nearby, secured with a chain, before moving an installed stand.

Avoid a shock when using power tools when working on your boat by always plugging into a ground fault circuit interrupter.

— Jan Mundy

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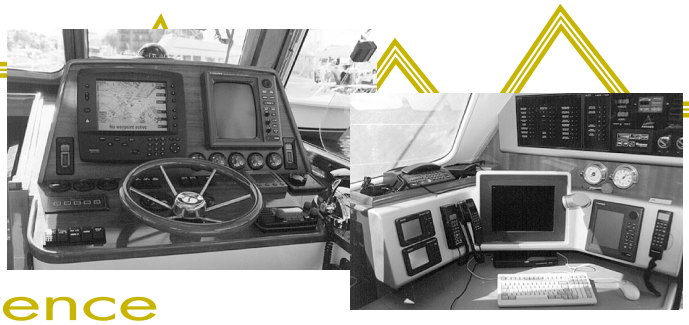

PROBLEM:
Noise and Interference

SOLUTION:
Find the cause, and determine how the noise spreads to the affected equipment, then use a suitable technique or product to solve the problem.

Each time equipment is added to your boat, the chances of creating noisy interference increases. When it becomes severe, it can interfere with the proper functioning of electronics.

By Larry Douglas

Nearly all boats emit electrical noise created by onboard electrical or electronic devices. Noise is the natural byproduct of energy conversion or in some cases, energy use, such as a jet engine where fuel goes in, noise comes out. Noise is also one measure of energy conversion inefficiency. Other examples of energy conversion inefficiency are heat and vibration.

When electrical or electronic noise causes problems in other equipment it becomes interference, sometimes called electromagnetic interference, or EMI. A radio frequency variant of this is radio frequency interference (RFI). Don't be overly concerned with these two terms, however. Making a distinction between EMI and RFI may be important to technical folks, but is of little value when finding and curing interference problems, mostly because all interference is EMI in one form or another.

Noise Makers

Lots of equipment creates noise when running normally. A prime example is your engine's starter motor. Your boat probably has one or more bilge pumps, a freshwater pump, perhaps an electric fuel pump or anchor windlass, and numerous other motor-driven devices. Any or all of these motors can produce electrical noise when operating.

Another common noise producer is a VHF radio. The same transmitted energy that sends voices out for miles can also cause problems in an autopilot, entertainment system and other equipment. This type of interference is considered RFI.

Alternators can produce a whine that changes in frequency with engine rpm. The whine becomes louder as current draw increases to charge batteries and to power accessories. If the whine suddenly becomes much worse without an obvious cause, the problem is likely a shorted alternator diode. This needs immediate attention to prevent damage to batteries and any connected electronic equipment.

DC- or AC-powered fluorescent lights create RFI from ionized gas inside the tube. The lamp's ballast also uses an electronic voltage converter circuit that may create noise. The "raspy" noise is easy to identify and may interfere with any, or all, radio receivers including loran, DGPS, and even VHF radios.

Locating Interference Problems

Noise spreads by conduction from devices wired to the same electrical power source, or by radiation through the air. Alternator whine is an example of conducted noise. Spark ignition noise is an example of radiated noise. Conducted noise is usually easier to find and simpler to reduce or eliminate than radiated noise, but both are curable or, at the least, significantly reduced. To locate interference, begin by isolating the cause of the noise. One popular method is to turn equipment on and off in various combinations until the noise goes away, then make it return reliably. When searching radiated noise sources, use a portable AM radio to isolate RFI. Just tune the radio to a frequency between broadcast stations and note the noise level from the loudspeaker as you walk around the boat. As you approach the source, the radio's loudspeaker becomes noisier.

After locating the noise source, you need to determine how the interference is getting into the affected equipment. Is it being conducted via DC power wiring or being radiated through the air, or both? This is more difficult to determine. Sometimes it helps to temporarily disconnect the suspect equipment from your boat's electrical system and power it from another battery. If the noise goes away, it's conducted, not radiated. Once the source and

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method of propagation of the interference is known, you can apply a suitable solution.

Interference-Solving Techniques

Whenever practical, solve interference problems at the noise source, not at the affected equipment. This eliminates the problem for all the affected equipment at once.

Problem solving step one is to make certain all the equipment manufacturer's installation instructions have been followed exactly. A loose or missing connection can create EMI, as well as causing poor performance. Next, you need to attempt to physically separate the EMI generator from the affected equipment and to separate each unit's wiring from the other.

When these two efforts are not enough, it's time to look at other solutions. Three methods are commonly used to reduce or eliminate electrical interference: isolating, shielding, and grounding. Each works with specific types of noise and can be used alone or in combination with the others.

Isolating can be as simple as moving the equipment farther away from the noise problem or as complex as providing a separate power source, such as a battery or power supply not connected to any other device or circuit.

Shielding consists of putting a metal barrier around the source of the interference, or the equipment affected by it. This metal enclosure keeps EMI energy from leaving (or entering) the equipment. To be fully effective, the enclosure should connect to a good ground (more on grounding below), and all wires entering and leaving the enclosure must be shielded as well. Using "shields," in the form of shielded cable, keeps EMI from entering or leaving power and signal wires, most often seen in radar cables, radio antenna coaxial cable and depthsounder transducer cable. Shielded cable has either a braid made of bare wires, or a metal-coated plastic wrapping located just beneath the outer jacket with a bare wire running adjacent to the wrapping, commonly called the drain wire. In both types, one end of the metal jacket connects to a good grounding point in the boat. The other end connects to the equipment, thus completing the shielding effect of the metal enclosure. Never use shields to carry current or signals, as it defeats the purpose of the shielding, just as you should never use grounding wires to carry current.

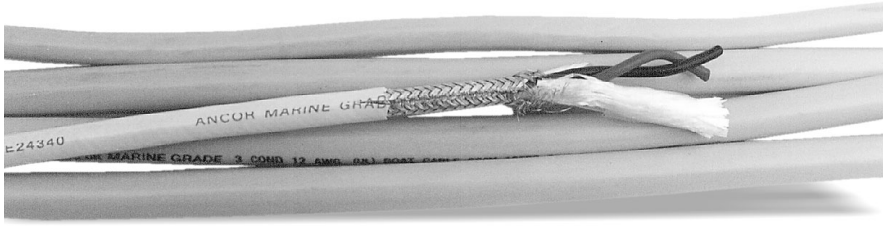
Some typical applications for shielded wire include engine-driven (AC) and alternator-driven tachometers; fuel flow sender wiring; DC wires that run near magnetic or fluxgate compasses; autopilot wiring, especially rudder feedback wires; low-level audio and video wiring; and data or computer wiring. Two-conductor marine grade shielded cable from Ancor (Tel: 800/424-wire; www.ancorproducts.com) is available in 10, 12, 14 and 16 AWG at many marine stores. Ancor also makes a 2 conductor 20 AWG version with foil shield and drain wire, suitable for instrument wiring. To purchase other sizes or cable with more conductors, you'll need to visit an electronics supply store.

Shielding and isolating work best with radiated noise. Sometimes just twisting a unit's DC power wires together reduces the noise level. Try to achieve six or so turns per inch of length for #16 AWG or smaller wire pairs. Larger wire sizes (12 AWG and up) only permit four turns per inch or less. Aluminum foil "shields" rolled over the wires help in some cases, or use coils of a narrow flat copper strip that is wound around the cable.

Grounding is a complex subject. There are as many opinions about grounding as there are boatbuilders. All boats with AC and DC electrical systems require an identifiable location known as the "vessel common ground," but many do not. It's the single point where the vessel's AC ground (the green wire in the AC cable), the DC negative cable (from the batteries), and the bonding wire from the galvanic corrosion prevention system all come together

Electronics Mapping

Before installing new electronic gear, it's a good idea to conduct a test run. Temporarily mount the unit, securing it with tape in the preferred location. Route the wires and transmitting cables (if equipped), and leave lots of slack to allow relocating the unit. Where wires are bundled in a conduit, temporarily fasten new wiring with cable ties. Operate all pumps, depth sounder, radios, navigation receivers, stereo equipment, fluorescent lights and other electronics and electrical equipment, and check for interference. Move the unit around until interference is eliminated. Sometimes, all it takes to cure interference is to separate or change the stacking order of the wires or cables in the bundle.



Ancor Marine's twisted wire with tinned copper shield blocks EMI and RFI from affecting sensitive electronics.

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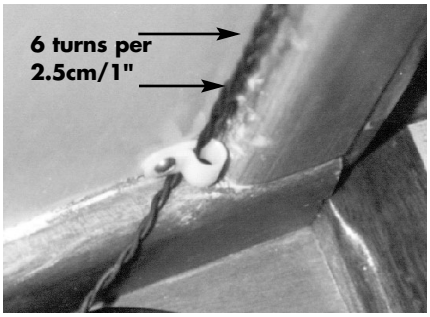
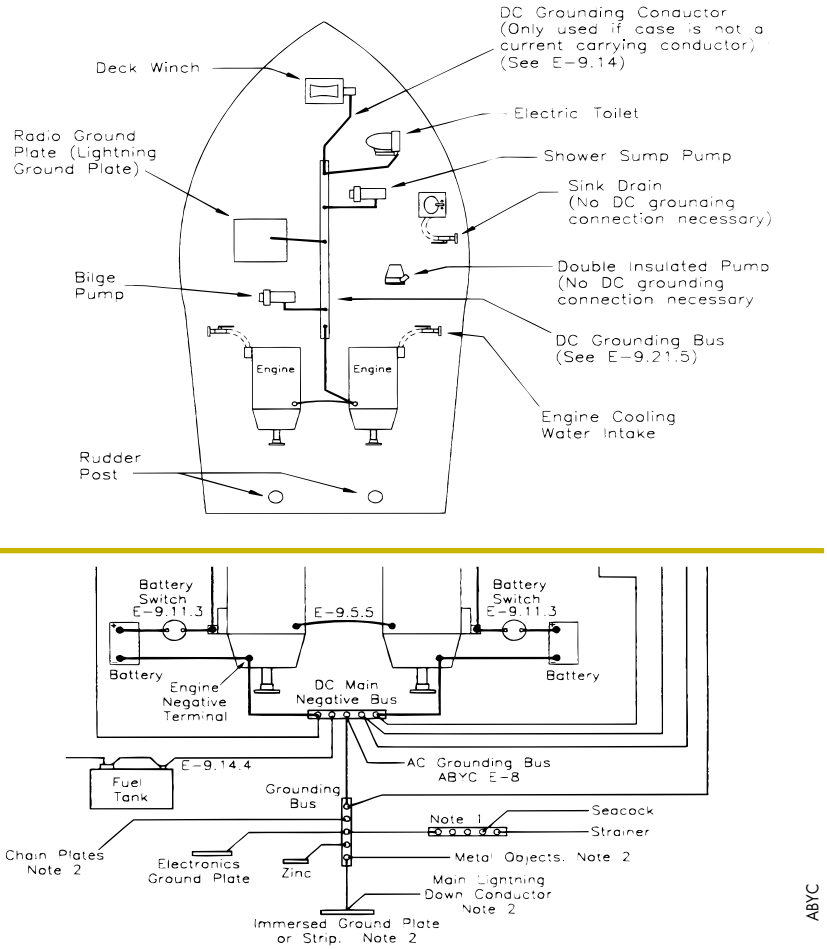
Electronics



Sometimes just twisting together the unit's DC power wires (known as a "twisted pair") reduces the noise level.

(Figure 1). This point also requires a #8 AWG or larger wire going to the DC circuit panel(s) specifically for grounding electrical and electronic equipment. In its absence, installers often tie the green grounding wire from the equipment to the negative power lead somewhere near the DC panel. At best this does little good. At worst, it will cause EMI problems. A less than optimum, but commonly seen alternative is to use an engine bolt for the common ground point. Since engines have noise-producing devices mounted on them, this is a bad idea. This can also cause electrical current to flow through moving parts of the engine and result in early bearing failure. A better solution is to connect a separate #8 AWG or larger green wire from the grounding bus of the DC electrical panel to the negative battery post of the battery that feeds your electrical and electronic equipment.

FIGURE 1



The function of the vessel common ground — a bronze or copper bus bar directly connected to an immersed ground plate, external keel casting — or engine negative terminal is to hold the DC negative circuit and the boat's various grounding circuits to a common (earth) potential.

When grounding equipment to reduce noise, you will find that many devices lack an external ground point, making grounding an impractical solution. In the absence of a grounding wire or screw, connect a grounding wire to a case screw. If you've traced the noise problem to a device having no provision for grounding, it's worth a try.

To Filter or Not

Filtering combines both grounding and isolating. A filter electrically separates the EMI component from the DC power, and either absorbs it within the circuit (converting it to heat) or conducts it to ground.

When choosing a filter, select one from a marine-specialty manufacturer, avoiding products that are intended for automotive use (i.e. stereo systems). Some of the better-known marine filter manufacturers are Marine Technology, Newmar and Professional Mariner, and less known are Gold-line and ITC. Filters install in the DC wiring, either near

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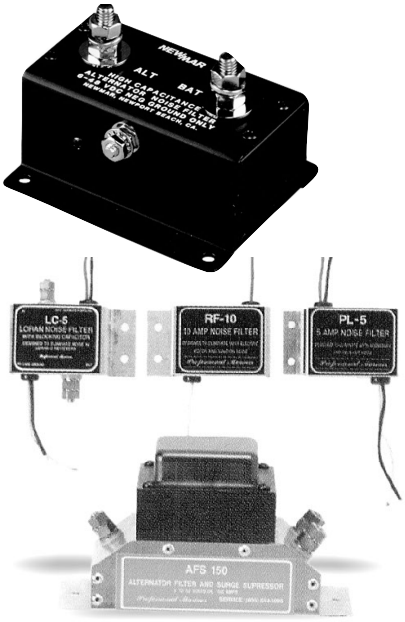

Marine filters differ in the noise they reduce or eliminate and in voltage or current ratings.

the noise source or the affected equipment. It's important to consult the manufacturer's information on selecting and using its filters before purchasing or installing them. Different filters reduce or eliminate specific types of noise and many have specific voltage or current ratings.

Be aware that in severe cases, no technique or filter may completely remove all traces of noise, but can significantly reduce levels, allowing the equipment to work reliably.

More Sources and Fixes

Don't overlook the battery and the battery charger, as the cause. Sometimes, a problem that looks like EMI or RFI is actually caused by low voltage (i.e. a dead cell in the battery) or a poor connection. All electrical and electronic equipment needs a reliable power source. The best noise filter you can have is a properly charged battery in good condition.

It's also a good idea to regularly check your electrical distribution systems for loose or corroded connections. While on the subject of poor connections, my favorite technique for reducing alternator noise is to connect a properly sized wire (rated for the alternator's maximum output current and the length of run) between a ground terminal on the alternator and the appropriate battery's negative terminal. This bypasses the numerous questionable electrical paths and joints of cast aluminum and cast iron at the engine, providing a more reliable connection and often a more consistent output voltage. Using this combination, our boat has never needed an alternator noise filter.

About the author: Larry Douglas is an ABYC-certified Marine Electrical Technician, and a designer and installer of AC and DC electrical and electronic control systems. Since converting to diesel engines (no more ignition noise), rewiring the starting system with heavier wires, isolating the starting battery from the house bank, and installing heavier gauge wiring, his 1978 12m (40') Tollycraft no longer has any interference problems.

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Dockside New Products

Shop Tested Sticky Teamwork

Duct tape is often referred to as poor man's solder and for good reason. A quality duct tape, the thick, ultra sticky stuff such as 3M Marine's cloth duct tape (#6969), can temporarily patch a hole, repair a torn sail, join metal, plastics, rubber or whatever. It has a high tensile strength and is water resistant, but over time degrades when exposed to UV. When this happens, the adhesive transfers onto the contact surface and typically requires cleaning with a strong solvent-based remover. (Some petroleum-based hand cleaners do an excellent job of removing adhesive residue, and they're safer to use. Apply and wait 20 minutes or so, then wipe off.) For general purpose, low-strength work, a better choice may be 3M Marine's Vinyl duct tape (#3903, shown in foreground). An economical 6.2mil tape, it costs half the price of the cloth version. In our UV exposure tests, both tapes dissolved at the same rate, but the vinyl version had minimal adhesive transfer since the adhesive is less aggressive.

Turbine Power

A new and improved wind generator from Ampair (www.ampair.com) can charge a single battery or up to three battery banks. Built to withstand extreme weather conditions, the Pacific 100 (US$995) has a sealed, direct drive permanent magnet alternator with AC-DC rectifiers. There are no commutator brushes to wear out, and no air brake or thermal cutout is needed to protect from burnout. Electrical slip rings and brushes allow the unit to seek the wind and feed the two-wire battery connection. Six balanced fiberglass blades apparently produce near theoretical conversion efficiency at wind speeds of 7 to 18 knots. Operation is seemingly quiet and vibration free. Options include various mounting kits and a voltage regulator to prevent battery overcharge. Made in the UK, Ampair is distributed in North America by Jack Rabbit Marine (Tel: 203/961-8133; Web: www.jackrabbitmarine.com). If you're interested in knowing how various wind generators stack up against each other, log onto www.chelseagreen.com.

Where's Waldo?

Maptech (Tel: 1-888/839-5551; Web: www.maptech.com), the chart people, has added an e-mail tracking feature to its Offshore Navigation 4.5 program. Provided you have a computer onboard with Internet access, a GPS, and the program (US$199), you can email a GPS position along with a message. When someone wants to find you, they log onto www.maptech.com, read your email and click on the attachment to view your boat's location on a detailed marine chart.

Shop Tested Ready Mix Repair

Pettit Marine Paints (Tel: 1-800/221-4466; Web: www. kop-coat.com) has relaunched its one-coat epoxy resin repair products under the FlexPoxy brand. It's the same proven formulation: a 100% pure solvent-free epoxy, mixed at a ratio of 2:1. Use FlexPoxy to repair fiberglass, wood, aluminum, steel, concrete and some plastics (do a spot test first). Available in 450ml two-component, self-sealing cartridges (US$59.95) for larger jobs, which are dispensed with an applicator gun (US$18.95). Or throw a couple of 50-ml burst seal packages (US$9.95) into your spares box for smaller repairs. To use, break the seal, squeeze the hardener into the epoxy resin, knead until the mixture is one uniform color, then apply. With a mixed consistency of thick peanut butter, it doesn't sag, run or shrink, and can be colored by adding paint or pigment pastes. Sculpt FlexPoxy to form any shape, to fill joints or plug small or large holes without added fillers.

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Working time at room temperature is 15 to 25 minutes, depending on the thickness applied. It cures rock hard in about 16 hours, yet remains highly elastic. When cured, it's easily sanded, planed, sawed or drilled, and painted without a primer. (Like most epoxy resins, it must be overcoated or will breakdown from UV exposure.) Clean up with denatured alcohol. It's not recommended as a fairing compound over gelcoat. Use 3M Marine Premium Filler or similar product instead.

Shop Tested Dry Appeal

Dry Telfon Lubricant (US$11.95/CDN$$8.95) from Captain Phab (Tel: 905/706-0583; Web: www.captphab.com.) sprays on wet but dries in 20 minutes or when solvents flash off. An excellent replacement for grease and other "wet" lubricants, once dry, it won't attract dust or dirt particles, and won't rub off. Use it to reduce friction, sticking and chafing on most equipment, such as electrical connections, furling gear, hinges, linkages, locking mechanisms, sail tracks, snap fasteners, trailer hitches, turnbuckles, winches, sliding windows, even zippers. Non-staining, it dries clear (do a sample test before using on zippers as it darken Sunbrella in our test and may stain other fabrics). As it also sheds water, a light spray on the transom can eliminate exhaust stains. A combination of Teflon and a petroleum naphtha base, its strong aroma demands use in a well-ventilated area.

Optimum Protection Plus White

Environmental concerns are surely to bring tougher restrictions on coatings manufacturers and a new generation of antifouling paints. One of the first out of the gate is Interlux Micron Optima (street price estimated at US$180 to US$240 per gallon). A two-part, activated chemical paint film matrix with a 7:1 mixing ratio, the base contains a scant 28.45% cuprous oxide; the activator contains 47.04% zinc pyrithione. Optima apparently controls all types of shell and weed fouling in fresh, salt and brackish waters. Biolux technology controls slime and algae growth. Applied by brush or roller over fiberglass, wood and properly primed metal (not aluminum), two coats are required for maximum protection. Removal of an existing hard coating, if in sound condition, is unnecessary; soft antifoulings must be removed. A multi-season coating, you can haul and relaunch without repainting. As an added bonus, it's a self-polishing copolymer; similar to a bar of soap it washes away, so there is no paint build-up. Launch times range from 2 to 72 hours, depending on the temperature and humidity. Available currently in black, blue and red, look for white on the shelves by spring 2002.

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Good Boatkeeping

SIMPLY STORING STUFF

Easy-to-build deck restraining brackets to securely and safely contain those must-have-stowed-on-deck items.

Story by Zora Aiken, illustrations by David Aiken

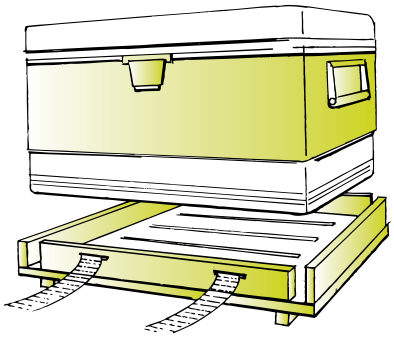
Some folks think a boat, particularly a cruising boat, looks "salty" or properly equipped only when its decks are loaded with stuff, mostly jerry cans of spare diesel fuel, water jugs, coolers, dive gear, a windsurfer, or any other toys that will fit onboard. Granted, the eye of the beholder plays a big part in this, but try the "neighbor appraisal" and see if your boat would be welcome in the marina.

Too much stuff on deck looks messy. Worse, it can also be a safety hazard, making it difficult for people to move around on deck, and creating another kind of hazard if it breaks loose in a rough sea. A plea for neatness has another aspect. Since living aboard is based on the marina owner's idea of what's appealing and what's not, keeping a low profile may be critical to the entire lifestyle. Some things, however, like fuel cans or a cooler dedicated to fresh-caught fish, simply must be carried on deck.

Such gear is often placed on deck and loosely attached with line or shock cord to a stanchion. This may work in calm weather, but when waves start to roll, so may the can and cooler, resulting in a possible fishbox or fuel-can overboard situation.

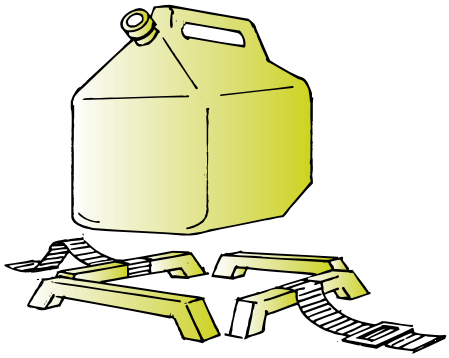
A practical solution that coincidentally looks neat, is to make custom holders or brackets for these on-deck items. Measure the length and width of the cooler, for example, and build a shallow box, about 7.6cm (3") high (**Figure 1**). Make it of teak glued with epoxy resin, or

FIGURE 1



maintenance-free StarBoard assembled with 3M 5200, and fasten with stainless-steel screws. Leave spaces at the corners of the box so water drains easily. Prop the box's floor on short "feet" (small squares of wood will do), or fashion custom runners (**Figure 2**) so the bottom doesn't sit in water splashed on deck. Attach hold-down straps to one side of the box to wrap over and around the cooler and secure to your assembled

FIGURE 2



box on the opposite side, or tie the straps or line through side handles, if equipped, then attach to the box. The box itself, of course, should be secured to the deck. Now, you have no rolling, no shifting and no breaking.

The box can also be made of aluminum (**Figure 3**), an especially good choice if you have a friend in the custom metal fabrication business.

A simpler tie-down arrangement uses short handrails. Buy four rails of the appropriate length; fasten them in position directly to an eye-

FIGURE 3

bolt mounted on deck (**Figure 3**). Shock cord eventually gives up its holding power, so use line or other strapping material to secure the item to the handrails.

About the authors: David and Zora Aiken are the authors and illustrators of numerous boating, camping and children's books, including "Good Boatkeeping" and "Good Cruising" published by International Marine. They live aboard "Atelier," in Grasonville, Maryland.

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