

The Cruiser's TOOL CHEST

Tools For The Cruising Powerboat

by Steve C. D'Antonio

photography by the author

Combination
box/open-end
wrench set. Note
the sturdy canvas
pouch. This will
keep your wrenches
organized and alert
you easily when
one is missing.

THE RIGHT TOOL FOR THE JOB. THAT'S A saying we have all heard at one time or another. There is much truth in it, especially aboard a boat. However, having the right tool doesn't mean having every tool. Indeed, few cruisers have the luxury of unlimited space in which to store even the required tools. As a result, deciding which tools should go to sea and which should remain ashore requires careful consideration.

What follows is a list of tools that every passagemaker should have on board. It's not a comprehensive listing of every tool that should be stowed aboard—just the most commonly used ones. All of these tools will fit into a

relatively small toolbox that weighs about 30 pounds (not including the box).

The listing includes manufacturers, part numbers, and some insight. Most of the tools listed carry a lifetime warranty, and this should be a prerequisite to any tool purchase.

Common Tools

The closest friend of the mechanic—amateur or professional—must be the ubiquitous combination open-end box wrench (*MAC Tools SCH11KR, Craftsman Pro Series, S&K*). The wrenches should be well balanced with a smooth, bright, triple chrome finish, six-point configuration (this is a detail worthy of some debate; however, it's my personal preference), 15 percent box offset, and thin construction. These are the makings of a fine wrench. The smooth nickel chrome exterior indicates a high level of finish that is especially rust resistant and easy to clean. Six-point (12-point tools do have their virtues, although they are better when put to use on 12-point fasteners) means that it is less likely to slip on rusty or rounded bolts, and the offset allows it to work in confined locations. A roll or pouch is included with most quality sets. Canvas is better than vinyl, as it will last longer and is repairable. It also allows the user to find the desired size and quickly draws attention to a missing wrench. The standard set includes 11 sizes from 1/4" to 7/8" (10-19 mm for a metric set, which most boats will now require in one place or another). Sets advertised in mail order catalogs for





Assorted wrenches, sockets, extensions, and socket wrench.

\$25 should be avoided. It is impossible to manufacture a quality wrench for that price, and the savings is not worth it, even if it's just for occasional use. This holds true for all tools. If the price seems too good to be true, it usually is.

Socket Wrench Set

Source: wrench-Craftsman VII 44813, sockets-MAC SXD126TR.

The socket wrench set should share many attributes with the combination wrenches: smooth nickel chrome finish, thin wall construction for good access to tight locations, and a six-point pattern.

A 3/8" drive is the most versatile and practical for onboard applications; however, larger fasteners will benefit from a 1/2" drive, especially stubborn ones. The sockets in this set range from 1/4" to 15/16 (again, 10-19 mm for a metric set) and are housed in a tapered tray. The tray serves the same function as the pouch. It makes a given size socket easy to find and draws attention to those that are missing.

Other organizers are available—in rack or magnetic form, for instance—and they will serve the purpose equally as well. If you have room for only one set, I prefer to carry all deep sockets. The logic being that a deep socket will most always work where a shallow socket would be used. However, a shallow socket will never work when a deep socket is required. If you have room for deep as well as shallow, this is all the better.

Be sure to include a spark plug socket of the correct size (5/8" or 13/16) if a gasoline engine or

outboard are aboard, as they are not usually included in standard socket sets. These sockets are different from ordinary sockets in that they usually incorporate a rubber insert feature that keeps the spark plug in the socket until it's installed.

The socket wrench itself must have a positive release feature, not just spring friction. This means that the socket cannot be removed unless a button on the top of the wrench is pushed. This prevents sockets from ending up in the bilge or bay.

The set should also include at least one extension, preferably six inch. It, too, should be equipped with positive release. If it's not, this can be added (S&K 45195).

Screw Drivers

Source: MAC, Craftsman Pro, S&K, and others.

My tool kit contains 11 screwdrivers of various lengths and widths, all either Phillips or standard. There are several 1/4" and 3/16", one

Assorted screwdrivers.



large 3/8; a micro drive (S&K 85154) that houses several tips in its handle (especially useful for disassembling everything from radios to sunglasses), and a 90-degree ratcheting driver that is both Phillips and standard.

They all have a bright chrome finish and, with the exception of the micro drive and 90-degree, they all feature a hex fitting at the base of the handle. A wrench can be fitted to this so that additional mechanical advantage can be gained. The tips of all but the two previously mentioned are vapor blasted. This is noticeable as a slight dull gray finish at the end of the shank. It causes this area to be slightly rougher than the chrome, preventing the tip from slipping out of the screw head.

If other screw heads are aboard, such as square, Pozidriv, Torx (there are both male and female), 12-point head, or some other proprietary fastener, sockets for these, too, should be carried. Many engines, pumps, generators, or electrical/electronic equipment incorporate some of these more obscure fasteners. Look around the cabin, deck, and engineering spaces to see if any of these are present.

Adjustable Wrenches

Source: MAC AW6 & AW12, Crescent, Craftsman.

This should not be a substitute for a proper open-end wrench. However, there are times when they will be necessary. The better adjustables, such as the ones listed above and the Crescent in particular, possess a trait that is quite valuable. Through a design feature, it is able to maintain its adjustment even after being put down, picked up, turned, and dropped repeatedly. This is quite helpful when working with a fastener by feel alone. The wrench does not require constant adjustment.

Unbeknownst to many users, these wrenches do have a top and a bottom. Simply put, the adjustable jaw should trail the direction of the turn. Following this procedure will increase the life of the tool.

Large and small adjustable "Crescent" wrenches.

Pliers

Source: MAC, Craftsman, Channelock.

There are several tools that fall under this category. The standard pliers that I prefer (MAC M5410G) are 10 inches long, offering maximum advantage. This is a rough tool that should be used for the coarsest of work. It has compound jaws, a flat section, and a serrated semicircle section. It is virtually indestructible and can be pressed into service as a hammer in an emergency.

The needle nose pliers, both large and small (MAC P9S & M326G), are a necessary complement to the kit. They are both of the cutting variety, but this isn't a prerequisite.

The slip joint pliers, also known as water pump pliers, or by the brand name Channelock, are carried in a large and small size (MAC P10 & Channelock 426). This tool is most useful in grabbing and turning round objects such as pipes or shafts.

It will leave teeth marks on anything that it touches, so its use should be restricted to objects that cannot be turned with a combination, socket, adjustable wrench.

The large model has a very desirable feature: It requires pressure on only the top handle when turning. This eliminates having to squeeze and turn simultaneously.

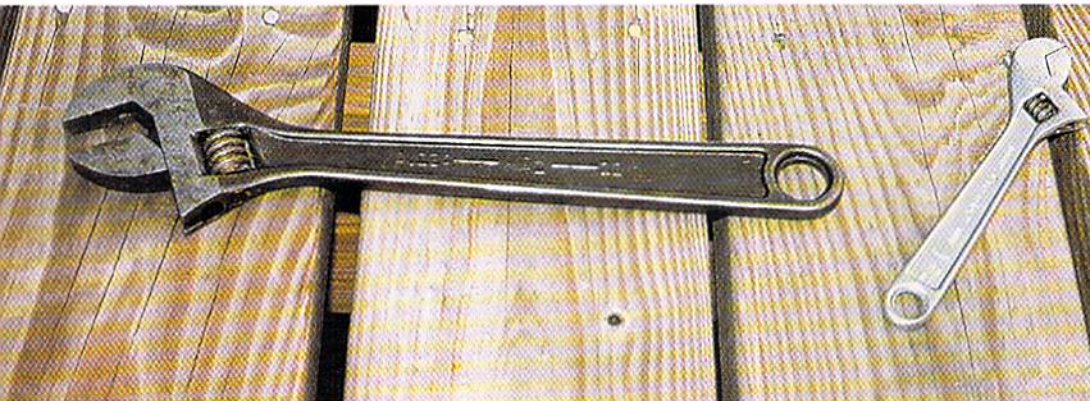
Finally, in this family there are the diagonal cutting pliers, or dikes (from Diagonal CutterS), (MAC M447G, Channelock, Craftsman). This tool is primarily for cutting wire, but the higher quality models will cut steel bolts and screws up to number 12.

There are two styles: the straight diagonal cutting pliers and the curved diagonal cutting pliers. The former offers greater cutting force, while the latter is better suited to flush cutting against flat surfaces where access is limited.

There is also a long reach version of this tool (P11SCS) that can be used to both grab (it has a small pliers tip) and cut in hard to reach locations.

Locking Pliers / Vice-Grip

This tool is thought of, in my tool chest, as unavoidable. When I was a small boy, a neighbor, the proud owner of a beautiful wooden Chris Craft in a time when owning a wooden boat was not unusual, taught me that locking pliers were only used by people who didn't have proper tools. At this impressionable age, these



words of wisdom sank deep into my nine-year-old brain. Although I own eight or nine types, my aversion toward this tool remains strong to this day. There are, however, uses for which it is fit, and at least a few sizes and varieties (straight, angles, large, and small) should be kept aboard, although not too easily accessible.

Ball Peen Hammer

Source: Craftsman, MAC, and others.

Not to be confused with a claw hammer, the ball peen is designed to make contact with metal. Claw hammers are designed to hit soft metals, such as nails, and wood. They should never be used to strike tool steel, such as cold chisels or drifts.

The ball peen hammer's uses (12-ounce is a good size) are many and require little elaboration. However, be warned, as overuse can lead to its operator being branded with the moniker "Primitive Pete." Never use a hammer, ball peen or otherwise, in place of the appropriate tool.

Measuring tape

Source: Craftsman, Stanley, MAC, and others.

The uses of this tool (12 foot is a versatile size) are self-explanatory. Its life will be extended considerably if the tape is not allowed to snap back into its housing at high speed. Doing this usually causes the hook to part from the tape, at which point it becomes unusable. An occasional light coat of CRC 6-56 will maintain the tape's smooth operation and keep rust at bay.

Scratch Awl

Source: Craftsman, Stanley, MAC, and others.

The awl can be used for a variety of tasks, including boring holes in soft materials such as wood and center-punching aluminum or bronze. It should not be used on steel. That work requires a center punch.

Gasket Scraper

Source: MAC SP8A.

Anyone who has been faced with the task of removing a well-adhered gasket in an inaccessible location will appreciate the value of this tool. Although there are several different styles and sizes available, the most important distinction is the fixed or removable blade. I prefer the former.

The removable-blade model, while sharp initially, tends to be fragile and is easily broken and difficult to resharpen. The manufacturer would rather you just purchase new replacement blades. The fixed-blade scraper, however, is robust and can be easily sharpened at sea with a stone or file.

Flashlight

Source: Pelican Products, Super SabreLite. Although it is listed last, the importance of this tool should not be underestimated. The tool chest flashlight lives a harsh existence, indeed. Not only must it survive repeatedly being dropped, as is inevitable when being held by greasy, sweaty hands, but also it is stored in an environment that is surrounded by heavy, sharp objects.

Although the magnesium-aluminum style lights have become quite popular and are well made, they are not truly waterproof. Since an onboard flashlight is likely to become submerged, this is an important feature. As a result, I have chosen a rated SCUBA diving light. Accordingly, it is waterproof. This means an unintended trip to the bilge, or overboard, won't kill it.

Furthermore, it is explosion proof. This may seem like an unimportant feature for the cruising vessel; however, if LP gas is aboard it may become more relevant. The light is turned on and off by rotating the bezel, and with a respectable degree of resistance. This task requires two hands. That is a bit of a hindrance, but it ensures that the light cannot be turned on in the tool bag inadvertently.

Special Tools

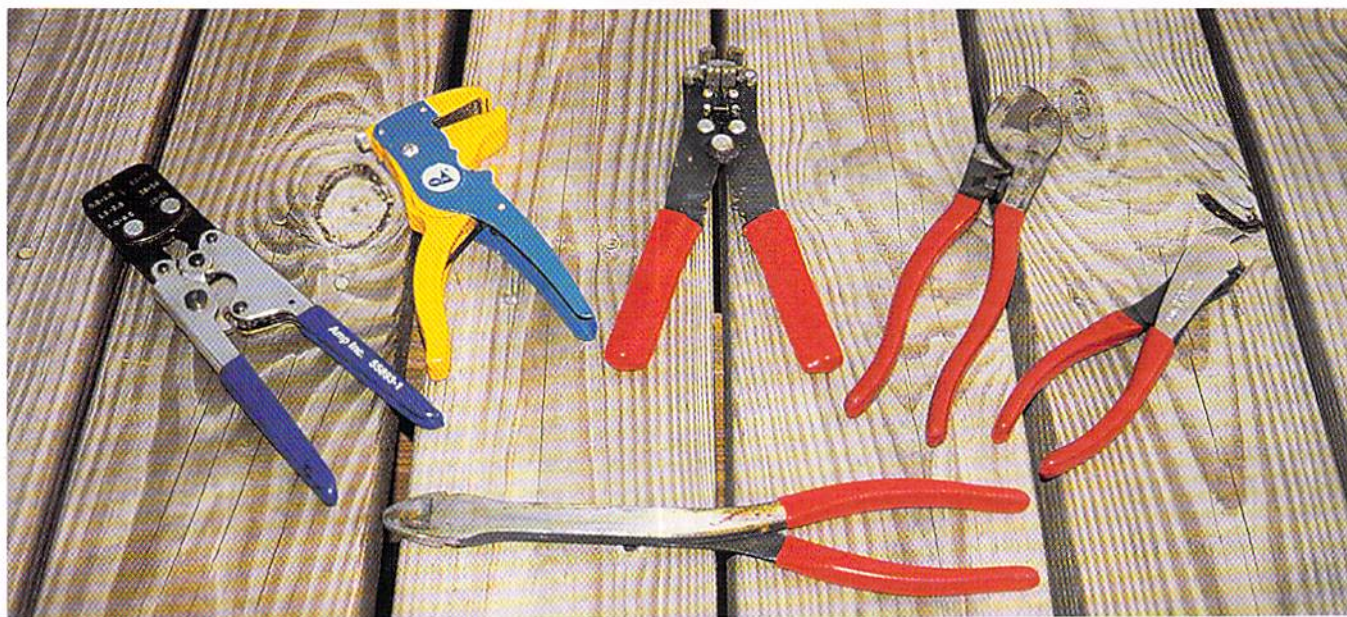
Electrical crimpers, conventional and ratcheting (*Channelock 909 and AMP 55893-1* respectively); the conventional crimping tool can be used for most solderless connectors. Its handles are long and broad. This gives good mechanical advantage and a comfortable grip.

The primary difference between this tool and its cousin—the automotive, and inferior, type crimper—is that it does its work forward of the pivot point. This means that it can be used under instrument panels and behind circuit breaker boards without requiring a great deal of handle swing.

It also allows the user, through mechanical advantage, to exert more force on the crimp while exerting less force on the handle. This tool is equipped with one die for insulated crimps and one for noninsulated crimps. They are clearly marked, and their uses are not interchangeable. If, for example, the noninsulated die were to be used on an insulated connector, as is often done, it may appear to give a strong crimp. In actuality, it would pierce the insulation, possibly allowing it to dislodge, causing the potential for a short or cross circuit.

The ratcheting crimp tool will work on any insulated connector between 10 and 22 AWG.

**Having
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doesn't
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tool.**



Strippers and cutters. Left to right: ratcheting crimper, automatic wire stripper (x2), cable cutter, wire cutter (dikes), and long reach wire cutter (bottom).

The ratchet mechanism insures a proper and complete crimp each time it is used.

It is, however, especially useful for heat shrink connectors. Since the insulation on these connectors is very supple, it is more fragile and prone to piercing if over crimped or crimped with a sharp die. The ratchet crimp controls the crimp pressure and is equipped with gently radiused dies. This makes it ideal for this type of connector.

Hose pinch-off pliers (KD145); when replacing primary fuel filters or searching for leaks in cooling, water, or fuel systems, this tool can be useful. Its jaws gently apply pressure to a hose, without damaging it, to stop the flow of liquid. They can be locked in place while the work is being completed. They will work even on the double walled USCG type A fuel line; however, they cannot be used on wire-reinforced hose.

If an electrical ignition system is to be found aboard, such as in a gasoline main engine or outboard, then a **spark plug boot removal tool** should be on hand (MAC SP700). This tool aids in the removal of stubborn spark plug boots. It can also be used as a troubleshooting device on multicylinder engines.

The handles of this tool are heavily insulated to protect the user from electrical shock. Some ignition systems use 40,000 volts D.C. volts to supply spark plugs with the requisite energy. While this D.C. voltage isn't lethal, allowing it to travel up your arm is an unpleasant experience.

In order to perform this test the engine must be running. Remove each spark plug boot, one at a time, and observe the change in engine RPMs. Each cylinder's shutdown should have an identical effect. If an ignition wire boot is

removed and no change in RPM or engine note is evident, then the corresponding cylinder is not firing. Further inspection is then called for.

Heavy-duty scissors or sheers (Klein Tools #2100-7); cutting heavy material such as canvas or gasket material requires a special cutting implement. Ordinary household scissors just aren't up to the task. Industrial strength but compact, these sheers are made out of chromed tool steel, which holds an edge better than stainless, and they are easily sharpened.

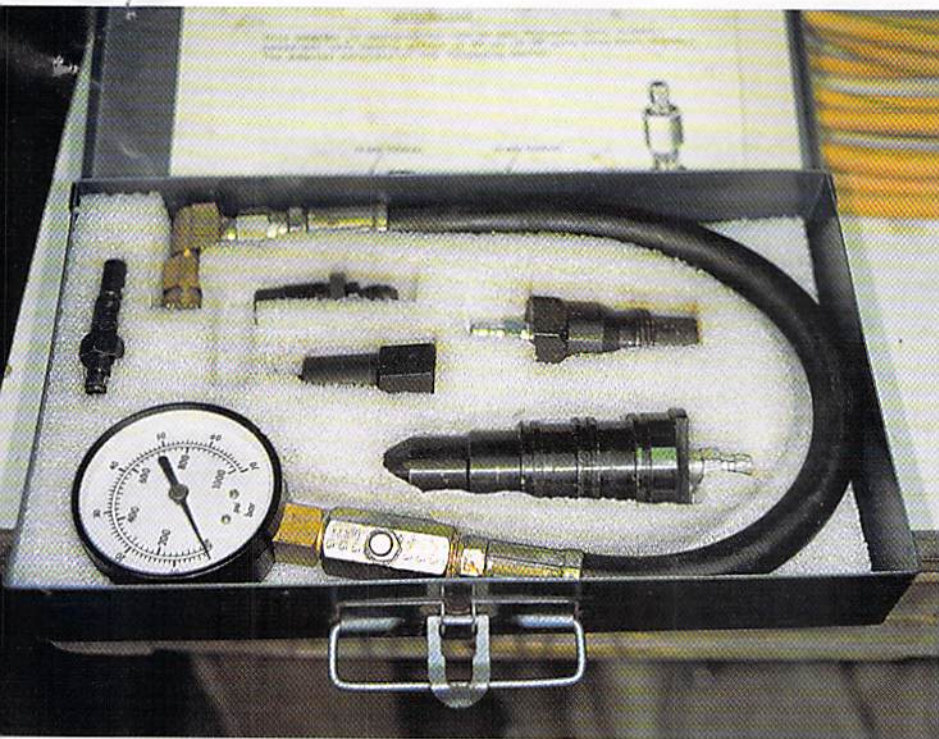
Battery cable cutters (MAC M911G, Channelock); this remarkably powerful tool's 911 part number is appropriate. It's great for emergencies.

While transporting a boat, I had the opportunity to use them under just these circumstances. A 2/0 battery cable had chafed against the engine block between a pair of paralleled 8D batteries and the main battery disconnect switch. There seemed to be no way of halting this impromptu arc welding demonstration.

The smoke in the cabin was becoming unbearable, as it was of the acrid sort that accompanies electrical fires. I rushed to my tool kit, intent on finding a wrench with which to disconnect the cables from the battery posts, when I noticed the cable cutter. I grabbed it and, with adrenaline pumping, sliced through the overheating cable.

Of course, this tool has other more mundane uses, primarily cutting large electrical cables up to 2/0. The cutting edges are elliptical, and the 9.5-inch overall length offers good cutting advantage.

The lesson I learned, related above, was a valuable one, and as a result I carry one of these



Compression tester (this one's for diesels—they're available for gas engines as well). This tool is usually found only in the true professional's tool chest. However, if you are traveling far from home, and far from professionals, you may want to consider it. It's an invaluable troubleshooting tool. If you do invest in one, ensure that you have the proper adapter for your engine.

tools in my pickup truck as well as in the onboard tool chest. Remember, electrical fires cannot be extinguished until the source of power has been disconnected.

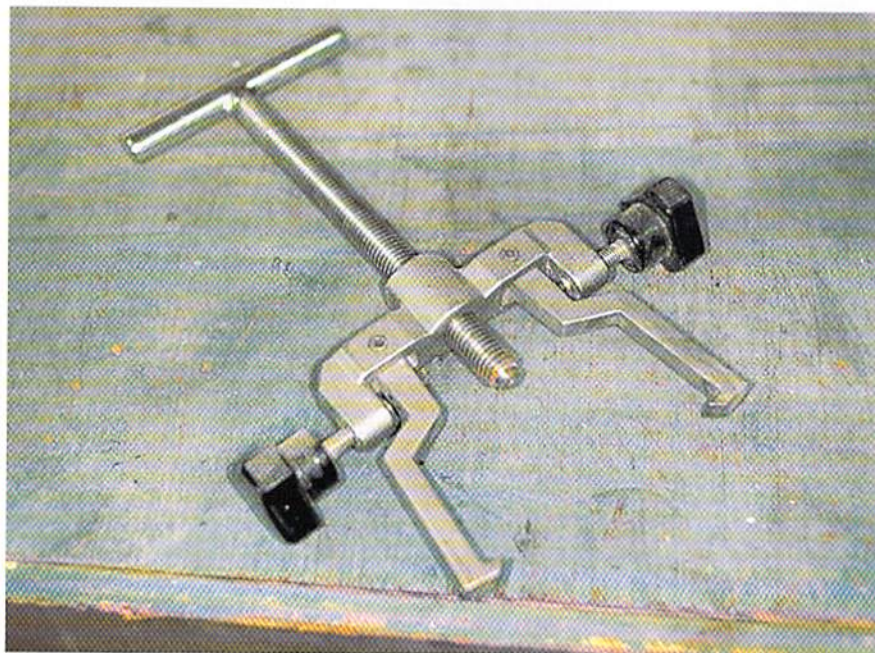
Low amperage electrical jumper leads (MAC JK 10); these test leads, although low amperage, are of super duty construction. The wire is #14 and insulated with flexible black rubber. The alligator clips at either end are over sprung, constructed of copper (not copper plated steel), and are insulated with rubber boots, one red and one black. They can be used to bridge suspect connections or circuits.

One common use is for troubleshooting starter solenoids and key switches as well as the primary wiring on windlass relays and solenoids. Do not attempt to bridge solenoid secondary circuits, as these will quickly overload and overheat these jumper wires.

Conventional and automatic wire strippers (MAC TCT10 & WSC200A, respectively); the wire stripper is an indispensable tool for any cruiser. Electrical repairs are an unpleasant fact aboard any vessel that is equipped with even the simplest of electrical systems. Having a tool that is easy to use and performs well makes the task a bit less painful.

The conventional wire stripper will strip stranded and solid (the latter should not be used anywhere aboard) wire from 10-22 AWG. Its key feature is the position of the stripping blades. As some previously mentioned tools, it is forward of the pivot point. This offers better accessibility and controllability. An added feature of this tool is that it will cleanly cut small machine screws from 4-40 to 10-24 without damaging the threads.

AC receptacle tester (right). This is very inexpensive insurance. It will alert you to faults, both shipboard and dockside.



Impeller remover. A necessity? No. Convenient? Absolutely. It took awhile for someone to introduce one of these (they come in different sizes, so make sure you get the right one for your application); however, once you've used it you won't want to go back.

Tap and die set
(metric and/or SAE).

If you aspire to true
mechanical
independence, this
set is a necessity.

There are myriad
uses for it; however,
you may want both
metric and SAE to
cover all the bases.

Far Eastern
manufactured sets
are often of inferior
quality, which is
usually

accompanied by a
too-good-to-be-true
price. Keep all of
the components
well oiled, or they
will rust.



In a pinch, it will crimp insulated and noninsulated connectors; however, this is a task better performed by a dedicated crimping tool.

The automatic or self-adjusting wire stripper will strip insulation on wires from 10 to 26 AWG. It does this quickly and easily. This alone would make it worth having.

Its real specialty is in stripping the outer jacket from duplex cable, 12-2, 14-2, and 16-2. Not all self-adjusting strippers will do this, but this one does so cleanly, neatly, and with ease. Considering that this type of cable is used throughout most vessels, it should be a welcome addition to the seagoing tool chest.

Telescopic magnetic pickup tool (MAC MP5A); not all magnets are created equal. When a large tool falls into the bilge, only a powerful magnet will retrieve it. This magnet is made from neodymium-iron-boron. Its cargo capacity is a respectable 1.5 lbs. This means that it is capable of retrieving most tools found in the onboard tool chest. Its wand is telescopic, and the magnet portion is flexibly ball jointed. I have even used it, in conjunction with a piece of line, to retrieve car keys from the harbor bottom.

Inspection mirror (MAC MC2); the inspection mirror is especially useful aboard for finding fuel, oil, and coolant leaks on the "blind" side of an engine or genset. In some installations, it can aid in inspecting battery electrolyte levels. The wand should, like the magnet, be telescopic and articulated at the end.

The telescope of this and the previously mentioned tool should be kept lubricated with a light machine oil to prevent rust while retracted.

Feeler gauge set (MAC FG013); adjusting valve rocker lash, ignition points (rare these days), or spark plug gaps are a few items that require the use of a feeler gauge. The gauge set listed here possesses a unique feature that makes it easier for the less experienced to use.

One portion of the feeler's blade is equal to its advertised thickness. The rest of the blade is approximately .002" thicker. Accordingly, when the clearance is correctly set the thinner portion of the blade should pass through the gap while the thicker portion will not. This technique lends itself especially well to valve clearances, something virtually every inboard gas and diesel engine requires adjustment of periodically.

Oil filter wrench (MAC OF4B); the needs of the vessel should be determined before purchasing this tool. Some power plants use spin on oil and fuel filters of different sizes. The tool listed here is a handle that includes four interchangeable bands. This kit will, therefore, fit virtually any fuel or oil filter.

The inside surface of the straps is perforated for maximum contact with the filter's sheet metal, and the handle rotates through 180 degrees for confined-area use. If two different sized filters are present, then this tool costs little more than two separate wrenches but is twice as versatile.

12volt DC test light; conventional and ground sense (MAC ET125C & ET120, respectively) test lights are useful for troubleshooting DC circuits or determining power availability. These testers have sharp probes that can be used to pierce insulation so that tests can be performed along a circuit when looking for a break. If this is done, a small quantity of silicone sealant should be applied over the hole after the test is complete.

The conventional tester is fitted with a single ground wire, insulated with flexible rubber, and a heavy-duty alligator clip. The light in the handle illuminates when positive and negative 12-volt power is connected. It is not polarity sensitive, which means it can be used to check for a ground as well as positive sources.

The ground sensing model is similar except it uses two alligator clipped leads and a set of red and green LEDs in the handle in place of an incandescent bulb. It lets the user know immediately if a positive or negative source is being probed. This feature will be appreciated by anyone who has searched in vain for a 12-volt source at a circuit breaker panel, only to find that the test light clip has been attached to

an ungrounded source.

Allen wrench set (Bondbus 13 pc ball driver); Allen, or hex, wrenches are used in some locations aboard, including winches, electronics, and engines. This set ranges from .050" to 3/8". It has a unique feature that allows the wrench to fit the fastener even if the two are off parallel by as much as 20 degrees. This style of fastener is made in metric as well as SAE, so check to see if these are used aboard and lay in the proper sizes.

Shore power polarity testers 15 and 30 amp (Marinco 9000 & 9030); this small tool is cheap insurance against reversed polarity, open ground and other potentially dangerous situations. The 15-amp version can be plugged in aboard to determine the safety of wiring aboard and ashore.

The 30-amp model can be plugged into the dockside outlet before the vessel's shore power cable is attached. Power condition is indicated through a series of colored lights.

Digital Multimeter

These tools have come so far down in price, there's virtually no excuse not to have at least

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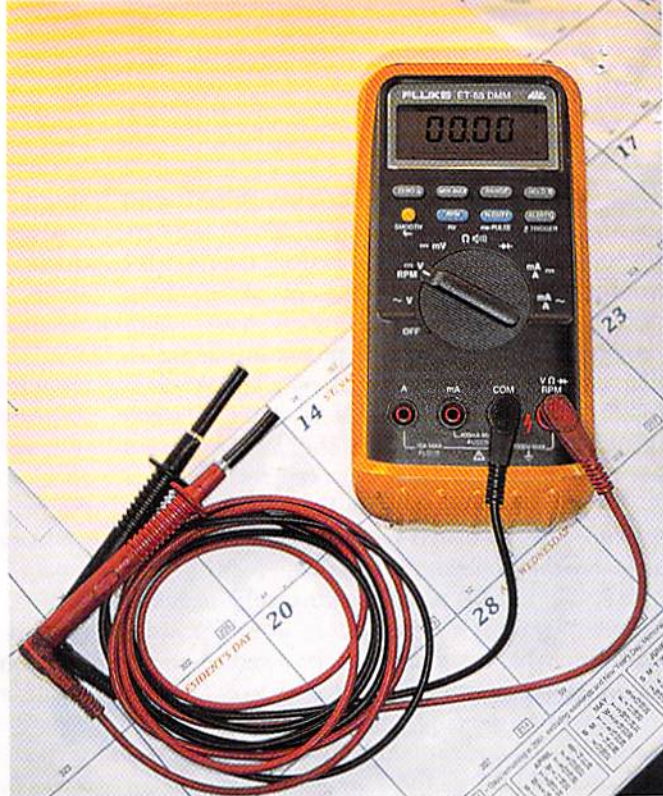
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one aboard. As mentioned earlier, beware of ones that appear too cheap. \$35-50 should buy an excellent and reliable one; \$130 and up will get you into the professional realm. If you have an inverter aboard and think you are savvy enough to troubleshoot it, you'll want a DMM that measures voltage in "true RMS." The definition of this term is lengthy; suffice it to say, if you measure some inverter outputs (the AC side) with a nontrue RMS DMM, the readings you get may be incorrect.

Other Important Gear For The Tool Chest

- A roll each of red and black electrical tape, preferably 3M's Scotch 33, kept in its original plastic container.
- 3M Scotch Brite scuff pad, fine and medium grades (maroon and gray color, respectively). This is ideal for cleaning many types of surfaces,



The now ubiquitous digital multimeter (DMM), sometimes called a digital volt meter or digital volt ohm meter. Whichever term you choose, this tool is indispensable and should have a permanent place in the cruising tool chest.

The Quality Crimp:

What is commonly known to most cruisers as the crimp, or solderless, connector is a product of the aviation industry. Shortly before WW II, with the advent of mass-produced aircraft looming on the horizon, a simple, cheap, effective, and reliable method of attaching wires to screws was deemed necessary. The result was the solderless connector.

High quality connectors start with high quality materials. When a connector is manufactured, a die stamps it repeatedly. This helps to cut and form the metal, but it also work hardens it. Work hardened metal is brittle and difficult to form. As a result, it is not preferable for crimping. Annealing returns the copper to a softer, more malleable state. The barrel portion of a quality connector appears seamless. This is because it is actually welded or brazed together. This means that it can be crimped at any point around the barrel without bursting. The inside portion of this barrel has serrations that are designed to cut into and grab hold of the wire as the crimp is made. This forms a good mechanical, as well as electrical, bond.

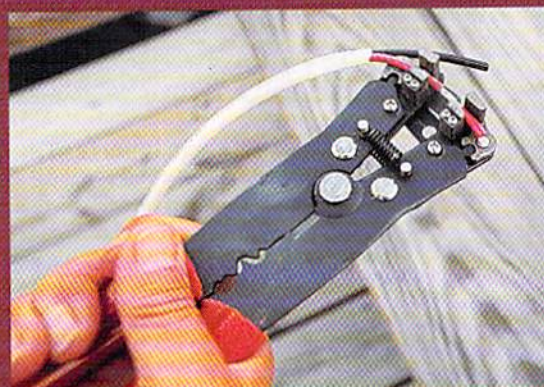
Once the connector is stamped, cut, and annealed it is then tin-plated. This yields superior corrosion protection. Untinned copper or brass connectors should not be used anywhere aboard. They are quick to develop verdigris after only a short exposure to salt air.

There are three kinds of insulation available on solderless connectors: PVC, nylon and heat shrink. The PVC tends to be more brittle and likely to crack if over crimped. This can lead to a short or cross circuit. Nylon insulation is much more durable. It is very difficult to pierce or remove and as a result is more desirable. It is distinguishable from the PVC by its translucent, as opposed to opaque, color (although it utilizes the same familiar red, blue, and yellow color coding). Heat shrink insulation is similar in appearance to nylon, except it is somewhat suppler. Care should be exercised in crimping it. It is not difficult to create small holes while crimping. These will grow during the heating/shrinking process. Crimping tools with gently rounded dies should be used for attaching this type of solderless connector.

To assist in wire entry, the mouth of the connector should be tapered or funnel shaped. With this, the wire strands are less likely to peel back as the connector is placed on them. Once the conductors are safely tucked into the crimp, the extension



A ratcheting crimper, which crimps both the conductor and the strain relief portion of the terminal (when equipped) simultaneously.



An automatic stripper in action.

especially electrical contacts, light bulb bases, etc.

- 600 grit emery paper. This fine grade sand paper is especially useful for cleaning breaker point ignition systems and spark plug electrodes.

- Electrical wire ties, 6", with and without mounting holes. These have a multitude of uses in various locations aboard and ashore.

- 3M Silicone sealant and 101 bedding compound in 3 oz. tubes (and equivalents). Silicone is good for sealing and emergency repairs (in an emergency I've used it to repair the fuel diaphragm on an outboard) above the water line. 101 is a bedding compound sealant, not to be confused with 5200, which is an adhesive sealant. 101 should be used on any installation that requires bedding or a gasket, such as deck hardware or through-hull fittings, if there is the slightest possibility that it will ever be disassembled. The small tubes are resealable, fit well in the tool chest, and if they harden, it's not as much of a waste as the large 10 oz. cartridges.

- Spiral note pad, pen, pencil, narrow- and broad-tipped felt markers.

- 1/8" x 8' nylon line. This can be used as a messenger when pulling wires through bulkheads. It can also be used to secure a tool to the operator's wrist when working over water or the bilge.

- Copper conductant paste (Kopr-Shield, manufactured by Thomas and Betts, is one variety). This product helps to prevent corrosion from forming around electrical connections. It can be applied to wire before it is inserted into crimp connectors or between battery lugs and posts.

- 1/16" stainless seizing wire. In addition to being used for seizing, this wire can also help retrieve lost parts in difficult to reach areas, or for emergency repairs on small parts.

- Earplugs, safety glasses, and gloves. Hearing damage is cumulative. Most professional boat yard workers use it even when sanding or working with pneumatic tools. The small foam plugs that are rolled and inserted into the ear are inexpensive and easy to use.

Eye protection should be worn whenever there is the possibility of debris becoming airborne. This is especially so when drilling or

leading from the funnel is also crimped around the wire's insulation. This insulation crimp is constructed of brass, and it serves as a strain relief aid. It is especially useful in areas of movement and vibration, i.e., a cruising vessel.

There is some debate as to which tools are the best for crimping. Clearly, ratcheting tools are superior due to the uniform pressure they produce. This is the only type tool that is approved for aviation use by the FAA. For the purposes of the cruising power boater, this may be overkill. Although the ratcheting crimp is preferable, the conventional, nonratcheting crimper can yield good results if attention to detail is observed.

Follow these steps to obtain a reliable crimp:

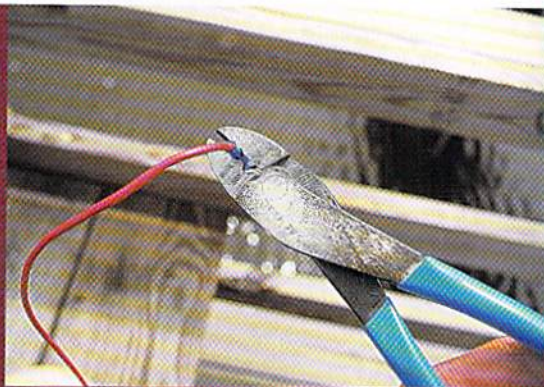
- Insure that the crimping tool being used is of the proper size and die configuration for the crimp being used.

- Strip the wire. This should be done without damaging any of the strands. The strands should remain straight and uniform. Any strands exceeding the diameter of the conductor will catch on the crimp as it is inserted.

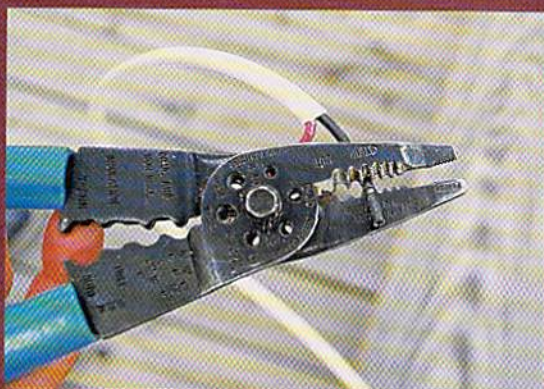
- If using a ratcheting tool place the crimp in the tool. Be sure it is in the proper die station, red, blue or yellow. If using a nonratcheting tool it will be easier to place the crimp over the wire first, then carry out the crimp.

- Insert the wire into the crimp. The conductor should be flush with the flange end of the crimp barrel. Uninsulated wire should not protrude from the rear end of the conductor, as this will prevent the strain relief sleeve from functioning properly.

- Execute the crimp. The ratcheting mechanism should travel through a full cycle before the crimp is released. Remember, if using a nonratcheting crimping tool, enough pressure must be applied to break down the oxides that are present on the inside of the connector, and so the serrations can imbed themselves into the wire strands slightly. This area of the crimp must be gas tight. If gas, in the form of air, is present then corrosion will follow. Alternatively, over crimping will elongate and weaken the wire strands. This will create a mechanically weak connection that will have higher than acceptable resistance. If the tool being used does not simultaneously crimp the strain relief sleeve, this must be crimped separately.



A conventional crimper in action.



A conventional stripper in action. Note how the stripping is performed forward of the pivot point. This facilitates work in confined locations.

cutting metal and fiberglass. Battery acid is also not compatible with human eyes, and safety glasses should be worn whenever lead/acid batteries are handled or checked. Keep the glasses in their original box to prevent damage to the lenses.

Gloves are excellent protection against sharp, abrasive, or hot gear and tools. Caution: Gloves should not be worn when drilling or cutting with power tools, as the glove material can be caught by the blade, drawing the user's hand into it. Heavy-duty rubber gloves should be worn when handling chemicals or acid.

The Tool Chest

The tool chest itself is very dependent on the type and size of vessel upon which it is used. Naturally, larger vessels equipped with workbenches and vices will probably have the room for a dedicated rollaway style tool chest.

Toolboxes may be more appropriate for smaller vessels.

Whichever you choose, ensure that it is securely mounted to the boat and that drawers or cabinet doors will not fly open, disgorging all of your precious tools into a rotating engine or the bilge.

A word of caution: Plastic is probably better than metal for portable boxes. Metal boxes, while sturdy, will scratch gelcoat, paint, and brightwork. Plastic does not suffer this liability.

Tool Etiquette

Proper maintenance of tools will increase their life and improve their performance. The primary enemy of the seagoing tool is, as one might suspect, rust. If a pivoting tool is allowed to rust to the point of seizure, then its life is considerably shortened, assuming it can be forcibly unseized. Each time this is done material is lost from the

•Release the crimp and inspect. The wire should be held firmly, and a slight expansion of the flange end of the barrel should be evident. This is called "bell mouthing." This indicates that the crimp pressure was applied at the proper distance from the end of the barrel.

A better, more reliable crimp can be achieved by using a copper based conductant compound (such as the previously mentioned T&B Kopr Shield) applied to wires before installing solderless connectors. This will aid in creating a gas and liquid tight seal.

In order to receive approval from UL Labs, or the military, crimp connectors must meet many specifications. Not the least of which is tensile strength. For example; A #12 AWG (American Wiring Gauge) crimp should be able to support 70 lbs. for UL approval, and 110 lbs. for Milspec approval.

A quality crimp connector should possess the following features:

- At least a UL, or preferably a Federal Government Spec (Mil-T-7928), approval.
- Annealed copper construction.
- Tin plating.
- A smooth, burr free edge.
- Insulation that is not easily dislodged from the connector.
- A UL or Mil tensile strength rating.

The most reliable styles of solderless connectors for marine use are; butt, ring, flanged spade, and snap spade. Any types of quick disconnect, while under some circumstances necessary and acceptable, are not preferable.

When selecting a solderless connector, never cut back conductor strands to fit a connector. Use the correct size connector for the wire: Red—AWG 18-22, Blue—AWG 16-14, Yellow—AWG 10-12. The sizes of the rings on ring connectors are equally as important. Using the incorrect size ring will result in a poor connection and loose fastener. Ring sizes range from #6 screw to 1/2".

The life of properly installed, high quality solderless connectors, used in conjunction with tinned marine grade wire, can be measured in decades.



Copper conductant paste being applied to a conductor prior to crimp installation. This makes for a durable, trouble free crimp that will last for many years.



A ratcheting compound (crimps both conductor and strain relief simultaneously) crimping tool.

A properly crimped nylon insulated ring terminal.



Make sure you have the correct tools to service these, the most commonly replaced components on your engine.

bearing surfaces in the form of iron oxide. This will increase the tolerances, giving the tool a "sloppy" feel as well as destroying the alignment between cutting surfaces.

There is a host of sprays and liquids that make incredible claims about their ability to fight rust and corrosion. I have tried many of them and found that, for the most part, they do not really work. If they do work it is only for a short time. This seems to be due to the consistency of the liquid being applied. It's too light and too easily displaced by sweat, dirt, and use.

I have, however, discovered a product that does have some staying power. I initially began using it on the hydraulic/electric power trim systems of outboard engines. This gear lives at the interface of air and sea, a perfect breeding ground for corrosion. Not only did it prevent rust, as the electric motor casings are made of mild steel, it stuck to the parts for an average of 400 hours of in water use. This was impressive enough for me to consider using it on tools, and as a mechanic, my tools were exposed to rain, sun, salt spray, humidity, and the occasional submersion on a daily basis. The product is marketed by CRC Ind., Inc. of Warminster, Pennsylvania and is called **Heavy Duty Corrosion Inhibitor**, part no. 06026.

The key to the longevity of this spray product is its consistency. It goes on wet, like other familiar lubricant aerosols, but it dries to an

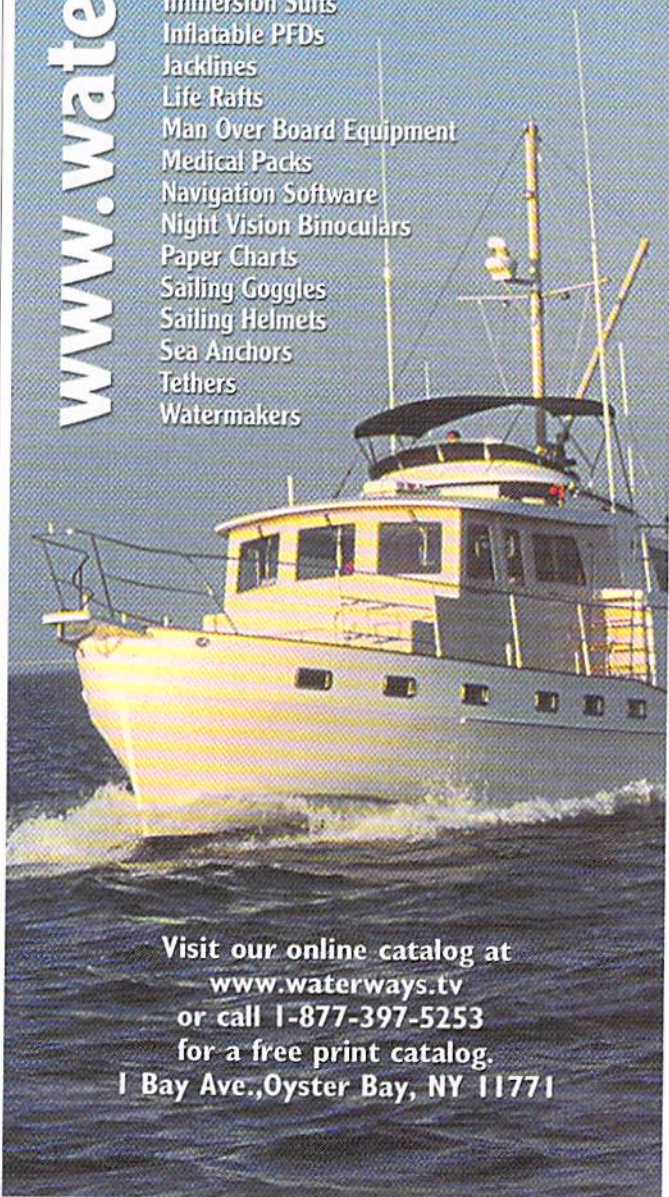
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amber colored waxy consistency that is slightly sticky. After it dries it can be buffed a bit to decrease the stickiness. It has excellent abrasion resistance and it defies repeated salt spray.

Edged tools such as cutting pliers, cable cutters, and scissors will work with greatly reduced effort if kept sharp. This can be accomplished with a small mill file, a rat-tail file, and a quality sharpening stone. Be sure to corrosion-inhibit the surface after sharpening.

Since the aforementioned corrosion inhibitor is not a lubricant, in the true sense of the word, pivoting and turning tools will benefit from a periodic application of light (SAE 10 or 20) machine oil to the bearing surfaces. Socket wrenches are especially susceptible to rust on their hardened carbon steel gears. This portion of the tool should be kept well oiled.

If a tool is submerged in seawater, it should first be rinsed in fresh water. This should be done as soon as possible, especially if this is a pivoting tool with close tolerances. It should then be dried. If available, blow off the tool with compressed air, or shake it with a jerking motion, especially in the case of tools with hidden gears, ratchets, or bearings. Finally, dry it off and coat the moving parts with a liberal amount of oil and the rest of the tool, if not chromed, with HD Corrosion Inhibitor.

Pointed tools such as awls, test lights, and scissors can injure the user. Reaching into a toolbox and meeting the end of a sharp awl is a memorable experience. To protect the box, and myself, I place short lengths of snugly fitting surgical tubing or rubber hose (vacuum tube works well) over the ends.

It is worth mentioning that all tools aboard should be engraved with the vessel name and a portion of the hull ID number or the owner's initials and last four digits of a Social Security number. This may discourage theft or aid in repatriation of borrowed or lost tools. Police departments often do not recognize initials alone as proof of ownership.

Pulling It All Together

The preceding list is simply a starting point. You'll want to add and subtract tools based on



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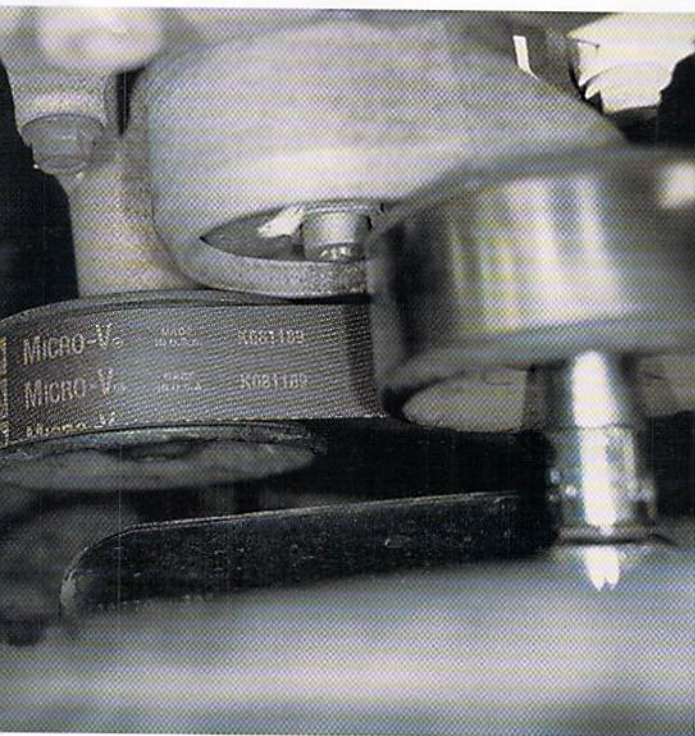
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A breaker bar and socket fit to the tensioner pulley of a serpentine belt. Without this tool, even if you have a replacement belt you may not be able to install it.

the size and construction of your boat, as well as the type of power plant, genset, and other systems found aboard.

If, for instance, your vessel's engine is fairly new, it is probably equipped with a single serpentine belt. Have you ever changed it? If not, I strongly recommend you do just for the practice. In doing so you will probably discover you are lacking one important tool required to accomplish this task—a breaker bar.

Most serpentine belt systems use an automatic, spring-loaded tensioner pulley. The operative word in this case is tension. These pulleys usually require a fair amount of effort to release in order to remove or install a belt.

The best tool for accomplishing this is a 1/2-inch breaker bar with a pivoting head and the appropriate sized socket, which may be metric.

Try changing this belt when you're dockside and in no hurry. If you can do it then, you'll be able to do it in a hurry if necessary on a dark windy night while transiting a lee shore.

The right tool for the job means more time under way, enjoying yourself, and less time in the engine room inventing new expletives for inadequate or broken tools. ●

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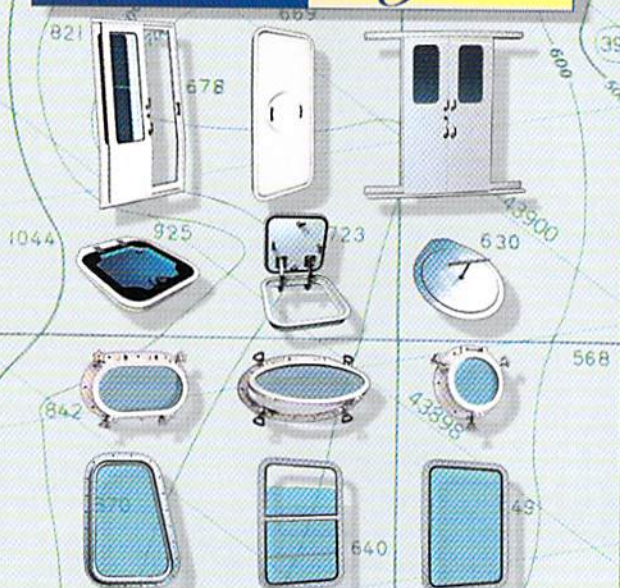
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