

# DIY

boat owner

# the MARINE MAINTENANCE MAGAZINE

# INSIDE

## Features

### Spring Fitting Out

An itemised checklist of all the information you need on cleaning, engine maintenance and testing, care of electrical systems, plumbing, rigging and canvas plus a handy engine maintenance log.

### Cast-Off

Anchoring signals.

### DIY Projects Things to make:

Branding electrics; Safety plugs for thru-hulls; Hose extentions.

### Engine Troubleshooting

Weather-controlled horsepower; Determining propeller pitch; Bleeding a diesel engine.

### Electronics

Installing and replacing depth and speed log transducers.

### Fiberglass Repairs

Step-by-step to repairing cored and uncored fiberglass hulls and decks.

### Painting Handbook

Complete guide to painting includes painting new or old bottoms, coverage charts, abrasive guidelines, application tips, troubleshooting, seasonal painting log.

### New Life for Worn Decks

Refinishing techniques for fiberglass wood, metal or concrete decks.

### Departments

#### TechTips

Boat-tested tips.



**Refer to DIY 1998 #2 for step-by-step instructions on using polyurethane paints;**

**Refer to DIY 1999 #1 for complete application guidelines to antifouling paints.**



**Refer to DIY 1999 #2 for details on fiberglass cosmetic repairs.**

# TECH TIPS

**TIGHT FIT:** To slip a hose onto a barbed hose fitting, coat the fitting and the inside of the hose with liquid dish detergent. A thin layer of silicone sealant placed on the fitting works well and also prevents leaks. For reinforced-vinyl hose, heat the hose end with a hair dryer until it softens and expands. Quickly slide over the hose fitting.

**MUSTARD BEATER:** To remove ink or mustard stains from vinyl seats, lightly rub with acetone or oil-free nail polish remover.

**CLOSE SHAVE:** Dirt on upholstery comes off easily with ordinary shaving cream.

**CAULKING:** To prevent the nozzle of caulking cartridges from solidifying after use, insert a #8 screw or 2" common nail into the tip. Wrap the nozzle end and the head of the fastener with electrical or duct tape. Flatten the tape to keep out air.

**STAIN-FREE TOPS:** To remove stains on plastic countertops rub with a damp cloth and baking soda. For more stubborn stains, dab a little toothpaste on the stain and rub lightly with your finger. Don't use abrasive pads or powders as these surfaces are easily scratched.

**LIGHT EVERLASTING:** Light bulbs often become so corroded in their sockets that they are difficult to remove. To prevent moisture from corroding navigation and trailer light bulbs, coat the bulb base with petroleum jelly or a light grease. A light coating on both sides of the rubber lens gasket also provides a better seal against leakage.

**SWEET SMELLING:** Hang a stem of dried eucalyptus in the cabin or lockers. Your boat will smell like a florist's shop.

**EXHAUST GAS:** Excessive smoke coming from a diesel engine is a sure sign of imminent trouble. The best way to tell what's happening in the bowels of the beast is by the color of the exhaust. Upon start up, all diesel engines produce whitish smoke, caused by water vapor, for about four or five minutes. Any longer and white

smoke may also signal a compression problem, possibly a leaking or cracked cylinder head or gasket or water in the fuel. Blue smoke is caused by engine oil getting into the combustion chamber — a sure sign of excessive oil consumption and probably a compression problem. If your engine emits black smoke or too much smoke, look for a clogged or dirty air cleaner or incorrect fuel injection timing. Black smoke at low rpm is caused by a defective fuel injection pump or faulty injectors; however, at operating speed, the engine could be overloaded. If this happens, check propeller sizing.

**TAPE REMOVER:** To remove old tape from metal (boom, mast or stanchions) wipe with lacquer thinner. Nail polish remover also removes the adhesive residue from masking tape; just coat the tape, let it soften and carefully peel off.

**MAT FINISH IS BETTER:** Never, never use Armor All or any other silicone-based compound to clean your inflatable. It gives an attractive, slippery, highgloss finish, but if the fabric tears there's not a glue available that can attach a repair patch. Repairs must be handled by a service center and are costly and time consuming; it requires severe sanding of the fabric or application of harsh chemicals to remove the silicone compound out of the fabric.

**BATTERIES:** Avoid placing batteries in series that are of a different brand, size and age. Premature battery failure will result.

**X MARKS THE SPOT:** The positioning of your boat on the trailer directly affects tongue weight when towing. Bow stops help determine the placement, but often the boat rides higher, particularly when the trailer is buried deeper than usual on a ramp with a long grade. To correctly position the boat every time you load, mark the spot where the bow roller rests against the boat with a dab of nail polish.

**FRESHER WATER:** To sweeten stale, bad-tasting drinking water, add a teaspoon of baking soda or a few

water purification tablets. If this fails, it's time to drain your tank and give it a thorough cleaning. Since you've gone this far, you might as well replace the hoses.

## DIY BOATER'S TOOL KIT

Tools make all the difference. With the right tools and a few basic skills you can carry out many jobs yourself. Customize your tool kit to fit the equipment on board. This list will get you started.

Knife	Multimeter
Pliers	Selection of crimp-on connectors
Adjustable wrench	Moisture-displacing lubricant or penetrating oil
Funnel and paper filters	Oil can
Assorted screw drivers (metric and imperial)	Rags
Allen keys	Old toothbrush for cleaning small parts
Hammer, small and medium	Portable fuel can (just in case)
Vise grips	Service manuals
C-clamps or Vise grip clamps for holding work	Duct tape
Assorted hose clamps	<b>Power+</b>
Deck plate key	Extra transom drain plug
Spare Fuses	Spark plug wrench and gap gauge
Spare ignition key	Engine filter wrench
Extra bulbs for navigation and interior lights	Starting cord (for small engines only)
Length of fuel hose	Spare sheer pins (older engines)
Spare engine cooling hose	<b>Sail+</b>
Spare water pump impeller	Wire cutters
Extra belts	Hacksaw and extra blades
Spare engine filters	Heavyduty rigging cutters
Extra propeller	Pop riveter
Jumper cables	
Electrical tape	
Wire crimpers and cutter	

# Step-by-Step SPRING FITTING OUT



At last, the arrival of Spring and the annual migration of boat owners to marinas and boat yards. The customary sounds of sanders, grinders and buffers; the familiar smells of paints and cleaners in the air.

Spring's cooler days are the perfect time to check your boat and equipment before the summer arrives and you would rather be boating. Use this checklist as a guide to organizing your pre-season maintenance. Try to get an early start to ensure you're ready for launch day. Begin by removing the winter cover. Look for rips, chafe and wear and repair before packing away. Cover off? Let's get started.

# TOPSIDES

- Hose or wash down all surfaces using a cleaner (preferably biodegradable) and warm water to remove winter's dirt and grime. Rinse well. Remove waterline scum with an algae remover and all-purpose cleaner.
- Check fiberglass surfaces for any **nicks or hairline cracks** in the gelcoat (see Repairing Fiberglass Hulls and Decks on page 26) and repair before painting.
- Use a specially formulated color restorer to remove stubborn stains and restore color and lustre to dull, faded fiberglass.
- Apply a marine fiberglass cleaner/polish or wax to protect the gelcoat from fading and chalking. A one-application cleaner/polisher is easiest — simply wipe on, let dry and rub off. Waxing involves more elbow grease and should be power buffed. Remove the old wax first with a dewaxing solvent. Waxes with high carnuba content and ultraviolet inhibitors, are preferred. Apply wax to deck vertical surfaces only; never wax nonskid.
- Aluminum hulls: if paint has chipped off, apply an etching solution then touch up with a primer and vinyl-based paint. A coat of polish or wax over a painted or bare hull protects the finish.
- To remove stains caused by mildew forming on bulkheads and the cabin ceiling, wash all interior surfaces with a mild detergent or mildew-resistant cleaner.
- Check sealant around fittings, cleats, stanchion bases, hatches, ports, etc. Remove and rebed any thru-bolted hardware that leaked last season.
- Look for loose or corroded hardware, screws, rivets and other fittings.
- Clean stanchions, lifelines and pulpits with a general purpose yacht scrub or metal cleaner. Inspect all bases and connections.
- Use a metal cleaner to remove oxidation from stainless steel, chrome, bronze and brass. For a long-lasting shine, brush on a coat of clear lacquer or varnish.
- Spray a moisture-displacing lubricant such as WD-40 or Corrosion Block on locks, hinges and sliding door tracks to prevent rust.
- Remove the floorboards and vacuum out the bilge. Check limber holes are free of debris.
- A carpet deodorizer sprinkled on carpets then vacuumed should remove winter's stale odors.
- Repaint name or apply a new graphic decal. Use a hair dryer to remove old decal.
- Remove dirt, grime and stains from fenders with an easy spray on/wipe off cleaner such as Seapower, Mary Kate, Boat Armor So-White or Aurora Speed Clean which also do a great job on power cords and inflatables.
- Wash all dock, mooring and control lines in freshwater. Check for wear and replace if necessary. Reversing end-for-end is often all that's needed to distribute wear.
- Clean Plexiglas and Lexan portlights with a cleaner formulated for plastics. Do not use an abrasive.
- Paint the bottom with antifouling paint or a wax (see Painting Handbook).

## NOTES

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## 10 EASY STEPS TO APPLYING NEW GRAPHICS

1. Use a hair dryer to remove the old graphic. Thoroughly wash the hull surface, then wipe with a clean rag and acetone.
2. Position the vinyl lettering and mark the corners with masking tape on the hull.
3. Spray the hull surface with a soap and water solution.
4. Carefully peel the paper backing away from the letters.
5. Lightly spray the adhesive side of the lettering with soapy water solution.
6. Place the lettering in position, aligning the corners of the paper masking with the tape. Insure letters are level.
7. Gently smooth over the surface of the paper masking with a squeegee, increasing pressure as the lettering starts to dry.
8. Smooth evenly to force all excess water and air bubbles out from under the lettering.
9. Allow to dry thoroughly before peeling away the paper masking.
10. Lettering should be dry in 10 to 15 minutes. Gently peel back the paper masking. If the lettering starts to lift, smooth it back down with the squeegee and allow to dry longer.

## BELOW WATERLINE

- Remove marine growth from navigation transducers and knotmeter impellers with a rag or a light sanding. Do not apply bottom paint to exposed transducer face.
- To clean bronze underwater parts, hand sand with 400-grit wet paper.
- Examine all underwater metal for signs of electrolysis.
- Check shaft and rudder pintles and gudgeons for wear or excessive play.
- Check the rudder for cracks or holes. Lightly lubricate the rudder sheaves and rudder tube.
- Remove any accessible external strainers, clean and apply antifouling paint before replacing.
- Clean sacrificial zinc anodes on propeller shaft, rudder or hull with a wire brush and replace when oxidation has destroyed more than 1/3 of the original piece.
- Replace cotter pin in the shaft if corroded or split.

### NOTES

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## CLEAN-UP KIT

- 50 feet (15 metres) of hose
- Boat soap and scouring cleanser
- Vacuum cleaner
- Dust pan & brush
- Rust remover and old rags
- Large sponge and long-handled mop
- Bilge cleaner
- Polish and wax
- Scouring pads
- Wire brush
- Scraper
- Wet and dry sandpaper
- Rubber gloves, dust mask
- Lubricants, grease

## ELECTRICAL

- Batteries: for unsealed lead acid batteries, check the electrolyte level in each cell. Top up with distilled water to the manufacturer's "full" line. Don't overfill. Using a hydrometer, test the specific gravity in each cell. A fully charged battery should have a specific gravity of 1.265 to 1.275 at 25 C (77 F). A reading less than 1.120 means a dead battery. With vent caps in place, scrub battery terminals and posts with a wire brush or a stiff toothbrush and clean with a diluted baking soda solution to neutralize any acid. Rinse with freshwater and dry with a clean rag. Charge battery. Check specific gravity again. If all cells are still low, hardened sulfate may have accumulated on the plates, a result of improper charging. You can probably salvage the battery by charging at a higher than normal voltage and low current. Have it inspected by a battery supplier before replacing. Install fully charged battery with the ignition or battery switch in the off position. To prevent corrosion, apply a thin coating of petroleum jelly to contact points and connector bolts.
- To prevent a rust-like greenish-blue coating from forming on battery cable ends where they connect to the alternator, starter or switch, remove cable, spray with a marinegrade electrical contact cleaner, wipe clean and reconnect.
- Inspect wiring for wear and loose terminals. Clean all fuses at their point of contact.
- Move all toggle switches on the electrical panel. Spray with a moisture-displacing lubricant, if needed. Check that interior and deck lights are working.
- Connect shorepower and test system with an AC circuit tester (a three-prong device available at hardware stores).

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## SAFETY EQUIPMENT

- Replace all batteries in strobe lights, personal safety lights and other safety equipment even if batteries still hold a charge.
- Check the charge level on all fire extinguishers; it should read "full." Shake a dry chemical extinguisher to loosen the powder and prevent it from caking. Have older extinguishers hydrostatically tested.
- Examine life jackets for chafe and broken stitching. Check straps.
- Check expiry date on all flares. Keep old flares for spares; you may need them someday. Discard any that have wet casings safely ashore.

# SPRING FITTING OUT

(Safety Equipment continued)

- Check safety harnesses and tethers for damage to straps and hardware.
- Test the portable air horn. Carry an extra canister. Have a blow horn on board as a backup.
- Inspect anchor rode, shackles and swivels. Replace or switch end-for-end if worn.

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## AVOIDING SHOCK TREATMENT

Take care when operating power tools outdoors in the spring when yards are wet and muddy. Use only extension cords rated for outdoor use and fitted with waterproof plug ends. Discard any cords with damaged insulation or plugs. Power tools with a three-prong, U-ground plug require a similar U-ground extension cord and outlet. Double-insulated tools have a two-prong plug (no ground wire) and can be operated with a two-wire extension cord. If the condition of the plug, socket or outlet looks suspicious, check the wiring with a circuit tester (available at most hardware stores). An incorrectly wired plug can cause a power tool to come "alive" when plugged in. A Ground Fault Circuit Interrupter plugged directly into an electrical outlet or the end of a long extension cord when required, will protect the operator from a lethal shock. A safer bet is to use rechargeable cordless tools.

## PLUMBING

- Clean freshwater tanks with baking soda and water. Fill tanks with water and either turn on all galley and head faucets or hand pump (manual pump) the water through the system. Turn on shower, washdown, cockpit shower, water heater, aerators, etc. If you winterized the system with non-toxic antifreeze, repeatedly purge the system with freshwater until all traces are eliminated. Carefully dispose of the antifreeze.
- Check the head for any ice damage or cracks. Reconnect hoses and hose clamps to the head, if necessary. Lubricate all head fittings.
- Inspect the shower drain, tank and sump pump for soap buildup and blockages. Run freshwater through the sump pump.
  - Lubricate all seacocks with a Teflon-based grease or spray. (Remove hose or lubricate from the outside.) Open and close seacocks several times. If difficult to turn, dismantle, clean and grease. Replace any that do not move freely.
  - Inspect bilge pumps and clean strainers. On diaphragm pumps, lubricate the handle at pivot points and at the bottom of the handle socket. For electrical pumps, clean the impeller to prevent from clogging. Run high-pressure water through the cockpit drains to flush out any debris. To check the float switch, turn on the pump and raise the switch by hand.
  - Check all hose clamps and replace if corroded or broken. Clamps should all be noncorroding, marine-grade stainless steel. Double clamp all waterline or below thru-hull fittings.

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## STOVES

- Propane installations: check for leaks using a leak detector or non-ammonia 1:1 soap and water solution. Open all and apply the solution to all joints and connections using a small brush. Telltale bubbles will reveal any leaks.
- Alcohol: pressurize the system and check for leaks. For non-pressurized stoves, fill reservoir(s) and look for leaks.

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# ENGINES – All

- Use a quality marine cleaner to degrease and remove caked dirt and old grease.
- Wire brush any rust spots, scratches or chipped paint and apply a rust-preventive paint or primer and color-matched paint.
- Check motor mounts for cracks and loose fasteners. Pry up with a screw driver to ensure mounts are securely fastened.
- Inspect cables and wires for wear. Look for loose fasteners.
- Check all engine, fuel and plumbing hoses for wear and chafing. Replace hoses that are worn, broken or tired (brittle or dry) or spongy when squeezed. Use some force – yank hard and twist hoses to ensure they are not worn and are firmly attached. Replace any suspect hoses.
- Change fuel filter. Check water/fuel separator bowl. If it contains water, sediment or sludge, you'll need to drain and clean fuel tank.
- Spray all electrical contacts with a light mist of a moisture-displacing lubricant.
- Lubricate engine control cables with a quality silicone or lithium grease to prevent seizing. Remove old grease first. Some cables are made of mild steel and may need replacing.
- Check the water pump impeller. If the impeller vanes have become stiff and taken a permanent "set," it's time to replace. Before reinserting, coat the sliding face, pump shaft and impeller shaft with anticorrosive grease. Be sure the curve of the impeller vanes is opposite to the direction of rotation.
- Examine engine zincs. Replace if pitted or more than 50 % eroded.
- Tighten all powerhead nuts and bolts with a wrench, then use a torque wrench, torquing to factory specs as specified by the manufacturer in the service manual.
- If you spill oil in the bilge when changing the filter or oil, don't pump it overboard. Save the environment and place absorbent bilge "socks" or sponges (sanitary napkins work well in a pinch) in the bilge. The sock is a fully contained sleeve filled with an oil absorbing material that removes oil from bilge water. In many boating areas, you will be fined (US\$5,000 in some States) if caught pumping oily bilge water overboard. When removing, wring out in a bucket and properly dispose ashore.
- Check the propeller for nicks or burrs, corrosion or fouling and bent blades. File small dings. If badly damaged, have propeller reconditioned by an authorized repair center.
- Buff a bronze propeller with bronze wool. For a lasting smooth finish, warm the prop with a hair dryer, then apply a light coating of high grade marine wax.
- Following the manufacturer's recommendations, grease or lubricate anything that moves!

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## ENGINES – Inboard

- Check and clean raw-water intake strainer.
- Carefully rotate the shaft and check for bends or distortion. Check the stern bearing for wear. If removal is warranted, check your technical manual for specific details or seek the advice of a trained mechanic.
- Check alternator and other drive belts for wear. Worn belts often have a rolled, fuzzy edge. Black dust with rubber particles also indicates a worn or slipping belt. Check tension. Press belt midway between pulleys with your index finger and measure the “give.” Belt should give no more than 1/2-inch (10 mm) with about 22 lb (10 kg) force.
- Clean or replace all filters.
- Inspect the exhaust system. Close the drain cock in the waterlock or “lift” muffler.
- Check shaft and rudder stuffing boxes. If the stuffing

box dripped steadily last fall and turning the nut slightly by hand (not too tight, or you may score the shaft) didn't stop the water flow, you'll need to replace the packing material. The stuffing box should drip 5 to 20 drops per minute per inch of shaft diameter when underway. When at rest, the stuffing box should not leak a drop. Hand tighten only; never tighten the stuffing box with a wrench. After launching, start the engine and adjust the flow rate following a half hour running. It should drip about once every 30 seconds to 1 minute when the shaft is spinning and be dry when the boat is at rest. Now's the time to check the propeller shaft for vibration. Realign if necessary.

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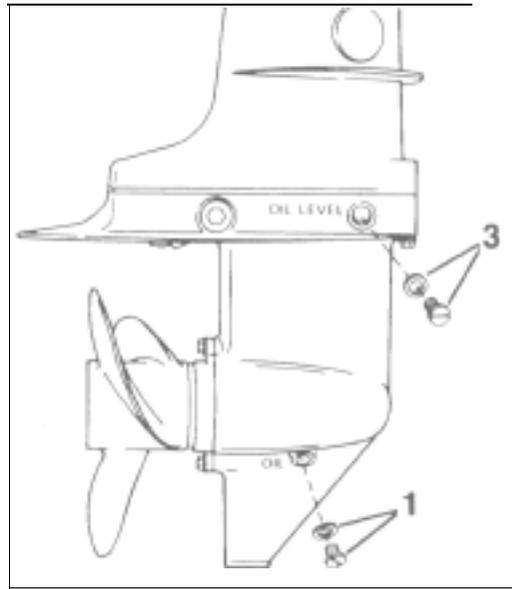
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## ENGINES – Gasoline

- Wash the exterior and apply a marine wax to deter fouling and zebra mussels.
- Remove spark plugs and replace if badly worn, fouled or insulators are cracked. Clean the old ones and keep as spares. If in good condition, replacement is optional but they should be cleaned and regapped annually (except prong-less plugs) according to the engine manufacturer's specifications. To replace, finger tighten, then give a 1/4-turn with a wrench. Check the plug leads for cracks or damage. Clean the terminals.
- Inspect the portable fuel tank. Make sure the vent is clear of debris. If fuel is leaking at the connector, then replace the O-ring.
- Lubricate the tilt tube, steering link rod pivot points and swivel pin/bracket. Remember to remove all traces of old grease.
- Remove the distributor cap and rotor and inspect the inside for small cracks. Wipe clean and spray with a moisture-displacing lubricant. On conventional ignition systems, check the condition and spacing of the point set. If burned or out of alignment, replace and set the dwell.
- Check the wires and terminals from the starter solenoid to the starter motor.
- Remove the carburetor flame arrestor. Check for damage to screens. If screens appear to be clogged, clean the arrestor in solvent and air dry before installing. Tighten nut securely.

# LUBRICATING A 2-STROKE

Once again, lubricate the gear housing in the lower unit. (This should be done spring and fall and during the boating season, depending on engine hours.) With the propeller off, remove the fill plug and washer. Refer to your owner's manual for location. Using a lubricant specified in your owner's manual, insert the nozzle of the lubricant tube into the filler hole. Remove the vent screw and washer; never add lubricant to the gear housing without first removing the vent screw. Add lubricant until the excess begins to flow out of the vent hole. Next, drain off about 1 ounce of lubricant to permit expansion. Replace the vent screw, fill plug and washers. If the fluid level drops check for cracks in the casing or around fill holes. Have a marine mechanic pressure test the gear case if 1 / water drains from the filler hole 2/ metal particles are present on the magnetic fill plug 3/ lubricant is a milky brown color.



*When lubricating the gear housing of the lower unit, refer to your owner's manual for precise location of fill and vent plugs.*

- Check all fluid levels: crankcase, drive unit, trim/tilt pump and power steering pump. If oil and fuel filters were not changed last fall, then do it before first starting the engine. When completed, check levels again.
- Inspect and clean or replace fuel filters. Apply a light oil to the seal of a spin-on filter for easier removal.
- For engines with oil injection, top up the remote oil reservoir with oil as specified in your owner's manual.
- Prime the fuel system (squeeze the primer bulb) and check for fuel leaks. Examine hoses, carburetors and gaskets for leaks.
- Tighten the trim gauge sender, if necessary, and look for frayed wires.
- Turn the wheel. If hard to crank, grease the steering mechanism and lubricate the cables and pulleys. (First, clean off the old grease.) For power steering systems, check the reservoir level and top up if necessary. On boats with dual-cable systems, check for tightness. If there's excessive play, adjust the engine adapter according to specifications in your service manual.

# SPRING FITTING OUT

[Engines — gasoline continued]

- Top up the power trim reservoir. Refer to your owner's manual for refilling procedures.
- Check your owner's manual for locations of all engine grease fittings. Remove all old grease first and apply one or two strokes of a grease gun loaded with a quality marine grease.
- Inspect the emergency stop switch, clip and lanyard.
- Check the oil level in the trim/tilt pump. If the level is low check for leaks. Refer to your owner's manual for refilling procedures.
- To remove the propeller, disconnect all spark plug wires before pulling the prop. Look for any monofilament fishing line and grease prop shaft splines with a anti-corrosion grease. Before replacing propeller, test run the engine. Tighten the prop as outlined in your owner's manual.
- Stern drives: run the engine up to temperature, then drain and change the engine oil and check the crankcase oil level (see Dryland Engine Testing). If necessary, have a marina pressure test the gear case to check all seals.

Check the oil level in the drive unit by removing the oil vent screw and sealing washer from the drive shaft housing. Oil should come out the hose; if not, pour gear lube into the vent hole. Put the drive unit in the down position. Remove the fill cap from the reservoir and check the oil level. It should be up to the bottom of the filler neck; add if necessary. Clean power tilt and lift rams with a rag and light oil. Inspect the drive boot, exhaust boot and control cable bellows. Grease all U-joints. Check the hose connection between the stuffing box and the stern tube. Replace if worn or broken. Clean and tightly fasten the flame arrestor on the carburetor. Inspect the manifolds and waterlock mufflers for cracks. Remember to close the muffler drain cock.

- Outboards: make sure the water intake screen is free of obstructions which may cause the engine to overheat. Remove the engine cover and inspect for loose sound insulation and reglue as required. Check the condition of the manual starting pull cord. If your outboard has a trim tab, check for corrosion; replace if less than half remains. For boats with hydraulic steering, check oil level, clean and grease the outboard engine tilt tube and cylinder slider assembly (attached to the tiller arm). Use a quality marine grease. Test run the engine (see Dryland Engine Testing).

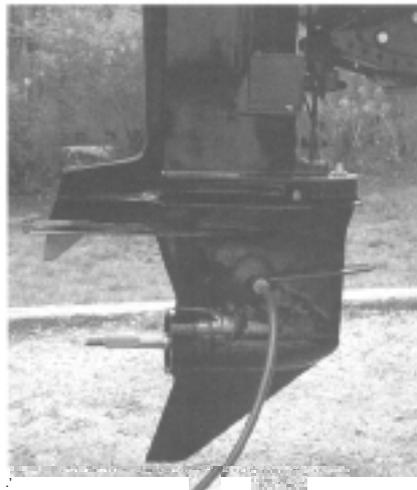
## NOTES

## DRYLAND ENGINE TESTING

You can test run your outboard or stern drive before launching with the help of a flushing adapter connected to a garden hose. This device slips over the lower unit, covering the engine cooling holes.

To begin, remove the propeller to prevent accidental contact. Open the engine compartment (stern drive boats). Turn on the water. With the water running and the shifter in neutral, start and idle the engine. Make sure water runs out the water exhaust. Control water pressure as full water pressure may cause damage to the water pump or engine. Do not exceed 2,000 rpm. Make sure voltmeter, oil pressure and water temperature gauges are operating properly. A steady stream of water at the rear of the powerhead indicates that the water pump is operating. Check for oil, water or fuel leaks. To flush the engine of carbon deposits, spray an external engine tuner (OMC Engine Tuner or Mercury Power Tune) into the carburetor intakes while the engine idles fast. If you haven't done this in a while, you'll see lots of gunk pouring out the exhaust outlets.

For stern drive-powered boats, check fluid levels in the drive unit and crankcase, allowing about 5 minutes for the oil to drain into the oil pan after shutting off. Remove the dipstick. The oil should be between "full" and "add." Add oil as specified in your owner's manual. Drain the engine oil you put in last fall and add a new fuel filter.



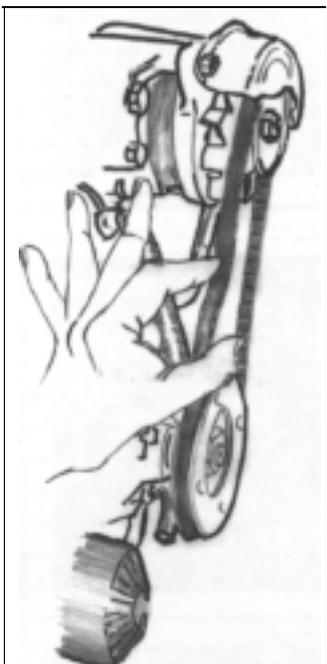
Pre-launch engine testing is easily performed with a flushing adaptor.

# OILY SOLUTIONS

Marine lubricants are not just “lubricants.” They are specially formulated to keep your engine in peak running condition; running longer and burning cleaner. Never, never use substandard or automotive-type lubricants. Using “bargain” products or 30-weight oil may void your warranty. Use only lubricants prescribed by the engine manufacturer. Marine oils are given a TC-W (two-cycle, water-cooled) rating. TW-C2 oils are designed for outboards under 40 hp; larger engines must use TW-C3. These oils contain a detergent additive that provides better lubrication and reduces engine wear.

## ENGINES – Diesel

- Change the primary and secondary fuel filters (if not done prior to lay-up). Drain the water reservoir at the bottom of fuel/water separator. After changing fuel filters, bleed the engine, starting at the separator, to remove any air. Check the fuel filter in the engine and clean if there is water and sediment in the filter. (See instructions on bleeding a diesel engine.)
- Reconnect the propeller drive shaft to the transmission (assuming you disconnected after haulout). If the shaft



**The one-finger test:** press belt midway between pulleys with your index finger and measure the “give.” Belt should give no more than 1/2-inch (10 mm) with about 22 lb (10 kg) force.



# SAIL

## RIGGING

- Wash the mast with water and a mild soap (avoid using detergents which can cause corrosion in the alloy). Rinse with water, dry and apply a light coating of polish.
- Inspect fittings, tangs and all fasteners for signs of corrosion. If corroded, remove and rebed. Check for hairline cracks, bent fittings and pins, loose fasteners and wear. Examine all cotter and clevis pins. Check chain plates for hairline cracks.
- Inspect turnbuckles. To get last year's grease off turnbuckles, dip in mineral spirits and scrub with a toothbrush. Lubricate with a specially formulated lubricant to reduce friction. Replace worn cotter pins. Stainless steel cotter pins are stronger than bronze and should always be used for rigging. Always open cotter pins to a minimum of 30 degrees.
- Check base of mast. If corroded, clean with a wire brush, apply an aluminum primer then paint with a quality epoxy based paint.
- Check mast lights. Replace bulbs, if necessary. To prevent corrosion, cover bulb base with a thin coating of petroleum jelly. Test lights with a multimeter before stepping mast (see Testing Your 12-Volt System).
- Carefully remove halyard sheaves and apply a light coating of Teflon grease on bearings, sheaves and pins to reduce friction. Replace and check that halyards run freely.
- Clean the mast track, roller furling track and spinnaker track with a rag dipped in solvent. Apply a lubricant or Teflon grease.
- Lightly lubricate all moving parts.
- Inspect all standing rigging for broken strands and kinks. A nylon stocking rubbed over the stays detects any flaws and saves your hands.
- Check swages for cracks. Examine the ends of all reusable compression fittings, such as Norseman or Sta-Lok, for corrosion and frayed wires.
- Check all halyards, sheets and topping lift for chafe and wear. Check splices for strength. Consider switching end-for-end or replacing if lines are worn. To remove a halyard, attach a polyester cord messenger line to the bitter end and pull through.
- Attach spreaders and shrouds. Install rubber spreader boots or rollers to reduce chafe and wrap all exposed cotter pins with rigging tape.
- Remember to install wind indicator and antenna(s) before stepping the mast.
- WINCHES: dismantle, clean with a degreaser and coat the gears, bearings and interior winch surface with a recommended lubricant. This reduces friction and corrosion. Carefully disassemble following the manufacturer's instructions. If you're without a schematic diagram, sketch

# SPRING FITTING OUT

(Sail — Rigging continued)

the removal order and placement of the individual pieces.

Snap rings break easily; carry spares

- **SAILS:** if you didn't inspect your sails last fall, do it now. Check the seams, chafe patches, batten pockets, bolt rope, luff and foot tapes for broken stitching and signs of chafe. Inspect the main headboard and clew areas for signs of stress. Check the elastic in the ends of batten pockets. Make sure slugs or slides, grommets, thimbles, snap hooks and reef grommets are fastened securely. Check for chafe where sails contact the spreaders or bow pulpits. If the leech edge of a roller furling genoa/jib is worn, consider adding a narrow acrylic cover along the outer edge and foot to protect the sail from ultraviolet rays. Check the spinnaker for pinholes: hold the sail up to the light and carefully examine every panel. To remove surface dirt, hose sails off with freshwater. Rub stubborn stains with a mild soap or detergent and sponge or soft brush. Try Davis Foaming Sail Cleaner for tough stains. Dry, flake, then store in bags.

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## CANVAS

- Inspect all awnings, Bimini tops, dodgers and boom covers. Look for chafe, holes, broken stitching, dirt and stains. When canvas rips like tissue paper, it needs replacing.

- Thoroughly clean all vinyl upholstery, convertible tops, boom covers and other canvas with a high-quality cleaner. Follow with a vinyl protector, preferably one that contains a sunscreen.

- To clean vinyl windows, Plexiglas and acrylic, use a cleaner that is designed for the job. Do not use an abrasive. Clear-vinyl roll-up curtains and dodger windows will weather, become cloudy and eventually crack, if not protected from the elements. Products such as Davies Klear-to-Sea, MDR Plasti Clear, Aurora Clear View or Star brite Plastic Polish/Restorer are specially formulated to protect against weathering and restore vinyl that has started to age.

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## FUEL CONDITIONING

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Engine operating problems are often caused by old or contaminated fuel and octane levels which can cause premature engine failure. Lead was added to fuel to control engine knock. When lead was removed, other additives were added to fuel to boost octane levels (a measure of knock resistance). Octane levels vary. Look for fuels with a minimum rating of 87. Fuel rated at 91 to 93 is the best you'll get. These fuels burn cleaner, have the least amount of alcohol and the highest concentration of detergent additives. Ideally, alcohol-free gasoline is preferred, but you won't find any. Alcohol in fuel attracts water and "eats" fuel-pump diaphragms, carburetor parts, rubber fuel lines and other fuel system components and can cause premature fuel-injector failure in EFI engines. Detergents or cleaning agents found in super-unleaded gasoline, help to reduce the risk of hard carbon deposits forming on the pistons.

Carbon deposits may occur regardless of the fuel you use. Rough idling or loss of top-end rpm may be a sign of carbon buildup. Using a fuel additive, such as OMC Carbon Guard, on a continual basis will help minimize carbon buildup (Mercury and Yamaha have similar products). Two-stroke engines (excluding EFI engines) should also use an aerosol combustion-chamber cleaner (OMC Engine Tuner or Mercury Power Tune) every 50 hours of engine use to remove carbon deposits. For four-stroke engines, add the additive before every oil change and the aerosol cleaner every 100 hours. Never use automotive-style additives as they are not designed for marine engines.

Fuel conditioners reduce varnish deposits, break down any water and prevent corrosion in fuel tanks. Adding a fuel conditioner when refueling helps keep gasoline fresh and the fuel system clean. Gasoline has a life of about three months before it begins to deteriorate. Water is denser than gas or diesel and settles to the bottom of the tank, possibly causing corrosion during winter storage. You should have added a fuel conditioner to your fuel tank last fall. If you didn't, and you aren't starting the season with a fresh tank, do it now before starting the engine for the first time. Stabilize gasoline fuel tanks during long-term storage with a conditioner such as OMC 2+4. Add one ounce for every 1 gallon (3.8 litres) of fuel. Diesel engines are also affected by water in the fuel system, which may cause early wear of fuel injection parts. For diesel tanks, use a specially formulated diesel fuel conditioner.

**Lastly, remember Murphy's Law, the one that reads "The most critical part of any job will be forgotten" — and close all seacocks and insert the bilge plug on launch day!**

# TESTING YOUR 12-VOLT SYSTEM

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Your boat's 12-volt system is fairly basic. Electricity must always travel in a circular path from the power source. Break the path and you're without power. The best way to determine electrical problems on board is to use a battery operated multimeter. This handy device measures voltage and resistance and can identify about 99 percent of your problems. Most 12-volt electrical problems are caused by: **1/** a break in the electrical path due to corrosion of the connection points; **2/** exposed or broken wires causing an open circuit; **3/** short circuit where the positive and ground wires make contact. You can pay up to \$200 for a multimeter, but a \$25 unit is sufficient for occasional use.

Packaged with complete instructions, a multimeter is relatively easy to use. Attach the two test leads into the jacks on the meter. To measure voltage, set the dial to the correct scale. Place the red test lead on the positive connection in the circuit and black lead on the negative. When testing mast lights, for example, hold the leads on the positive and negative prongs of the deck plug exiting from the mast. If voltage is not passing through the wires, then something — a burned bulb, broken wire, closed switch — is preventing the voltage from traveling back to you.

When measuring resistance there is no polarity (the test leads can be reversed). Set the dial to Rx1 . Hold the two leads together and check that the meter reads "zero" and adjust if necessary. Place one test lead on each connection. To check a light bulb, place the test leads on each connection. Provided the meter reads "zero" the bulb is okay (high resistance signifies a burned bulb). If the bulb works, check the voltage in the fixture socket. If the socket has voltage than the connection between bulb and socket is bad. Clean the contacts on both with an eraser or emery cloth, and try again. If the light fails to operate, check each connection along the path to the electrical panel. Use the multimeter to check voltage at the panel and resistance of the fuse. If power is not getting to the panel, then the problem is on the battery side of the circuit. Conversely, if there is voltage, then the problem is with the switch. Remove the switch and check the resistance. A sound switch will read zero resistance in the closed or off position, infinite in the open position. If, however, the switch is not defective, there's a wiring problem between the fixture and the switch. Troubleshooting your electrical system can be a tedious procedure. Just remember to check all connections along the path and you should find the culprit.



## SOURCES OF ADDITIONAL INFORMATION

### Books

- The Fiberglass Boat Repair Manual*, Allan H. Vaitses
- The Boat Repair Manual*, George Buchanan
- Boatowner's Mechanical and Electrical Manual*, Nigel Calder
- Runabout Renovation, Jim Anderson
- This Old Boat*, Don Casey
- Marine Diesel Engines*, Nigel Calder

### Videos

- Basic Yacht Maintenance*, 90 min., Bennett Marine Video
- Spring Commissioning*, 40 min., Bennett Marine Video
- Inspecting Your Rig*, 85 min., Bennett Marine Video

# CAST OFF

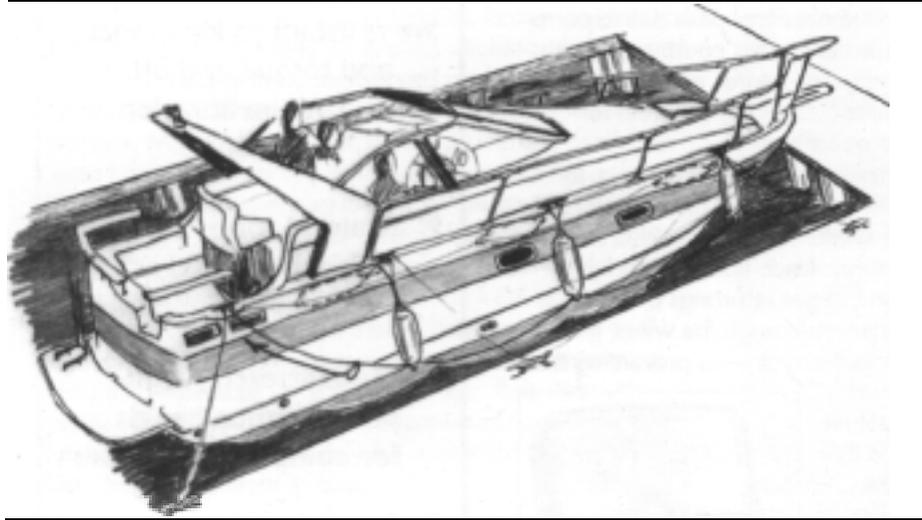
## FENDER CONTROL

It's not easy mounting fenders on

powerboats. Cleats on most small runabouts and some larger cruisers are scarce and seldom installed where you need them most, amid-

ships. Often, it's too dangerous to go forward; side decks are extremely narrow, the boat is without a walk-thru windshield, the fore-deck lacks nonskid or you're boating singlehanded.

Many boat owners have discovered the ideal permanent fix for controlling fenders. Reeve a length of 1/4" line through the lower eye of three or four fenders, depending on boat length. Attach the fenders to any available cleats, preferably along the widest point of the beam. Begin at the bow and fasten the free end of the line to a center or stern cleat. Check the length; fenders should be hanging vertical when the line is slack but not dangling in the water. Tie a knot or seize the line at each fender to hold securely in place. Pull up on the line and either splice or tie a loop in the end to wrap around the cleat. Voila! Fast and simple fender control from the helm and no one need leave the safety of the cockpit.



## LEAVING A DOCK

When tied to the weather side of a dock or when the current is pushing you onto the dock, use your engine, springline and fenders to get underway. Place a fender at the boat's stern (double-enders at the stern quarter) and one slightly forward (see illustration). Wrap the springline around a cleat or dock ring and double back to the boat. Reverse the engine and angle the rudder towards the dock to swing the bow out (1). Keep the line taut, as the bow swings into the wind (2). Now proceed slowly ahead and turn the rudder away from the dock (3). Take in the springline. When tied to the lee side of the dock, use a boat hook to push off. The wind blows the boat off the dock, allowing for a safe departure.



FIGURE 1

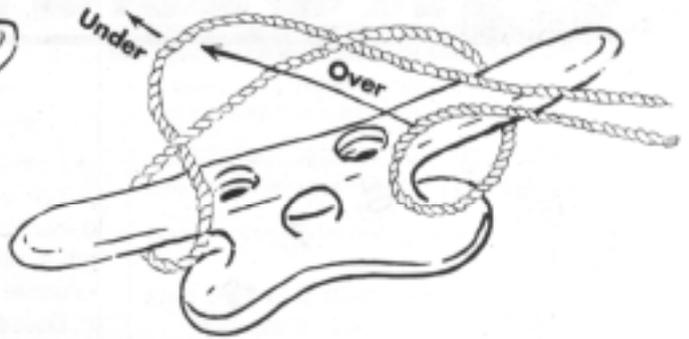


FIGURE 2

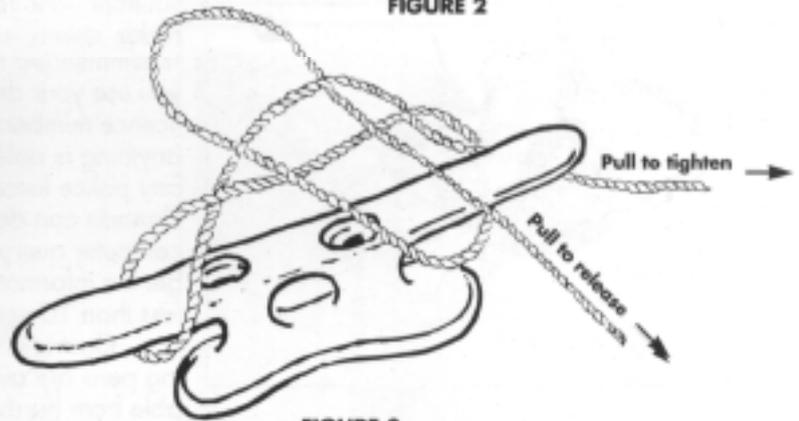
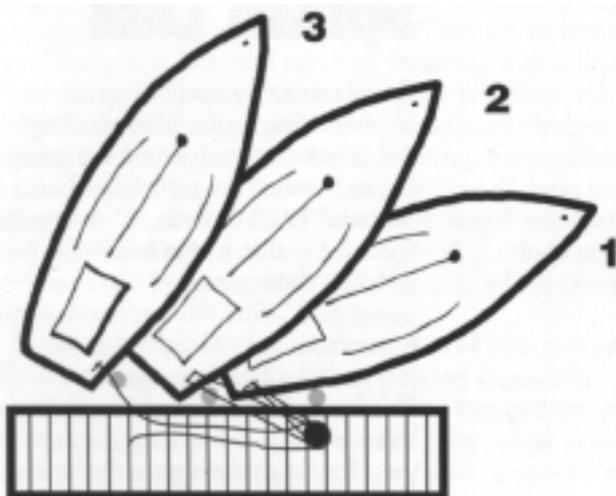


FIGURE 3

## Knotty Know-How

### Highwayman's Knot

This is a useful quick-release knot for temporarily tying up to a gas dock, lock holding wall or for fastening the stern ladder. Known as the Highwayman's or ring slip knot, the knot works best with braid, rather than twisted rope. To tie this knot, pass the line around a cleat or make a loop through a ring, railing, post or whatever. Pass the standing part of the line, which is secured to the boat or an object, under the loop so that it forms another small loop (Figure 1). Take the bitter **end** (free end) of the line and pass it through the second loop (Figure 2), forming a third loop. Yank on the standing part of the line to secure (Figure 3). To release, simply pull hard on the free end of the line. If you tie it right, this knot will hold fast and release freely every time.





## Identi-Etch

Most property stolen off boats is never recovered. Even if police suspect a theft, they usually have no proof. Often, boat owners never report the theft of smaller items as their value is lower than the insurance deductible. When a theft is reported, frequently the owner is unaware of the unit's serial number.

To deter theft and increase the chances of recovery, consider leaving your "mark" on all electronics

and other equipment. Use an engraving pen to inscribe an identification number on all valuable items stored on board — depth sounder, VHF radio, radar, stereo, etc. It's recommended that you use your driver's licence number: if anything is stolen, any police force in Canada can do a computer query and get the information in less than 10 seconds.

Electric engraving pens are available from hardware

stores for about \$20. (Economize and have club or marina members pool resources and purchase one pen.) Some police detachments, particularly those that have a marine department, have engraving pens that they lend to consumers at no-charge. Easy to use, they write much like a ball-point pen. Carve your number on the back panel or under the base of the unit. First check your owner's manual to insure you don't interfere with radio transistors or other electrical components. Write clearly and position

numbers and letters close together to prevent a thief from altering; changing a 1 to a 4, for example.

If something is stolen from your boat, and the theft is reported to police, computers alert police nationwide to be on the lookout for items bearing your licence number. Even when a theft is not reported, personally identifying your equipment allows the law to apprehend the culprit, possibly resulting in an unexpected phone call months later.



## Splash less

There's an easy and cheap means of preventing water from soaking the countertop every time the pump is used: attach an extension. Cut a piece of 1/2" ID hose, 8" in length. Coat the inside of the hose with liquid dish detergent and slip over the pump end. Slide the hose so it overlaps about 2 1/4" from the end or just past the bend so it won't fall off. This hose diameter and length fit a Whale pump. Pumps vary, so check your faucet and distance to the sink before purchasing hose.

# Emergency Plug for Thru-hulls

Every boat that has thru-hulls or seacocks should have safety plugs on board. In the event of a seacock or hose failure, the plug is driven into the opening, keeping the water out.

Make the plugs of softwood, such as cedar or pine; oak, mahogany or ash are much too hard and may crack the seacock housing. Easy to make, you'll



need a hand plane or sharp knife, saw of some kind, rasp, 80-grit sandpaper and oil sealer.

Two sizes of plugs fit all thru-hulls on board. For large plugs (1 1/2" ID), use 1 1/2" stock cut into 5" lengths. Taper plugs from 1 1/2" to 3/4", cutting into an octagon shape with the help of an electric or hand saw. Place in a vise and continue tapering with a jigsaw and finish with a rasp. Alternatively, try whittling with a sharp knife or block plane. Finish off with sandpaper and round the ends to prevent splintering. For smaller seacocks (3/4"), use 1" cedar or pine, cut 4" long and taper to 3/4". Drill a small hole in the larger end for the lanyard. Dip each plug in oil, hang to dry, attach a lanyard of 1/8" polyester cord, and tie around the base of the thru-hull.

Make a few spares for every size of seacock and stow them in your tool kit. When needed (hopefully, never), just tap the plug into place. The lanyard wraps securely around the seacock base to keep water pressure from forcing the plug out. Every year, inspect the plugs for rot and cracking and oil when necessary.

# ENGINE TROUBLESHOOTING

## HORSE SENSE

Horsepower produced by any internal combustion engine is dependent upon the air temperature, barometric pressure and water vapor (humidity) content. Designated horsepower ratings actually refer to the power that the engine will produce at its rated rpm under a specific combination of weather conditions. Engine manufacturers establish horsepower ratings from data obtained by a dynamometer, correcting all values to the power the engine will produce at sea level, 30% relative humidity, a temperature of 25 C (77 F) and a barometric pressure of 29.61 inches.

If you've noticed a loss in engine power on a hot, humid July afternoon, blame it on the weather. Summer-like weather conditions cause a loss in engine power, decreasing boat speeds by as much as 2 or 3 miles per hour. An engine operating in the summer may produce 14% less horsepower than when operating on a dry, fall day.

Weather-inspired horsepower loss also affects propeller sizing. At launch time, the propeller allowed the engine to turn within its recommended

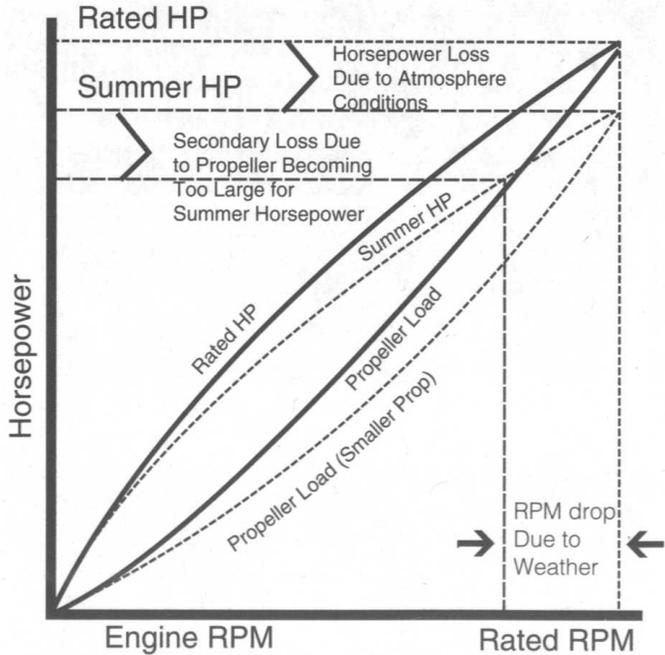
rpm range at full throttle. Then summer arrives and the change in weather causes a pronounced drop in average horsepower; the propeller is now too large. The result: further loss of horsepower and decreased speed. All this can be rectified by changing to a smaller pitch propeller that allows the engine to operate at recommended rpm. You'll not only optimize the available horses but, and more importantly, reduce chances of damage to the engine.

## MATCHING PROP PITCH TO ENGINE RPM

Next time you're cruising the lake, glimpse at your tachometer and note the maximum rpm. What you see on your tach and how your engine responds to the throttle are directly related to the propeller.

Propeller pitch is responsible for engine rpm on an inch-by-inch basis. It measures the distance a prop moves in one revolution through a solid medium (like soft wood). A lower pitch provides great acceleration but top speed usually suffers. Higher pitch almost always increases

top speed, but getting there may take longer than usual. To determine the correct pitch for your boat, you need to test run your boat, motor and propeller set-up. (If your boat is without a tachometer, you'll need to purchase one.) Refer to your owner's manual for the recommended operation rpm range for your engine at wide open throttle (WOT). Check the propeller to make sure it's not nicked, dinged or bent, then run the boat with its normal load and weight distribution, adjusting the motor trim angle for high-speed running. Watching the tachometer gauge, carefully note the maximum operation rpm at WOT. Compare your reading with the manufacturer's specifications. This value is extremely important: an engine that runs at lower rated rpm or revs higher than the recommended rpm will, eventually, self-destruct. The variance in rpm can be corrected by choosing a propeller with a pitch difference of 1" for every 200 rpm. If the WOT reading is 400 rpm less than recommended, for example, select a propeller with 2" less pitch. Conversely, if the tach reads 400 rpm higher, choose a prop with 2" more pitch, but don't "overprop" or you will damage your engine. Install the new prop and with the boat similarly equipped, go for a trial run. If your calculations are correct, you should have the right size prop, or be only one size off.



top speed, but getting there may take longer than usual.

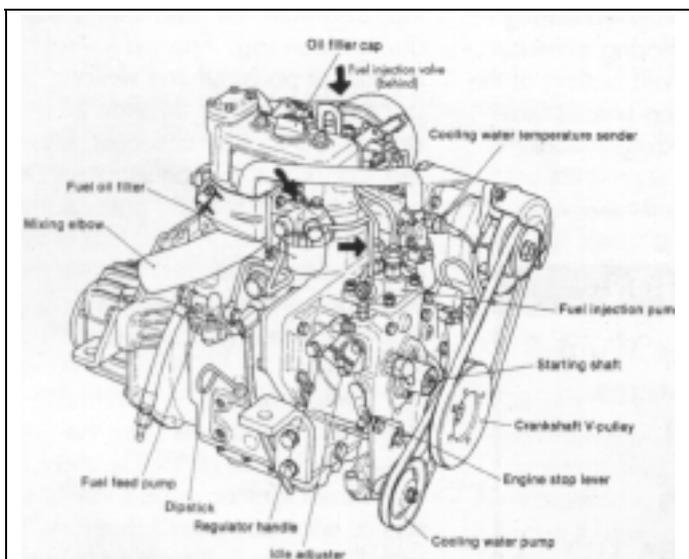
To determine the correct pitch for your boat, you need to test run your boat, motor and propeller set-up. (If your boat is without a tachometer, you'll need to purchase one.) Refer to your owner's manual for the recommended operation rpm range for your engine at wide

## BLEEDING A DIESEL ENGINE

Air entering any part of the diesel fuel oil system between the fuel tank and injection valves will cause faulty fuel injection.

To bleed the fuel system:

1. Place the throttle in the half-speed position. Open the fuel tank cock (if equipped).
2. Loosen the air bleed bolt at the top of the fuel filter. Manually operate the priming lever of the fuel feed pump on the engine until no more bubbles appear in the fuel flowing from the filter. Retighten the bolt.
3. Loosen the connector bolt of the fuel return pipe installed on the fuel injection valve and bleed the air by operating the manual handle of the fuel pump. Start with number #1 cylinder, then #2 cylinder; repeat the procedure for each cylinder.
4. Loosen the nipple on the fuel injection valve side, set the regulator handle to the operating position and raise the decompression lever to the no-compression position. Hand crank or start the engine. When cleared of bubbles, retighten the nipple. (When hand cranking, always turn the engine in the proper direction of rotation.)
5. After bleeding the air, start the engine. Listen for the sound of fuel injected from the injection valve. You should hear a high-pitched "hiss" at each cylinder. Place your hand on the fuel injection pipe; you should feel resistance. Check no more than two or three times to prevent flooding the combustion chamber with fuel.
6. Mark the heads of all engine bleed bolts and screws with a brightly colored nail polish. In case of emergency servicing, you'll be glad you did!



Note: Procedure for bleeding your engine may differ depending upon fuel injection system setup. Refer to your service manual.

## INSTALLING TRANSDUCERS

Transducer mounting location is the most critical part of your electronics installation. Whether you are installing a depth sounder or speed log, the principles are similar. The transducer acts like an underwater "antenna" that **sends and** receives signals. Underwater projections and the boat's natural movement through water create air bubbles and hull cavitation. A transducer face that is in "dirty" water will show a random readout on the display unit.

Always align speed log paddles parallel to the boat's centerline, at right angles to the keel and as close to the keel as possible or you'll get a false reading. To obtain accurate readings on your depth sounder, the transducer must be mounted in bubble-free water and as near horizontal (facing straight down) as possible and certainly within 15 to 18 degrees to maintain range; otherwise, the signal reflecting from the bottom may fail to return to the transducer. Runabouts can mount the transducer on the transom. In larger inboard-powered cruisers position the transducer amidship. On a sailboat, a position in the stem ahead of the keel is ideal. Units vary; refer to your

owner's manual for exact specifications.

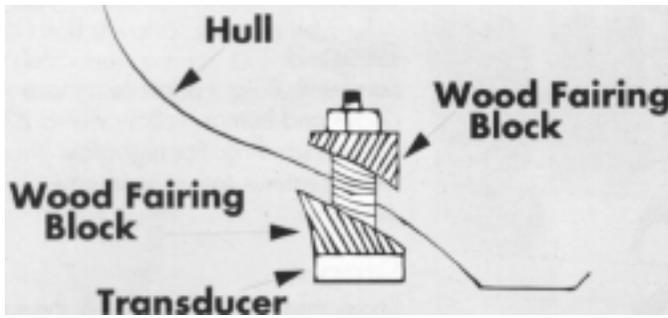
Transom mounting is the simplest and requires drilling holes for fasteners only. Before installing, run the boat at different speeds and note the area on either side of the outdrive where the water flow is smoothest (at least 1' from the lower unit). Make sure the location doesn't interfere with trailer supports and is away from strakes or ribs on the hull. Install just below the waterline, parallel to the ground. (Check manufacturer's instructions for exact horizontal location.) Some aluminum boats with strakes or ribs on the outside of the hull create excessive turbulence at high speeds; mount transducers below the waterline to avoid bubbles.

On thru-hull installations mount the transducer through the hull with the face of the transducer in direct contact with the water to insure maximum performance. The transducer should be well below the waterline in an area of minimum turbulence away from any hull projections or other thru-hulls capable of generating air bubbles. If the transducer head cannot be recessed flush against the hull a wooden fairing block is required. Flaring blocks must match the curved bottom of the boat with a matching block inside the hull. In-hull bonding, where the

transducer is placed in a well filled with antifreeze (water freezes in winter) or oil, offers a temporary solution. The well can be as simple as a 4" diameter PVC pipe with a threaded end cap, cut to length and glued in place. In non-cored fiberglass hulls, however, in-hull bonding may cause erratic readouts and it won't read at all through cored or cold-molded hulls.

Before drilling, double check your measurements and remember the adage, "Measure twice, cut once!" Cut through the fiberglass using a hole saw or drill fitted with a hole cutter. Drill slowly without applying excessive pressure or the saw will grab. To prevent chipping of the fiberglass (or wood), make a shallow cut on the outside, far enough for the drill bit to exit, then finish the cut from the inside. Dry fit the transducer and, if necessary, file the hole for a tight fit. If the transducer does not lie flush against the hull at all points, you'll need to fashion a wood fairing block made of mahogany or softwood. Treat the wood with epoxy to prevent rot and paint exposed surfaces. Mark the outside circumference before removing. Degrease the area with acetone and a clean rag. Apply a liberal amount of polyurethane sealant (such as 3M 5200, Sikaflex 241 and others) to the transducer, fairing block and hull. Join all surfaces. Do not overtighten the nut; particularly bronze thru-hulls. Always use bronze on wooden boats; never plastic that will crack or distort due to expansion. Remove any excess sealant with solvent.

One final note: when routing depth sounder cables keep well away from other wires. Electrical noise from ignition wiring, alternators or bilge pumps will interfere with the readout. Also, do not bundle with speed log paddle cable, as it may interfere with the log readout. Never cut any transducer cable.



Use two wooden fairing blocks to flush-mount a transducer against the hull. Shape the blocks to match the inside and outside curve of the hull.

If depth display is 00 or readings are erratic check for:

1. Faulty electrical connections.
2. Excessive buildup of bottom paint or marine growth on transducer face. Never paint the transducer.

3. Weeds on outdrive.
4. Transducer is out of the water (transom-mounted units).
5. Water conditions such as weeds, floating jetsam, tide rips and other turbulent water and naturally occurring thermal layers.

## Deep-V Solutions

Deep-V sailboats with full keels (Alberg 37, Contessa 26), that cannot mount a transducer on the centerline, have two options. Drill a hole through the middle just forward of the keel and attach a substantial wooden block to fair the curve of the transducer to the hull. With this type of installation, the unit sits broad in front of the keel, a target for deadheads and other underwater obstructions. A better solution is to install two transducers on either side of the keel, connected to a heeling switch. This switch averages the difference, producing near identical readings port and starboard.

## Replacing a Transducer

### Undersized hole

#### Step 1

Knock out the old transducer with a hammer, 2x4 and brut force or whatever it takes. If it still doesn't budge, grind off the flange or try sliding an Exacto knife between the hull and flange to break the sealant.

#### Step 2

To drill a larger hole, you need to rig a device to hold the drill shaft of the hole saw captive. On the inside, place a piece of 1/2" plywood over the hole, then find a volunteer to stand on it, holding it securely in position. Drill into the plywood until the saw teeth are buried about 1/8" in the hull. If you work alone, fashion a dummy plug of wood and glue into the hole. Let cure, then cut.

#### Step 3

Check the fit and install the transducer. Follow above guidelines

for new transducers.

### Oversized hole

#### Step 1

Fill the existing hole with epoxy thickened with microfibres to a non-sagging peanut butter consistency.

#### Step 2

Glue a 1/2" or 3/4" marine plywood plug to the inside, using epoxy thickened with Colloidal Silica so that it resembles mayonnaise.

#### Step 3

When cured, drill a hole to fit the new transducer with a hole saw. Follow fitting and installation instructions for new transducers.

OR  
Alternatively, some transducers have a flange that is substantially larger in diameter, as much as

50% larger than the shank. Rather than seal the hole with epoxy, an option is to fill the gap with polyurethane sealant, providing the difference is no larger than 1/4" on all sides. Don't do this with any sealant other than polyurethane — it's as strong as steel, yet remains flexible and bonds like Krazy glue, which I'm sure you discovered when you removed the original transducer if fitted with polyurethane. Only consider this option when the transducer has an oversize flange. Installation takes less than an hour and is used by many electronics installers to save their time and your money.

# Repairing fiberglass

## HULLS & DECKS

Fiberglass is a porous material with an outer surface protected by a polyester resin known as gelcoat. It can withstand plenty of abuse, but puncture the surface and you need to repair it to prevent water from entering the laminate. In areas of high stress or loading — stanchion and pulpit bases, chain plates, backstays, genoa tracks, mast collars, hatches and transoms — gelcoat often cracks, causing web-like cracks or crazing on the outside. Fine hairline cracks are easily filled with matching gelcoat obtained from the boat manufacturer or dealer. To quickly and effectively repair minor scratches and dings, use a gelcoat repair kit from Gelcoat International or Seacare available at many marine stores. These kits contain gel paste, hardener and color pigments to match the gelcoat. Deeper gouges that have penetrated the gelcoat or punctures require more labor to prevent water from softening the fiberglass. Major repairs to fiberglass boats are easily accomplished with a few basic tools, epoxy and fillers and where there is a puncture, extra laminate materials. The following instructions are based on the booklet, *Fiberglass Boat Repair & Maintenance*, and video, *Fiberglass Repair with West System*, both published by the Gougeon Brothers (Box 908, Bay City, MI 48707-99 18; Tel: (517) 684-7286, Fax: (517) 684-

1374). Remember, always wear protective clothing, plastic face shield and a face respirator when sanding fiberglass. When working with epoxy, apply a barrier cream and wear disposable gloves.

### REPAIRING MINOR CRACKS AND SCRATCHES

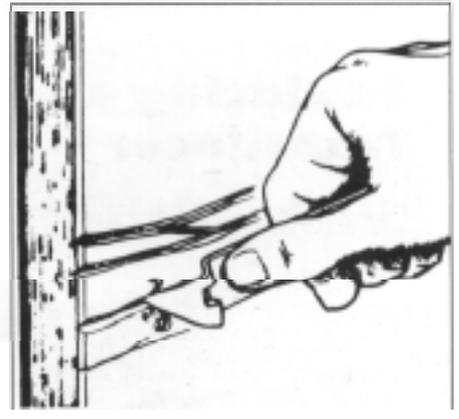
**Step 1**  
Remove loose or damaged material. Widen the crack with a sharp V-shaped tool (screwdriver, can opener or nail) and scrape down to the bottom of the crack. Dry out the damaged area with a hair dryer or hot air gun. Feather the edges with a scraping tool or 100-grit sandpaper and remove all dust.

**Step 2**  
Wet-out the damaged area with a small brush dipped in unthickened (resin and hardener only) epoxy. Mix together a high-density filler (microfibers or Colloidal Silica) with epoxy to make a thick, non-sagging, peanut butter-like paste. Trowel the mixture into the wetted out cavity with a small putty knife. Remove excess epoxy from the untreated surface with

a putty knife and clean with solvent before it cures. Let cure for 24 hours.

**Step 3**  
Sand with 80-grit paper to remove ridges and bumps. Follow with a 220-grit wet sanding. For high-gloss finishes, continue to wet sand down to 400 grit.

**Step 4**  
Epoxy must be protected from the sun's ultraviolet rays with gelcoat or paint. Obtain a small quantity of gelcoat from the dealer or boatbuilder and apply with a small Preval Auto Sprayer (available from some boatbuilder's supply stores and hardware stores). If you decide to paint, follow the manufacturer's recommendations for final preparation and application.



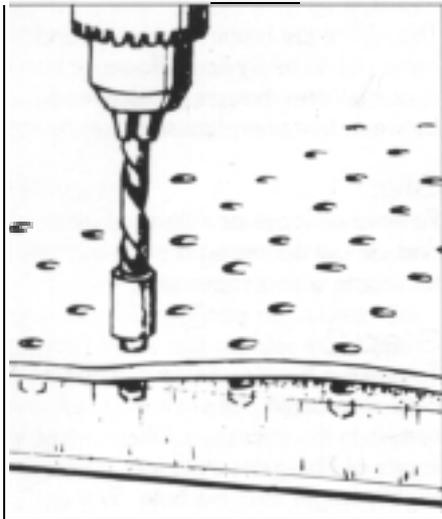
Use a can opener, sharpened with a file or grinder to open cracks for repair.

### REPAIRING DELAMINATED CORED HULLS AND DECKS

**Step 1**  
First you must determine the outer limits of the damaged area. Use a moisture meter or try the finger test. Exert pressure on the outer surface; a soft feel or slight depression (much like testing a cake for doneness) indicates a gap between the skin and core.

## Step 2

Drill 1/4" (6 mm) holes, 1" (2.5 cm) apart and about 6" (15 cm) beyond the delamination area. Drill through the skin and about 1/3 of the way into the core.



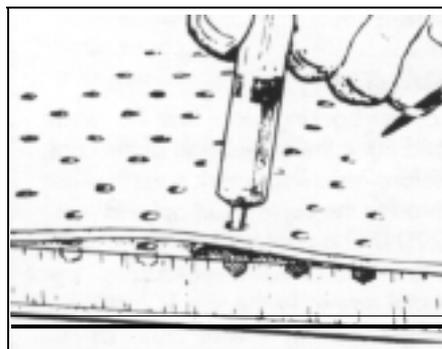
Step 2: Drill 1/4" (6mm) holes, 1" (2.5 cm) apart about 6" (15cm) beyond the delaminated area.

## Step 3

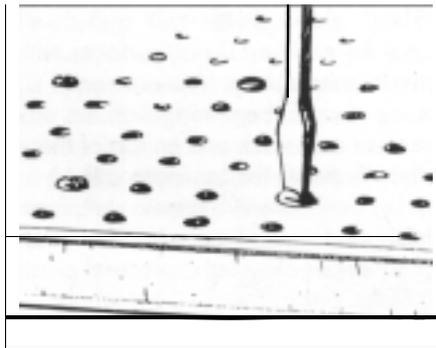
Thoroughly dry the core before gluing. Use a hair dryer or heat lamp to accelerate drying. Take care not to damage the skin with excessive heat. Drill a few test holes to check for dryness.

## Step 4

Mix epoxy with Colloidal Silica to a "catsup" consistency. Load into a syringe And inject into all drilled holes beginning in the center of the delaminated area. Flex the skin several times to work the epoxy into all areas between the skin and core. (Syringes



Step 4: Inject thickened epoxy into all holes beginning in the center of the delaminated area.



Step 5: Use sheet metal screws to hold the skin against the core until the epoxy cures.

are available from boatbuilding suppliers.

## Step 5

Cover the area with plastic or wax paper and place weights, apply pressure or screw in sheet metal fasteners to hold the skin against the core until the epoxy cures. Do not apply excessive force or the panel will distort. The plastic prevents weights from bonding to the surface.

## Step 6

When the epoxy has completely cured, sand the surface fair with 80-grit sandpaper. Fill low spots with epoxy and a low-density filler (it's lightweight and easy to sand) mixed to a "mayonnaise" consistency. Sand when cured and coat with unthickened epoxy. When cured, sand with 220-grit paper.

## Step 7

Apply gelcoat or paint over the epoxy. See Repairing Minor Cracks, step 4.



Step 6: Sand the surface then fill low spots with thickened epoxy.

# REPAIRING HOLES AND PUNCTURES

## Uncored Hulls

### Step 1

Remove all loose or damaged material. Draw a circular or oval outline around the repair area. Cut out the marked area with a saber saw. Inspect internal structural members for damage and dry the area. Measure the thickness of the laminate with calipers to determine the bevel diameter. From the edges of the hole, mark a line that represents a 12: 1 slope. For example, a 1/4" (.6 cm) laminate requires a 3" (7.5 cm) bevel from the edge of the repair area. Sand the bevel with a random orbital sander with a 50-to 80-grit sanding disc, producing a gradual slope from the outer edge. Sand the inside edge of the hole to remove the sharp edge. Wipe all surfaces with solvent and let dry.

### Step 2

If necessary, provide backing for the repair by either bracing, screwing or wedging plastic-covered Styrofoam or 1/4" (.6 cm) plywood over the inside of the hole. Cut the wood slightly larger than the repair area. If you cannot gain access from the interior, you'll have to make a patch (see Cored Hulls, steps 2 and 4, for instructions).

### Step 3

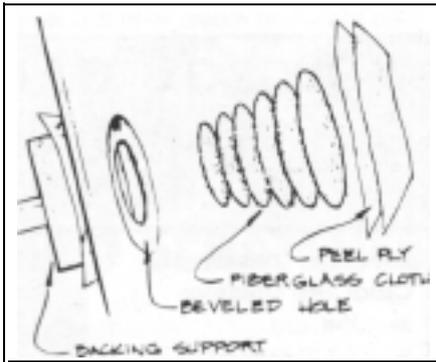
Laminate a fiberglass patch the same thickness of the original laminate. Use pieces of 15-ounce, 22-ounce and 12-ounce fiberglass cloth. First, tape a piece of fiberglass cloth over the hole and mark the outside edge of the bevel. Cut this first layer slightly smaller than the outer edge of the bevel. Check the fit, then cut each piece progressively smaller. The final layer should be slightly larger than the inner edge of the bevel.

### Step 4

Coat the exposed repair surfaces with unthickened epoxy. Wet-out each piece of cloth, beginning with the smallest and stack one on top of the other. Saturate the laminate with epoxy (laminate will have a dull, mat finish) and remove excess with a plastic squeegee. Lay out a piece of plastic to fit the patch, cover with peel ply, then the epoxy coated fiberglass patch. Apply epoxy thickened with Colloidal Silica to the beveled edge and position the patch over the hole. Work air bubbles and excess epoxy out of the patch with the squeegee. Remove plastic and smooth out again to remove remaining bubbles. Remove excess epoxy and wipe untreated area with solvent. Let cure.

### Step 5

Remove peel ply and plywood backing. With a sanding block, grinder or power sander, sand any high areas flush with the surface. For large areas, check for fairness with a straight edge. Fill remaining low spots with epoxy



To repair holes and punctures, make a patch using multiple layers of fiberglass cloth cured with epoxy resin.

and a low density filler mixed to a "mayonnaise" consistency. Fair the epoxy mixture with a squeegee or batten (depends on size of repair area). When cured, sand surface smooth with a sanding block and 60-grit paper.

### Step 6

Coat the repair area with several coats of unthickened epoxy applied with a roller and tipped off with a foam brush. (Follow the manufacturer's application instructions.) Add a pig-

ment to provide a color base for the paint. Allow to cure 24 hours before final wet sanding with 220-grit paper and painting or gelcoating.

## Cored Hulls

This technique repairs punctures and holes in balsa, plywood, foam or honeycomb cores that are sandwiched between two fiberglass skins.

### Step 1

Remove all loose or damaged material and cut out the repair area in a circular shape with a saber saw.

### Step 2

To make a backing plate in a cored hull, or uncored hull with restricted access to the interior, cut three or more layers of fiberglass cloth into squares slightly larger than the hole. Wet out each piece of cloth with resin/hardener mixture and stack together on top of a piece of plastic. Cover with peel ply and remove excess epoxy and air bubbles with a plastic squeegee. Let cure. When fully cured, remove plastic and peel ply.

### Step 3

Using a router, make a cut 1 1/2" (3.8 cm) from the hole, through the skin and core only. Chisel out the skin and core material. Dry the area thoroughly with a heat lamp or hot air gun. Clean with solvent and sand with 80-grit paper. To bevel the edge of the hole, first measure the skin thickness and mark a 12: 1 circular bevel line around the hole. Grind a gradual slope with a grinder and 80-grit sanding disc. Remove dust and wipe all surfaces, including the inside of the hole with solvent.

### Step 4

Lay the backing plate over the repair and trace the outer edge of the core. Before removing, mark a vertical line through the center. Cut out with scissors. Drill a pilot hole through the centerline and attach a self-tapping, sheet metal screw. To the screw, fasten a length of string or wire. (Alternatively, first thread a longer screw through a wood batten cut slightly wider than the outer edge of the repair area.) Remove dust from repair area. Apply unthick-

ened epoxy to the inside of the hole with a paper towel. Apply epoxy thickened with Colloidal Silica to the overlapping edge of the backup piece. Insert into the hole, screw side out. Align with the vertical mark and pull wire or string tight to squeeze out excess epoxy. Secure wire (or tighten the screw until the wood batten lies snug against the hull surface), remove excess epoxy and let cure. When cured, remove wire and screw.

### Step 5

Tape clear plastic over the hole and trace the outer edge of the core material. Before removing, draw a placement mark to facilitate alignment. Cut out the plastic and transfer the shape to the core material; cut with an Exacto knife and sand smooth. Insert into the hole and shave edges to fit, if necessary.

### Step 6

Coat the core material and hole with resin/hardener mixture. Apply epoxy thickened with Colloidal Silica to a "mayonnaise" consistency to the hole cavity, inner surface and outer edge of the core material. Insert core. Clean off excess epoxy with a putty knife and wipe epoxy from untreated area with solvent.

### Step 7

To laminate the outer skin patch, follow the same procedures for uncored hulls, steps 3 through 6.

## Testing for Dryness

It is imperative that the fiberglass laminate be dry before repairing or applying any coating. To test for moisture, cut 6" (15 cm) squares of polyethylene plastic, lay over the area to be repaired and tape all edges with elec-



*Duarte Picanco of Toronto-based Noahs checks moisture levels of the hull laminate prior to painting.*

trical or duct tape. Leave for a few days. If condensation forms, the hull requires further drying. Remove the plastic, wipe the area and plastic dry and re-tape the plastic in place. Alternatively, purchase a Moisture Meter to check the level and location of moisture in the laminate. These meters work by measuring the resistance of electrical signals passing through the laminate. A "dry" laminate typically

gives a reading of 2% to 5%.

## INFORMATION SOURCES

### Books

*Fiberglass Boat Repair & Maintenance*, 76 pages, Gougeon Brothers.  
*The Fiberglass Boat Repair Manual*, Allan H. Vaitses  
*The Boat Repair Manual*, George Buchanan

### Videos

*Fiberglass Repairs Made Easy*, 2 vol. set, 97 min. Bennett Marine Video  
*Cosmetic Gelcoat & Fiberglass Repair*, 3 vol. set, 250 min., Bennett Marine  
*Fiberglass Repair with West System*, 26 min., Gougeon Brothers

Credit: Illustrations reproduced from the booklet, *Fiberglass Boat Repair & Maintenance*, published by Gougeon Brothers, Box 908, Bay City, MI 48707-99 18; Tel: (517) 684-7286, Fax: (517) 684-1374.

## TOOLS

- Random orbital disc sander (takes 5" or 6" diameter discs)
- Electric sander saw
- Router
- Sandpaper, various grits
- Respirator
- Dust mask
- Moisture meter
- 2" putty knife
- 4" putty knife
- Fiberglass cloth, different weights
- Core material
- Epoxy resin

- Mixing containers
- Syringes
- Glue brushes
- Stir sticks
- Rubber gloves
- Barrier cream
- Plastic squeegee
- Solvent (acetone)
- Plastic or wax paper
- Electrical or duct tape
- Peel ply
- Chisels
- Exacto knife
- Rollers, foam brushes

# Painting Handbook

Follow these easy steps to a high-quality, long-lasting professional finish.

## PREPARATION:

Proper surface preparation is the key element to the success of all paint jobs. It's the least enjoyable aspect of painting, consuming about 90% of the total time allotted. It requires plenty of TLC: patience, muscle, sweat and more patience. All new and previously painted surfaces must be clean and free of grease, loose or flaking paint, mold release agents, oxidants or other contaminants. First wash with warm water followed by a brush cleaner or degreaser. Failure to do so will permanently bury the contaminants into the sanding scratches. Remove mildew in

interiors with a specially formulated cleaner or a 1: 1 solution of bleach and water. You can destroy mildew with a commercial product or make your own as follows: 1 cup of bleach, 1 cup of detergent, 4 litres of water. Mix and scrub thoroughly. Allow to soak in and hose off with clear water. Gloss paints give a mirror-like finish but also show all hull imperfections. Fill all obvious dents, scratches, etc., with an epoxy based product.

## DEGREASING:

All new and old boats must be cleaned and degreased before painting. New

fiberglass boats have a mold release agent (usually a wax) on the gelcoat. Previously painted surfaces have dirt, grease, old wax and other contaminants that must be removed. If not removed, paint adhesion will be affected. In some cases, the paint may not dry. Paints will not adhere if contaminants, such as wax, oil, fuel or fingerprints, are left on the surface. Before sanding, carefully wipe down the area to be painted with clean lint-free rags doused in brushing thinner or fiberglass dewaxer, lifting the dirt from the surface. Use plenty of rags, changing often. Wear protective rubber gloves (not disposable ones that are quickly disintegrated by solvents) and cover every inch. Don't chintz with the cleaner. One quart of cleaner should wipe down about 10 feet of boat. Make sure your work area is well ventilated. To check that all wax is removed, lightly spray with water. If the water beads, degrease again.

## SANDING:

Sanding a surface before painting provides a low-gloss, rough surface with a good anchor pattern for paints to adhere to. Sand by the "numbers," beginning with a larger grit and concluding with finer grit to produce a smooth, scratch-free finish. The recommended time versus grit routine is: 5% with 50 grit; 10% with 100 grit; 25% with 120 grit; 30% with 150 grit; 20% with 180 grit; and 15% with 220 grit. Be extremely careful when using a high-rpm disk sander, particularly when sanding gelcoat or epoxy. Do not

## HOW MUCH PAINT DO YOU NEED?

Boat Length/Type	Bottom	Topside Polyurethane	Topside Enamel	Waterline	Deck	Varnish	Interior
3.0 m/10' Dinghy		1 qt	1 qt			1 pt	
4.2m/14' Runabout	1 qt	1 qt	1 qt		1 qt	1 qt	
5.5m/18' Runabout	2 qt	1 qt	2 qt	1 pt	1 qt	1.5 qt	
6m/20' Sailboat	3 qt	2 qt	2 qt	1 pt	1.5 qt	2 qt	
7.3m/24' Runabout	3 qt	2 qt	2 qt	1 pt	1 qt	1.5 qt	
9m/30' Sailboat	1.5 gal	3 qt	1 gal	1 pt	2 qt	2 qt	2 qt
9.7m/32' Cruiser	1.5 gal	3 qt	1 gal	1 pt	2 qt	2 qt	2 qt
11m/36' Sailboat	2 gal	5 qt	2 gal	1 pt	1 gal	1 gal	3 qt
12.2/40' Cruiser	2 gal	5 qt	2.5 gal	1 pt	1.5 gal	1 gal	1 gal

Quantities are for 2 coats. For new or bare surfaces double the quantity.

# TIPS

## TEST BEFORE PAINTING

If the surface is prepared correctly and you've strictly adhered to all the rules for sanding, priming and recoating, chances are you'll have a flawless, professional finish. But even the best-laid plans do not guarantee a defect-free finish. It's recommended that you test a new paint system before starting to insure that thinner, undercoat and finish coat are compatible with your boat's existing surface. This procedure is critical, especially if the type of the existing finish is unknown. (It's also a good practice if you're changing hull or deck colors.)

apply excessive pressure as it may soften the existing coating, load the paper or gouge the surface, creating large circles that will definitely show through, even after applying multiple coats. Using a too-coarse sandpaper also produces scratch marks that are visible through the finish coat, especially with today's high gloss paints. Always use a sanding block when dry hand sanding. Keep sandpaper clean and change often. Brush or tap the paper to remove sanding residue when necessary, and improve the cutting action. Change the paper frequently. Always sand bare wood surfaces with the grain then paint or coat as soon as possible before the wood absorbs moisture. Use bronze wool, not steel wool for rubbing down varnish; steel particles embedded in the surface will eventually rust through the paint. (Be considerate and never sand when your neighbors downwind are painting or varnishing.)

After sanding, vacuum all dust residue and dewax again to remove sanding dust and contaminants before painting. After completing the final surface cleaning, resist the temptation to draw your hand over it! Use a vacuum cleaner to clean up dust in preparation for painting (compressed air works best, if available). Before applying the final coat, wet the ground or floor to reduce airborne dust particles. Allow an hour or two for the dust to settle before painting. Do not leave bare

wood exposed; if you cannot finish in time, protect the area from dew with a plastic cover.

## SANDING EPOXY:

The bi-product of epoxy is an oily or waxy surface known as amine blush. Remove all blush before sanding or applying any paint or varnish. Wait for the epoxy to reach a full cure, about two weeks. Clean the surface with a soapy water solution and 3M Scotch Brite pad to remove the wax. Wash with freshwater and dry with clean rags, wiping off the wax, changing rags frequently so that all wax is removed, not just spread around. Clean with recommended thinner or brushing solution before sanding or painting.

## SANDPAPER

Use AL0 (brown) sandpaper for wood. For fiberglass, epoxy or sanding paint between coats, use AL0 Lube Fre-cut (white) or waterproof (black). For blistered or peeled paint, begin with a coarse grit sandpaper (50 to 100 grit), depending on the condition of the existing finish. Progressively sand with finer grits (120 to 220) in preparation for the finishing coats. Follow the paint manufacturer's instructions to the letter. (See Abrasive Chart for recommended paper grits.)

## PRIMERS:

Primers are used as undercoats to fill the gelcoat or epoxy surface before applying the finish coats. A high-build

## ABRASIVES CHART

These are general recommendations. We suggest you follow the manufacturer's application instructions when painting, varnishing or coating.

Coating	Application	Sandpaper
Varnish	Stripping old varnish	60-100
	Between coats	220 or 320
	Before final coat	600
Bottom Paint	Stripping old paint	24-40
	Light sanding	60-100
	Between coats (if needed)	80-120
Gelcoat	Stripping old gelcoat	24-40
	Heavy sanding	60-150
	Intermediate sanding	220-320
	Finish sanding (before compounding)	600 or 800
Fairing Compound	Heavy sanding	24-40
	intermediate sanding	60-100
	Finish sanding	120-220
Epoxy	Heavy sanding	60-120
	Intermediate sanding	180 or 220
Topside Paint	Stripping old paint	36-60
	Intermediate sanding	80-150
	Sanding prior to painting	150-220
Primer	Between primer coats	150-220
Painted Wood	Stripping old paint	36 or 40
	Intermediate sanding	60-100
	Finish sanding	120-180
Metal	Stripping old finish	36 or 40
	Rust removal	40-100
	Light sanding	150-220

Courtesy of 3M Canada



sanding primer hides minor imperfections such as pinholing and gelcoat crazing. A primer may not be required but often gives better results; check the manufacturer's specifications.

## THINNING:

Thinning paints and varnishes keeps the wet edge open longer, allowing better paint flow and leveling of brush strokes between painted areas. Use only the recommended thinner for each specific paint. Thin paints as directed by the supplier and never more than 10 percent by volume. Too much thinner reduces film thickness, causing sags, slow drying and reduced gloss. Never use varsol, turps or petroleum-based products to thin, wipe down or clean tools when using polyurethane products. If a paint "pulls," a condition caused when the paint is too thick for the ambient temperature, add thinner but never more than recommended.

## WEATHER:

Watch your weather. Temperature, direct sunlight and humidity all affect drying times for many paints and varnishes. Some of the newer high-tech, one and two-component polyurethane paints are extremely susceptible to high humidity, which may affect their drying and hardening qualities. Choose a warm, dry and windless day (if possible) and apply in the shade. Some paints won't dry if the temperature is below 10 C (50 F); over 26 C (80 F) paints dry too fast, leaving highly visible brush strokes.

## HULL TEMPERATURE:

Most paints work best at 20 C (68 F) surface temperature. Fiberglass and wood absorb and release heat very slowly, aluminum extremely fast and steel about four times slower. Hull temperature also affects drying times between coats. Never paint on a damp surface.

## BRUSHES and ROLLERS:

You've spent a lot for your paint, do not economize on brushes. Buy the best quality you can afford. A good brush makes the job easier, faster and gives premium results. Select the right tool for the job. Choose a brush designed for the specific job and always use the largest brush possible. For topside painting, use a 2" brush. A badger-style, natural bristle brush that has a chiseled edge, rather than square, provides a finer working tip when applying varnish or urethanes. Use only solvent-resistant brushes and rollers. Rollers with a phenolic core will last

longer. Inexpensive, disposable foam brushes work well for tipping off epoxy, polyurethane and epoxy-based paints.

## COATING CHECK:

When recoating an unknown painted surface, it's important to first determine the breed of the original product. Marine paints are designated as either one or two-component systems. Most one-component paints can be applied over two-component products but not visa versa. To determine if an existing surface is a one or two component paint, rub a small area with a rag dipped in acetone. If the paint dissolves or wrinkles (reacts like a paint remover) within 10 minutes, it is a one compo-

## PAINTING SYSTEMS FOR METALS

**Steel:** Clean with freshwater and dry completely. Remove rust scale, corrosion and damaged coating by either sandblasting (preferred), disc grinding or wire brushing. Touch up any bare spots with primer and a brush to insure penetration into the rough surface. Apply primer immediately after cleaning, before new rust starts to form. Two coats will help to fill all pitholes. Smooth uneven surfaces with a fairing compound. Do not paint steel when the relative humidity exceeds 85 % and the hull surface temperature is below -15 C (5 F).

**Aluminum:** Clean all bare metal thoroughly with a solvent wash. Remove oxidation by scrubbing with a cleaning compound and bronze wool. Rinse well. Use an underwater epoxy or patching compound to fix loose rivets or split seams. On spars and small aluminum boats, apply primer with a brush, carefully filling all pinholes. Fair uneven surfaces with a fairing compound, if necessary. Apply a second coat of primer, followed by two or three coat of enamel or polyurethane, sanding between coats. On large aluminum hulls degrease surface with a non-alkaline, chloride-free detergent, followed by a sanding with 60 to 80 grit paper. If the surface is in poor condition, remove any anodizing or white rust by gritsweeping using a salt-free abra-

sive and freshwater wash. Dry completely. Remove all dust. Apply recommended primer before painting.

**Underwater hardware:** Painting shafts, propellers, trim tabs, struts, thru-hull fittings and outdrives requires special surface preparation. First, wipe clean and degrease to remove contaminants. Sand with medium grit emery cloth or sandblast (except outdrives) to bring metal to uniform bright finish. Degrease to remove all residue and apply an approved metal primer. All metal must be primed prior to application of antifouling paint. Follow manufacturer's instructions for applying successive primer coats and antifouling. Soft and vinyl antifouling paints are not recommended. To prevent galvanic corrosion, do not use a cuprous oxide bottom paint on outdrives.

**Keels:** Unprotected lead, steel and cast iron sailboat keels and centerboards are susceptible to corrosion or electrolysis. Covering such surfaces with an epoxy based coating gives protection and a treated surface to which antifouling can be applied. General preparation begins with a sandblasting or grinding with a 36-grit wheel to a bright metal, followed by a solvent wash to remove residue. Follow manufacturer's instructions for application procedures of specific epoxy coating.

## THE RIGHT TAPE FOR THE RIGHT APPLICATION

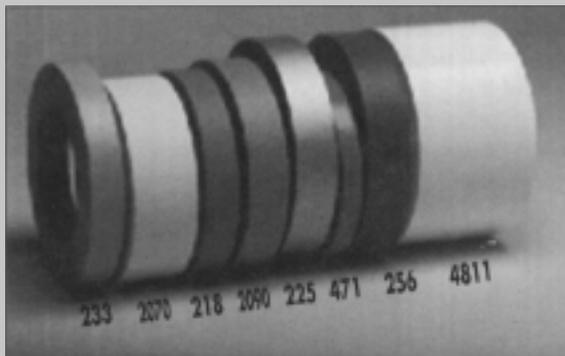
Remember when you last painted the bottom and came back the next day to remove the masking tape you purchased at the "Dollar Store." It had fully cured, leaving a tape residue on the hull, (known as adhesive transfer in tape lingo), maybe even lifted the recently applied paint underneath. On another day, you quickly removed the tape but discovered the tape's low-grade adhesive caused the red paint to seep under onto the white; not a pretty picture. Tapes used for masking an area when painting are grouped generically under "masking tapes," but that's where the similarities end. There are specialized tapes for detailing, striping, chemical paint stripping, bottom painting and long-term use. To obtain a professional look, always use a tape designed for each particular application. The following is a list of tapes available from 3M, one of the largest suppliers of specialized tapes.

**233** A high quality automotive masking tape. Not made for paint stripping, chemical stripping nor outdoor use. Better to pass on this tape for marine use.

**2070** A masking tape with a nonaggressive adhesive. Good for delicate surfaces, such as brightwork finishing and coating. Will not lift a cured finish.

**218** This tape is widely available and the only one generally sold at marine stores as a high-grade tape instead of masking tape — not! In fact, it's a fine-line striping tape used for specialized paint-stripping applications. Can only be left on for one day.

**2090** Known as Long Mask, this tape is weather-resistant and can be left on for up to seven days outdoors, allowing for successive coats without remasking. Not suitable for



chemical paint stripping or paint stripping.

**225** This weather-resistant tape is ideal for boat restorations as it can be left on outdoors for one month without sticking to the surface. Safe for all finishes including brightwork. Not suitable for chemical paint stripping or paint stripping.

**471** A striping tape good for all applications except chemical paint stripping. Gives a crisp edge that is extremely flexible, allowing paint masking around corners, portlights, hatches, etc. Last for up to one month outdoors.

**254** Developed for boot tops, this tape holds a perfectly straight, sharp line. Can be left on for up to five days outdoors, allowing recoating without remasking.

**4811** A plastic tape used to hold shrink-wrap or plastic tarps on boats during long-term storage. Last one year regardless of weather conditions. Easily pulls off without leaving adhesive residue on gelcoat. (Apparently, this tape was used by the US Military during Desert Storm.)

ment; a two component when there is no reaction or the paint softens slightly.

## COLOR SELECTION:

Light colors reflect heat, dark colors absorb the sun's rays. Heat generated by dark colors may cause the paint to crack, blister or fade. In warmer climates (not a great concern north of the 49th parallel), dark hulls tend to be excessively hot in the cabin. If you're planning to take your boat to Florida next winter, consider a light shade.

## PAINTING:

Before proceeding, read the label on the can and follow the manufacturer's guidelines. Prepare your tools; clean then dry all rollers and brushes, paint tray and other equipment before using. Just prior to painting, wipe down the surface with a cheesecloth rag damped with the recommended solvent to remove sanding and airborne dust. Mask uncoated areas with a quality, solvent-resistant paint striping tape designed for the task at hand (see Tape Chart). If you insist on using common masking tape, never



leave it on overnight or in the rain. Stir the paint well — don't beat it — to combine deposits and pigments that

have settled on the sides and bottom of the container. Repeat often while painting to prevent settling in the can or paint tray, especially when applying antifouling and polyurethane paints. Strain varnish and previously opened paints through a paper filter. For best results, paint the hull's topsides first, followed by the boot top

and bottom, to prevent spills and drips on a newly painted area. To avoid uneven drying and wrinkling, always apply out of direct sunlight. Do not work from the original can. Instead, pour a small amount of paint into a clean, dry container and recap immediately. Never pour any leftover paint

## THE LOW-DOWN ON BOTTOM PAINTING

When switching to a new bottom paint, chances are you'll have to remove all traces of the existing coating. This is especially true when replacing a soft with a hard bottom paint. Consider also removing the old coating if there is a buildup of four or five old coats.

For both new or old bare-bottom boats or previously painted surfaces, carefully wipe down the area to be painted with clean lint-free rags doused in acetone, brushing thinner or fiberglass dewaxer before sanding to remove any mold release agents and wax. Use plenty of rags, changing often. Wear protective gloves and cover every inch. Don't chintz with the cleaner. One quart of cleaner should wipe down about 10 feet of boat. Wipe dry with clean rag before hull dries.

If your boat is new, check with the manufacturer before sanding. Many newer boats come with a gel-coat anti-blister warranty that is invalid if sanded. Instead of sanding, dewax the hull twice, using clean rags; apply a primer as specified by the paint manufacturer. To insure all wax is removed, lightly spray with water. If the water beads, degrease again. On new surfaces without blister protection, thoroughly sand with 80- to 100-grit paper wet or dry. Wet sanding minimizes dust but you'll need to completely cover yourself in a rubber suit (old foul-weather gear works well), gloves and hat. Avoid contact with your skin as bottom paints contain toxic cuprous oxide. When dry sanding, wear protective goggles, clothing and a mask to avoid inhaling dust.

On previously painted hulls, you'll first need to determine the type of the existing coating. Not all paints are compatible. Many hard bottom paints cannot be recoated with a soft paint. Test the new paint by first coating a small area. If it's not compatible, most will bubble instantly. If this happens, you need to remove all traces of the existing bottom paint before you can recoat. If the boat was hauled late in the fall, you probably didn't have time to remove last season's paint, which is now well hardened. You'll have to scrape, sand and scrape some more. Most soft paints are easily removed with a scraper and lots of muscle. Sand with 60- to 80-grit paper or use a wide scraper with a replacement blade and fiberglass compatible paint and varnish remover; sharpen or replace blades often. You can carefully grind the paint off, but even the most experienced grinders will gouge the gel-coat which will then need filling and fairing. When removing paint with a chemical stripper (before you start, test a small area to insure solution does not harm the hull surface) you must sand, wash and degrease afterwards. Another option is to use Peel Away, a system that removes multiple paint coatings from fiberglass, wood, steel, aluminum and glass, usually in a single application. It contains no methylene chloride. Besides removing antifouling paints, Peel Away removes urethane and enamel paints, varnishes, non-skid finishes and epoxy based coatings. (DIY Boat Owner is testing this product next month; a full report follows in our Fall issue.) An easier method is sandblasting. Make sure the surface is completely dry and void of any osmosis problem areas before continuing.

If you're touching up last year's bottom paint, give it a light wet or

dry sanding with 80-grit paper to remove any loose or flaking paint and dried marine growth and provide good adhesion to the new coat. Clean the surface (see Degreasing) to remove dust and contaminants before painting. If the surface is in good condition, cleaning the surface with a rag and recoating from the waterline down about one foot may be all that's required.

After preparing new or old hulls, dewax again to remove sanding dust and contaminants before painting. Choose your paint carefully. Get recommendations from your marine dealer and local boat owners. Apply a thin coat of primer with a brush or roller or as specified by the paint manufacturer. Apply the bottom paint as indicated on the label. Thin only as necessary and no more than 10% as it affects the antifouling properties. Shake and stir bottom paint before painting and repeat often while painting to prevent settling of the bixide in the can or paint tray. Bottom paints are highly toxic; always wear a face respirator when painting. Apply by brush or roller with a solvent-resistant phenolic core that gives better results than a brush. Applying in temperatures above 10 C (50 F) with a maximum humidity reading of 65% gives the best results. Paint early in the day; heat and sun may blister the coating. Two coats are recommended and will extend the longevity of the paint. Allow six to eight hours drying time before launching, up to a maximum of two months, depending on the manufacturer's specifications. To paint bare wood hulls, first clean the surface and apply a first coat thinned as specified on the label. Fill seams with a seam compound and apply a second coat. When painting the boot top, use an antifouling boot top paint.

## TIPS

**Tray liners:** To end paint tray cleaning, use disposable liners or try this over-the-counter solution for enamels or polyurethanes: cover the well with heavy duty aluminum foil. Small plastic grocery bags (the ones with handles will lock under the tray legs) work best with antifouling paints.

**Bounce-free Rags:** Never use remnants and castoffs that were machine dried with fabric softener for clean-up rags.

**Tack Rags:** Use a tack rag to remove sanding and airborne dust just before recoating. To make a tack rag, moisten cheesecloth with applicable thinner.

**Game Plan:** Never use products from different paint manufacturers in the same system. Use only the recommended primer, paint and thinner.

**A Cleaner Start** Clean all brushes, rollers, paint tray and other tools in

the recommended solvent before using. Most new painting tools contain dirt and other contaminants.

**Route Map:** When painting, always work left to right, if right handed, or vice versa if left handed.

**Deep-freeze:** Rather than clean brushes between short intervals, wrap in clean plastic wrap and put in the freezer. They stay flexible and take about 10 minutes to thaw. Works with most paints, including polyurethanes. Not recommended for varnish brushes.

**Brush Cleaning:** A quick and easy way to save brush wear: take a strip of wood, hammer a finishing nail into one end and attach it to a can of solvent with an elastic band. Hang the brush on the nail and adjust the wood so the brush hangs in the solvent without resting on the bottom.

**Can Rest Nail** a piece of 1x2 to the shelf support on the ladder. With a heavy band of rubber (piece of inner tube or similar) secure the can to the 1 x2. Exceptionally secure, you won't have to remove the paint can

when moving the ladder.

**Tape Remover:** To remove old masking tape that was left on the hull too long, try 3M Adhesive Cleaner or lighter fluid.

**Re-Opening Cans:** Remove paint skin before stirring. Use paper filters to strain paint into a clean container. Always strain varnish before using.

**Brush Shake:** A brush "spinner" (about \$30) does a superb cleaning job of removing all traces of solvent or water after cleaning.

**Solvent-less:** If brushes are left in a thinner or brush cleaner between use, shake well and dry before applying paint. Excess solvent dilutes the paint and may cause noticeable, localized imperfections.

**Moisture Meter:** To check humidity, wet a small area with a damp cloth. If it dries within 15 minutes, get out the brushes.

**Squeak Test** After dewaxing, give the hull the "squeak" test. Rub your finger across the wet hull. If it squeaks, you're ready to paint. If not, dewax again.

## TROUBLESHOOTING

**Problem:** Paint fails to dry

1. Temperature is too cool for a good flow.
2. Coating was applied too thick.
3. A one-component product was applied on a recently treated epoxy or fiberglass coat.

**Solution:** Remove all coats, degrease and try again.

**Problem:** Paint develops wrinkles

1. Too thick a layer, especially on horizontal layers.
2. Application in direct sunlight.
3. Recoating on a surface that has not completely dried.

**Solution:** Lightly sand the affected area, dry lightly sand and recoat.

**Problem:** Paint blisters

1. Blisters formed during application are usually caused by a very hot surface temperature or direct sunlight after application.
2. Blisters created after application are often caused by entrapped solvent or moisture under the coating.

**Solution:** Lightly sand to the first undercoat and recoat.

**Problem:** Fish eyes

1. Water, grease, wax, silicone or other surface contaminants will cause "fish eyes."
2. Low temperature.
3. Incorrect cleaning and sanding or insufficient sanding.

**Solution:** Remove paint while still wet. Clean and degrease. Sand and recoat.



back into the original container.

Always brush in one direction and on wood, brush with the grain. Avoid applying too heavy a film thickness that slows drying, causing the paint to sag and wrinkle. It is always better to apply two thin coats than one thick coat (exception: see Coverage). When applying multiple coats, especially top side paints, always use paints with the identical batch number that is printed on the lid (or bottom) of the container. To apply polyurethane paints and varnishes over a large surface area, use the roll and tip method. You can cover a large area faster and it gives a more uniform spread. To begin, wet the roller in a roller tray and apply paint over a small section, about 2' by 3'. Wet the tip of a badger hair brush or foam brush with paint and tip or drag the brush horizontally across the painted surface to flatten any roller or lap marks. A disposable Preval sprayer (available at most hardware stores) does a fine job of spray painting smaller areas. A minimum of two coats is required for a high gloss finish; if time allows, three coats will extend the longevity of the paint. To maintain a wet edge (extend drying time), use a brushing solution or recommended paint thinner (see Thinners). If you're painting outside in the late afternoon, use sparingly or the paint will not dry before dewfall; horizontal surfaces are particularly susceptible to an early dew. Never paint a sacrificial zinc anode.

## PREVIOUSLY PAINTED AREAS:

Remove all loose or flaking paint. Degrease. Sand with 100 to 180 grit ALO. Spot prime with primer. Fill nicks and dents with a filling compound. When spot painting repaired areas with a finishing coat, use 220 grit sandpaper and feather into the existing paint.

## COVERAGE:

Paint coverage, as specified on the label, is critical. If the manufacturer rec-

ommends 1 litre per coat, for example, and you're using considerably less, there's a serious problem. Either it's applied too thin or the quality of paint is suspect. Contact the manufacturer before proceeding further.

## SAFETY:

Do not eat, drink or smoke when using marine paints and primers. Avoid skin contact and provide adequate ventilation. Many coatings are toxic and will irritate skin and eyes, some are highly flammable. Always wear protective clothing and use a dust mask when sanding or scraping. Wear a respirator when machine sanding, hand sanding antifouling or epoxy, or when applying polyurethane and bottom paints. Protect hands with disposable gloves or barrier cream, or use both. Never clean hands with solvents; use a waterless hand cleaner. Allow solvent-soaked rags to thoroughly dry before disposing. Follow governmental and local disposal regulations when disposing of all used tools and containers.

## LASTING SHINE:

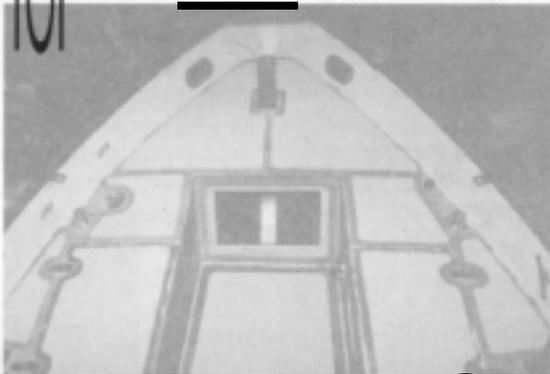
Applying polish to an enamel- or polyurethane coated hull painted with a linear polyurethane paint will help maintain the finish.

### PAINTING LOG

Keep a record of products and systems you use on your boat with this handy paint log. Fill in the blanks with a pencil and change whenever you repaint.

AREA	PRIMER		FINISH COAT		
	Thinner	Paint Amount	Thinner	Paint	Amount
Bottom					
Topsides					
BOOTTOP					
Deck					
Brightwork					
SPARS					
Interior					
OTHER					

# New Life



## OLD DECKS

### REFINISHING TECHNIQUES FOR FIBERGLASS, WOOD, METAL OR CONCRETE DECKS

All new boats have some type of nonskid finish that provides sure footing when maneuvering on deck. Wood and metal hulls usually have a painted nonskid surface while production fiberglass boats come standard with molded-in nonskid, a textured gelcoat with good traction. But like an old pair of shoes, colors fade over time, gelcoat chalks and the nonskid wears, turning your deck into a skating rink in wet conditions.

Small areas of damaged nonskid (about the size of your fist) are easily repaired with epoxy. First degrease to remove surface contaminants and wax and lightly grind the damaged surface. Try to retain some of the pattern that provides good adhesion for the epoxy. Using epoxy thickened with a low-density filler (such as Microlight) to a peanut butter consistency and a small putty knife, carefully rebuild the pattern. Use a slow hardener to increase the amount of working time; it has a

pot life of about 35 minutes at 12 C (55 F). Complete the job following the epoxy manufacturer's instructions, then cover the repair with gelcoat or paint.

When the damaged area is large, you have two options, depending on how much you want to spend and how much time you have to do the repair. Assuming you don't plan on laying a teak deck, the choices are to either paint or resurface the entire deck with a fabric nonskid. Applying an enamel or polyurethane paint is the least expensive. Stirred into the paint is a nonskid additive, such as silica sand, pumice, ground walnut shells or polymer beads. These beads adhere better to paint than sand and are available in fine or coarse grades. Also available are premixed nonskid paints that contain abrasive-resistant particles. A permanent solution for a badly worn molded-in nonskid, or if you're tired of repainting every few years, is to apply a deck covering. A more expensive and time consuming option, deck coverings resist sunlight and last for as long as you'll probably keep the boat. Some nonskids are more comfortable to sit or walk on in bare feet than others; test a sample first, if possible. Both painting and deck coverings are effective nonskid finishes that require little maintenance. A regular cleaning with soap and water — pack the abrasives away — is all that's needed.

## DECK PREPARATION

Regardless of the application you choose, the first item on the to-do list is to clean the deck to remove all contaminants. Make up a paste with an abrasive cleanser and water to remove oxidized gelcoat, soils and varnish. Rinse well with freshwater and let dry. Next, remove all traces of old paint with a belt or orbital sander and 60-grit paper. Nonskid compounds are highly abrasive and "eat" sandpaper; use the best paper you can find. A chemical paint stripper removes the existing coating faster but first test a small area to insure it will not harm the surface. Metal and concrete require more extensive preparations; check the paint or overlay manufacturer's specifications.

Scrub molded nonskid with a wire brush or bronze wool (never use steel, as steel particles embedded in the surface will eventually rust the paint) to remove dirt from molded crevices. Degrease fiberglass decks to remove wax and wash with clean water. Some products require that a molded nonskid pattern be sanded off to a smooth, flat surface. Imperfections are then filled with epoxy thickened with Colloidal Silica to a catsup-like consistency; use a batten to fair the surface. Let cure, sand and apply a sealer coat of unthickened epoxy. When sanding fiberglass or epoxy, always wear protective clothing and a respirator.

## PAINTING

Easily applied over wood, fiberglass or metal decks, marine enamel and polyurethane (more expensive, better longevity) paints are transformed into a nonskid deck surface by adding a nonskid compound. To reduce glare on sunny days add a flattening agent to a gloss paint (check availability with the paint supplier) or use a semi-gloss or flat paint,

You'll need about two days to complete the job, so pick a rain-free weekend and begin by wiping the deck surface clean with a solvent wash. Remove any deck hardware that you want to treat beneath and repair any cracks or dings with an

## Low Life for OLD DECKS

epoxy putty. (For complete instructions see *Repairing Fiberglass Hulls & Decks*.) Carefully mask around nonskid borders and areas that will remain unpainted with a weather-resistant striping tape. Use either 3M's 2090 Long Mask, which can be left on for up to 7 days outdoors, or 471 that is extremely flexible for masking around corners, portlights, hatches, etc. and lasts for up to 1 month. Both tapes allow successive coats without remasking. You'll need 7" solvent-resistant foam rollers, smaller 3" rollers (cut to length with a hacksaw) and narrow brushes to touch up around hardware and hatches. Apply a primer followed by an enamel or polyurethane paint (follow application directions on the label). A primer coat is usually applied first, followed by a topcoat mixed or covered with a nonskid compound and a second coat. Check the manufacturer's application instructions for specifics. Pour the primer or paint into a metal paint tray lined with aluminum foil. Stir nonskid additives into the paint or sprinkle over the paint after applying. When adding grit to the paint, stir the mixture frequently to prevent the additive from settling. Let dry and apply a second coat without sanding. Two coats are generally recommended. To reduce gloss, add a flattening agent to the final coat. When adding nonskid after painting, roll the paint on and quickly sprinkle on the granules before the paint becomes tacky. Use a fine sieve to scatter the compound. Let dry, then vacuum or brush off any excess compound that did not stick to the paint. Many marine paints are highly toxic; wear protective clothing, gloves and a respirator.

If the molded nonskid surface is in good condition, you can paint without sanding. If additional nonskid is required, simply mix grit with the paint to the desired texture. If you're unable or reluctant to sand or grind a molded, raised deck pattern, an option is to coat the entire deck with an epoxy and Colloidal Silica mix-

ture. Sprinkle a nonskid compound over the deck before the epoxy cures. Let fully cure. Vacuum the surface to remove excess and loose grit. Remove the amine blush (see *Working with Epoxy*), then apply a second coat of unthickened epoxy resin using the roller and tip method (roll on the epoxy and tip off with a foam brush). Follow with a primer then a quality marine enamel or polyurethane paint.

## PREMIXED PAINTS

A simpler method is to use a paint premixed with an abrasive-resistant pigment. Three readily obtainable products are: Akzo Sikkens Deckpaint, Epifanes Deck Coating and Sterling deck paints. Sikkens' product is a single component alkyd enamel, containing an abrasive-resistant pigment. When used with a system-matched primer, sanding is not necessary between coats. Available colors are white, beige or grey in a mat finish. A 750-mL can covers 75 square feet and sells for \$26.50. Epifanes (pronounced Eppy-far-nis) Deck Coating, is a one part polyurethane coating premixed with polypropylene beads. Easily applied to a primed and sanded surface, it comes in white or grey. The paint is rolled, brushed or sprayed on and left to cure for 24 hours before applying the second coat. A 1-litre can covers about 52' sq.

Sterling's two-component linear polyurethane deck coatings require no sanding: just clean, prime and paint. There are 100 different colors to choose from to which nonskid particles are added. A 1 quart container of primer or topcoat covers up to 100' sq. First apply a two-part primer mixed in a 2:1 ratio with a roller or brush for the hard-to-get-at areas. Before primer has reached a full cure (24 hours or

less), mix the two-component polyurethane topcoat, add thinner, nonskid compound and stir well. Mix only as much as needed and pour into a metal paint tray covered with aluminum foil. Apply over the primer with a roller, first painting a small area to check the grit quantity and add or remove as necessary to obtain the desired texture. Bubbles formed by the rolling process are easily eliminated by lightly rolling over the surface as the paint begins to cure. Let dry for a day, and apply a second

Sterling paint-on nonskid requires no sanding of the gelcoat before applying.



coat mixed with nonskid particles. When painting during cool weather (below 21 C/70 F) or when expecting fog or dew, Sterling sells an accelerator that speeds up the drying time and prevents moisture from damaging the gloss. The total cost to renew the deck surface of a 35' boat ranges from \$300 and \$500.

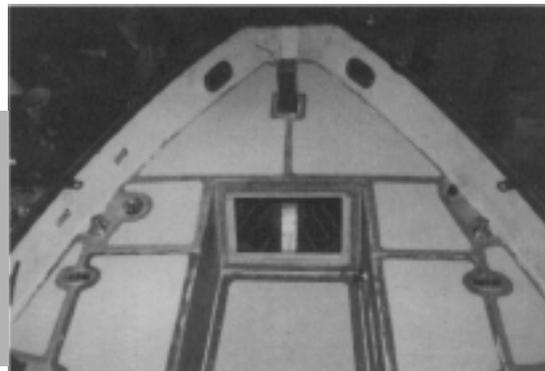
## DECK OVERLAYS

Made of a mixture of cork, rubber or polyurethane, deck overlays give a long-lasting, maintenance-free coating with superb nonskid qualities, especially when wet. Highly durable, overlays also protect wood and fiberglass decks from dings, gouges and chafe. On the negative side, deck overlays are high-priced, time consuming (allow at least 60 hours to complete) and add weight — approximately .5 lb per square foot. Sold in sheets or by the roll in a variety of patterns and textures, the most common brand names are Vetus, Treadmaster and TBS.

To determine the square footage of your deck when purchasing primer and paint, multiply the overall length of the boat x the beam x .75. Subtract areas of hatches, cockpit, etc.

Vetus is made in Holland of a rubber, cork and plastic composite that has a raised dot pattern finish. Available in grey or tan, it comes in 3' by 8' sheets for \$270; a half sheet (3' by 4') costs \$155. The sheets are glued in place with Vetus Fix, a type of contact cement (wear a respirator when applying). Treadmaster is one of the original deck overlays made popular in the 70s. Not as readily available as it once was, the current product is Treadmaster M, a 1/8" thick cork polymer with a raised, diamond-shaped pattern. Stock colors are teak, grey and white sand. Easily bonded to any deck surface with epoxy resin, a 4' by 3' sheet sells for under \$150. Made in France, TBS nonskid decking is a synthetic mixture of plastic resin and granular additives. Not as rough-textured as Vetus or Treadmaster, the flexible fabric has a somewhat smooth finish, similar to a premixed nonskid paint. TBS 20S, a 3/32" (2 mm) thick fabric recommended for boat decks, comes in grey, sand or ivory 50" wide, 3', 4' and 8' sheets or a 32' roll that costs under \$1,100. TBS is easily applied with thickened epoxy resin.

When applying a covering over a molded gelcoat nonskid, first sand the pattern level and fill with thickened epoxy before applying. For all deck materials, follow the manufacturer's recommendations to the letter! With deck preparations completed, take heavy weight tracing paper or brown Kraft paper (sold at art and office supply stores) and make templates. Draw then cut out a rough pattern. Have a variety of circular and oval shapes (cans, lids, etc.) at hand for producing fair corners and angles around hardware. Use a wood or fiberglass batten, held in position with weights, for marking long deck curves. Make templates as large as possible without becoming unmanageable; remember this stuff is soft, floppy and heavy. Leave a 1 1/2" or 2" gap between patterns and all deck hardware for water drainage. Trace and cut the final shape. Tape the paper template in place and transfer the exact outline to the deck with a felt marker. Remove the template, turn over and number each piece and mark the bow, stern, port or starboard on each. Remember to number the



Deck overlays are cut from paper templates then glued in place. Note the gap between the TBS panels for water drainage.

pattern outline on the deck as well. Continue making templates for the entire deck surface. Most boats are not the same on each side so cut separate port and starboard patterns. Making good patterns is exacting work and any misalignment will multiply once the fabric is glued in place. Tape the paper pattern to the wrong side of the fabric, mark the outer edge and cut to size using a straight edge and Exacto knife or scissors. Transfer the number and alignment markings to the fabric.

After each piece is cut out, you're ready to glue. (These instructions apply to epoxy applied overlays.) First, wipe down the deck and wrong side of the fabric with solvent to remove all contaminants and dust, being careful not to remove your alignment markings. Cover a large, flat working area with heavy duty plastic and tape in place. Working with a "volunteer," mix a batch of epoxy resin with slow hardener (increases pot life to about 25 minutes), thickened with Colloidal Silica to

a "mayonnaise" consistency. Using a plastic squeegee or large putty knife, spread an even layer of thickened epoxy over the entire underside of the fabric and corresponding deck pattern (apply barrier cream and wear disposable gloves when handling epoxy). Put lots on; combine any excess epoxy with the next batch.

Lay the fabric in position, matching all outer edges — depending on the size, this may require some "acro-

batics." Take a hard rubber roller (the kind used by boatbuilders when handling fiberglass cloth) and working from the center to the outside, apply moderate pressure to squeeze out air bubbles and excess epoxy. Continue "working" the fabric to remove all air bubbles. Clean excess epoxy away from the edges with a 1" putty knife and wipe uncovered deck areas with a solventdampened rag to remove residue. Remove any spilled epoxy from the fabric with solvent before it

hardens (test the fabric first for solvent resistance). When fully cured, sand between the panels, prime (if necessary) and apply 2 to 3 coats of enamel or polyurethane (preferred) paint following the manufacturer's instructions.

sanding. Protect hands with disposable gloves or barrier cream, or use both.

## **WORKING** WITH EPOXY

The bi-product of epoxy is an oily or waxy surface known as amine blush. Remove all blush before sanding or applying any paint or varnish. Wait for the epoxy to reach a full cure, about two weeks. Clean the surface with a soapy water solution and 3M ScotchBrite pad to remove the wax. Wash with freshwater and dry with clean rags. Wipe off the wax, changing rags frequently so that all wax is removed, not just spread around. Clean with the recommended thinner or brushing solution before sanding or painting. Always wear protective clothing and use a respirator when