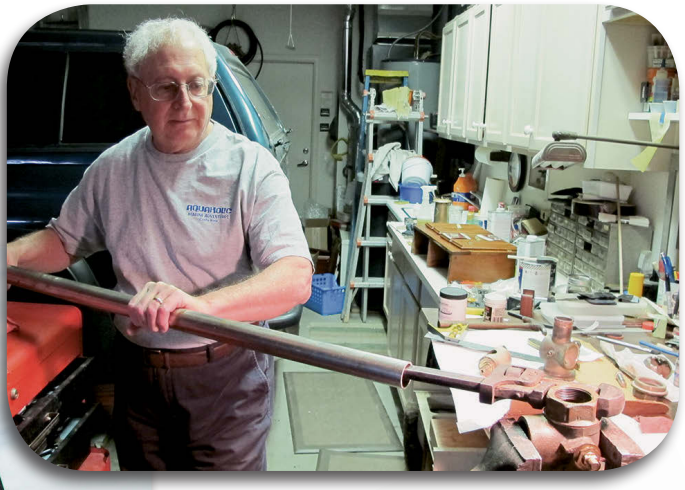
GOOD OLD BOAT™

The sailing magazine for the rest of us!

ARTICLES BY
ED ZACKO



Enjoy this collection of articles written by Ed Zacko

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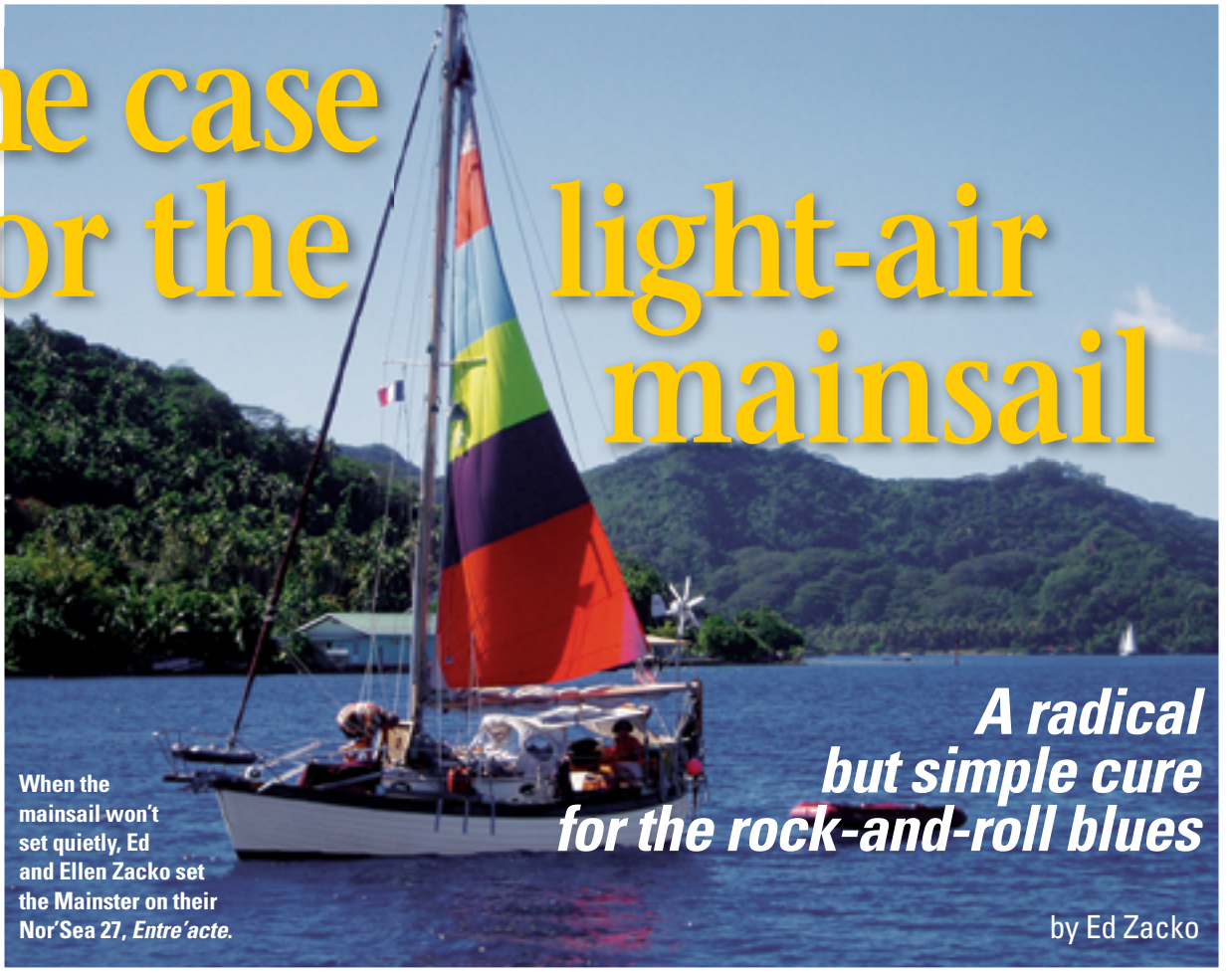

When the mainsail won't set quietly, Ed and Ellen Zacko set the Mainster on their Nor'Sea 27, *Entre'acte*.

A radical but simple cure for the rock-and-roll blues

by Ed Zacko

"The sails flapped and banged — about the ugliest sound a sailor can hear. Apart from nearly driving me crazy, the conditions were hard on the sail seams."
– Excerpt from *Dove* by Robin Lee Graham

Cruising books admonish us to carry clouds of sail for light air. They go on at great length describing large genoas, drifters, and cruising spinnakers. But, other than describing vangs and preventers, they seldom suggest a solution to the mainsail problem.

Countless words have been written about "the violence of calms," warning that more instances of rigging failure, dismasting, and torn sails occur during calms than in storms.

Sails work efficiently only when full and drawing quietly but it takes surprisingly little swell to start the mainsail slatting. Not only does this stop the sail from working properly, the noise it makes is unnerving and the damage from the slatting is cumulative and insidious. Because the material does not give, a slatting Dacron sail imparts severe shock impacts, on itself and on the rig. Each time that sail snaps, several things happen.

First, when sails slat, the cloth works and jerks on its seams. This working and jerking enlarges the holes around the stitching, wears out the sailcloth, and weakens the thread. The less a sail slats, the longer it lives.

Second, repetitive shock loads are transferred to the standing rigging. Chainplates, mast tangs, turnbuckles, and rigging wire are all affected. Swage fittings and fully battened mainsails are particularly vulnerable to these shocks. Like sails, the standing rigging is designed to withstand constant steady stress rather than sudden violent shock loads. The stainless steel will work-harden over time and break when you least expect it to.

Third, as you're already in a calm and not moving well, if at all, the slatting makes things worse. In any swell, as the boat begins to roll, the mainsail winds up like a pitcher on the mound. The momentum of the impact, along with the leverage of the boom, causes the boat to roll down farther in the opposite direction. As this process repeats, each cycle further hampers your forward progress.

Fourth, the constant rolling compromises the headsail you're flying. Large genoas will also slat and bang, imparting tremendous side loads to the forestay at the terminal fittings and contributing further to the problem. Nylon drifters and spinnakers will eliminate this shock but, when working alone without the mainsail, their effectiveness is severely compromised.

As offshore cruisers, we have tried all the known solutions over the years. Sheeting in the full main will not quiet the sail because of its draft. Tying in a double reef will flatten the main, and

sheeting it amidships can stop the slatting, but it also eliminates a major portion of the boat's horsepower. To make any real progress in light air, we need to fly as much sail as possible.

Enter the nylon mainsail

Our introduction to the nylon mainsail came through Dean Wixom, the father of the Nor'Sea 27. Dean carried one on his Nor'Sea 27, *Chinook*, for several years and loved it. On one of his visits to our home, he elaborated on the merits of this sail. But we argued against it, mainly due to lack of space on board. Frankly, it seemed like a wacky idea. Dean was not offended. He just smiled and went on his way. Subject closed. Or not quite!

On his next visit, Dean arrived at the airport weighed down with several sail bags. He brought all of his light-air sails for us to try on our upcoming Bahamas cruise. We resisted, but Dean persisted until we gave in. Weeks later in the Bahamas, as we sat with little wind, the noise and frustration overcame our reticence and we set the light-air mainsail. After only 10 minutes, we agreed: "We must have this!" Throughout the summer, we played with the rest of Dean's light-air sails as well, but the nylon mainsail completely absorbed us.

The concept of a light-air mainsail is simple. How could sailors as a group have missed something so logical? Aside from Dean, we know of no other person who has ever had and used one. Strangely, every sailor or cruising writer we've talked to has refused to discuss it. Just as we did in the beginning, others tune us out when we broach the subject.

Meet the Mainster

The sail that we've affectionately named the Mainster is very simple. The *idea*, by the way, is open to anyone, but the *name* belongs to us. Our Mainster is built of 1.5-ounce ripstop spinnaker cloth. It has simple broad-seaming, a wire luff, and drawstrings to shape the luff, foot, and leech. It is set "flying." That is, it's attached only at the

The Mainster, stowed in its sock in its own sailbag, takes up very little space.

On passage, the sailbag is lashed to the deck and Ed (or Ellen) hoists the sail directly from it.

In light air, working at the mast is no problem.

The Mainster's wire luff hooks to a snap-shackle attached to the gooseneck.

A downhaul controls luff tension.

Foot and leech lines allow for infinite variations in sail shape.

The clew outhaul stays rigged through its cheek block on the boom, always ready for action.

PHOTOS BY ELLEN ZACKO

The working mainsail is ready to be hoisted at any time and the Mainster can be doused with its sock on short notice. Moreover, the Mainster's flexibility allows it to be flown with a variety of light-air headsails; a cruising spinnaker, above left, or a hanked-on nylon genoa, above right.

head, tack, and clew. It can be hoisted with the main halyard or a dedicated spare. The tack is fastened to the boom gooseneck with a snapshackle and the clew is run out along the boom with an outhaul that runs through a cheek block at the end. Everything happens at the base of the mast. The topping lift supports the weight of the boom and allows for some basic sail shape. A vang prevents the boom from hopping around in the swell. Gross trim is accomplished with the mainsheet, fine trim with the outhaul and drawstrings.

Over our past eight years of cruising, we have refined our system. The main halyard remains attached to the mainsail on the starboard side of the boat while we hoist the Mainster with its own halyard on the port side. My wife, Ellen, has made a spinnaker sock that greatly simplifies the process.We stow the Mainster in its sock in a bag attached to the main hatch, always ready for use. We hoist the Mainster directly from the bag, sometimes even before lowering the main. As the Mainster unrolls, we connect the tack and clew to the snapshackles and simultaneously pull on the sock line and clew outhaul.

Instant silence! As soon as we raise the Mainster, it blankets and silences the working main. Once the Mainster is drawing, we lower and furl the mainsail.

The procedure for dousing the Mainster can take many forms, depending on conditions. In an emergency, the fastest way is to cast off the clew outhaul and pull on the sock downhaul. We don't recommend this method as the very thin cloth can become fouled on spreaders, shrouds, and mast steps. Fortunately, there is usually sufficient warning to make such a maneuver unnecessary. A better way is to ease the clew a little while pulling on the sock downhaul. We simply let the sail hang enclosed, like a sausage, until the worst passes. At that point, we can either open the sail once more or lower it completely.

As we ease the halyard, we roll the sail from the bottom up. This makes for easy and compact storage and prepares it for the next deployment. The beauty of the Mainster is that it's a one-person sail. One person can make the change from mainsail to Mainster or the reverse in less than three minutes. Snuffing the sail in an emergency takes less than 20 seconds.

It tacks and jibes silently and takes up almost no space on deck or below. The nylon cloth has a lot of stretch and absorbs the shock of slatting. Instead of the dreaded crash, all we hear is an occasional gentle "phump" with no shock or banging.

Unlike a spinnaker, a light-air mainsail is constrained by the mast, tack, and boom, so it can't get out of control as the boat swings in the swell. Another advantage over a spinnaker is that the center of effort remains constant as the boat moves around, so our windvane and autopilot love it.

> **"When the wind is on the beam, the combination of the Mainster and cruising spinnaker is dazzling."**

We have no fear of flying the Mainster at night, as it can be doused in seconds. Coupled with our large hanked-on nylon genoa, it brings us as close to a "set it and forget it" light-air rig as we can get. When the wind is on the beam, the combination of the Mainster and cruising spinnaker is dazzling. As I write this, we have been sailing wing-and-wing for two weeks with the Mainster set to port and the drifter poled out to starboard. We have not touched the tiller, sheet, or halyard in 14 days. Yes, we still move about in the swell but both sails are driving. In this light air, we are moving slower than a worm, but we *are* making progress and it's *quiet*.

It takes very little wind to keep nylon asleep, and the tension in the sailcloth is quite apparent, above left. Having both sails drawing reduces roll and contributes mightily to balance and drive. In this light air and in this sea state, a Dacron mainsail would never sleep, above right.

Drawbacks

There are only two problems with the Mainster. The first leap, it seems after watching other sailors wrestle with the concept, is to *accept the idea* in the first place. We sailors seem to be slow to accept any radically new idea that has not been heavily advertised and hyped.

Once past that hurdle, the second problem is finding someone who will build one for you. We were turned down flat by seven sailmakers, one with a resounding "No!" as he slammed his clipboard onto the table. Fortunately, Dave Thompson of Eggers Sails in South Amboy, New Jersey, inspected Dean's sail, listened to our idea and, though skeptical, agreed to build such a sail for us if we would accept all responsibility for the result. No problem there, since we had already spent a summer using one just like it and had no worries. The results were wonderful; we could not be more pleased.

The only complication that we can foresee for some rigs is with the use of lazy-jacks or a Dutchman system. With these systems, you *can* use a Mainster but you will have to snuff the sail whenever you come about and re-deploy it on the other tack outside the lazy-jacks. Some lazy-jack systems allow you to detach the lines and lead them forward and out of the way. With a little creativity, it would be easy to set up a clew outhaul that would work on either tack outside of these lines.

The Mainster is not a substitute for a working mainsail. It is designed for specific conditions that we encounter all too regularly: a swell together with a breeze so light you can barely feel its presence and much too light to fill your working main. For one thing, you will not be able to point high with *any* nylon sail. As the sail fills, the stretch of the nylon will cause the draft to move aft and the luff to sag to leeward. These factors are detrimental to windward performance but, at about 50 degrees apparent wind and greater, you will have two sails driving the boat. So, if the mainsail will fill and draw quietly,

The wind generator is still, but the Mainster and cruising spinnaker are full and pulling hard enough to give *Entre'acte* a bone in her teeth.

Resources

Dave Thompson, John Eggers Sailmakers
7076 Highway 35 N, South Amboy, NJ 08879
732-721-4667; www.johneggers.com

The Mainster has lines in its luff, leech, and foot with which to make the sail full or flat. Luff sag is not a problem when sailing off the wind.

we use it. If it fails to draw and begins to slat, we fall off and use the Mainster. Our philosophy is to keep the boat moving as comfortably as possible.

Make your own

This sail is simple enough that you could make one yourself, provided you have the basic skills, inclination, and a machine that will handle V-69 thread.

When you measure, use the topping lift to set the boom at a working height that will allow you to tack and jibe easily. Make certain that your boom will clear any boom gallows, and dinghies stowed on your cabintop.

If we were to make a new Mainster, the only changes we can think of would be to substitute one of the new non-stretch ropes, such as Amsteel or Spectra, for the wire luff and to relocate the foot-line Clamcleat from the clew to the tack. This way, the halyard tension, luff, and foot shape could all be set from one place at the base of the mast.

For eight years, the Mainster has been our first line of defense in the battle of the calms. At the first slap, up it goes. The cloth is rated up to 20 knots and, while we have never tested it to that extreme, when the wind returns we continue to fly it as long as we are comfortable. We often leave a first reef tied in the mainsail. If a squall threatens, we douse the Mainster with the sock, raise the already reefed mainsail, and let the sock hang in the lee of the main until we decide what to do next — very civilized.

The Mainster is perfect for those conditions when the headsail is blanketed by the main and fails to draw. In those conditions, the motion of our boat is much better with the Mainster alone than with a poled-out headsail. We have also enjoyed great success on a reach with the Mainster coupled with our large drifter sheeted to the end of the main boom.

In light air, nylon is king. With a light-air mainsail you can carry maximum sail and, while the swell will not go away, at least be moving in comfort.

Light air is indeed a challenge. Light-air sailing tests your ingenuity and patience, but these last two weeks aboard *Entr'acte* have been an absolute delight. Even if we had enough fuel to motor the vast distance involved, the sound of the engine would destroy this special experience. It's true that we are moving only as fast as a baby can crawl, but it is in these calms that the ocean comes alive. There's an astonishing variety of activity in the sea that we often miss because of the wind, waves, and motion. But when the wind and sea die down, we truly slow down, relax, and witness everything.

Ed Zacko, a drummer, met violinist Ellen while playing in the orchestra of a short-lived Broadway musical. Their own show is still running after 32 years. They built their Nor'Sea 27, Entr'acte, *from a bare hull and, since 1980, have crossed the Atlantic to Europe and back four times. Their current voyage has taken them through the Panama Canal and across the Pacific. Follow them at <http://www.enezacko.com>.*

From *Entr'acte's* log

With two sails drawing, *Entr'acte* has more horsepower, and also presents a colorful sight.

Thursday, January 6, 2006. Latitude 14° 43' N, longitude 47° 51' W. Speed 1.5 knots. Day 25. Destination: Trinidad.

For the past two weeks, the wind has been non-existent with only the long slow ocean swell to remind us that we are, indeed, at sea and not sitting in a boatyard. We departed Santa Cruz in the Canary Islands mentally geared for a very fast trade-wind passage, but the usually steady trade winds have disappeared. It seems as if every bit of wind in the world has disappeared.

The SSB radio is alive with tales of spinnakers wrapping and mainsails slatting, banging, and finally furled to prevent self-destruction. There are complaints of drifters unable to provide power as they try to work without the mainsail. Few are moving as they're low on fuel with more than 1,000 miles to go. Everyone is irritable from lack of sleep and the slow progress.

On board *Entr'acte*, things are different. With the slightest breath of breeze, barely enough for steerage, *Entr'acte* has been knocking off a steady 40 miles a day for 14 days. All ports and hatches are open, and Ellen is happily sewing clothes in the cockpit. Max, our Aires windvane, is steering faultlessly. The sea is absolutely flat. Not a ripple disturbs the water, save that long ocean swell. We have had long conversations with turtles as they swim with us. Our big treat is the family of dorado that has been accompanying us for 10 days. Mom and Dad are teaching Junior how to fish, and today the little guy managed to score his own meal. As we cheer in the midst of this absolute silence, Dad dorado actually makes eye contact with us; the water is that calm and clear. Who would believe that these conditions are possible in mid-ocean and for so long?

All is perfection, at least for us. *Entr'acte* is moving along steadily and comfortably, albeit very slowly, with the secret weapon we have affectionately dubbed the Mainster.

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Fire aboard

Prevention demands diligence and vigilance

by Ed Zacko

Ellen and I have been involved with two major boat fires over the years. The first was in the Caribbean on board *Entr'acte*, our Nor'sea 27. We had guests on board, something that disrupts the usual routine. We had just returned from a day's snorkeling and were all hungrily anticipating dinner.

Entr'acte was anchored in St. John, USVI, and the winter trades were blowing in earnest. All the hatches were open and the wind scoop was drawing welcome cool air into the boat. Ellen was preparing dinner in our small galley for more people than usual. The stove was running. While waiting for a pot of water to boil, Ellen tried to get a jump on the next day's varnishing. She opened a gallon can of denatured alcohol and began to pour some into a 2-pint bottle.

I was in the aft cabin with David, my brother-in-law, while Ellen's sister Joanne was writing postcards at the chart table and their son Jayson was in the cockpit playing with his new-found hermit crab in a bucket of water.

There was no sound, no flash, no warning — all we heard was Joanne saying, "Guys, we need you up here, NOW!" She actually sounded calm.

As I entered the cockpit, I was knocked back toward the aft cabin by a blast of heat from the main cabin. In front of me all I saw was a wall of flame. Joanne had climbed out the forward hatch but, through the flames, I could clearly see Ellen still inside the cabin, clothes smoldering. With all the willpower in the world, I tried to get to her but the force of the hot air pushed me back. Joanne finally succeeded in helping Ellen escape through the forward hatch, by which time her clothes and hair had started to burn. In one motion she came up through the hatch and dove over the side.

Disoriented? You bet! Ten seconds before, we were happily discussing the lobsters we caught for dinner and suddenly Ellen was in the water and we were fighting a raging inferno.

There was so much fire and so many flammable materials (oil, alcohol, paper, plastic, varnish, teak oil, cloth, and imminently wood) it was impossible to decide what technique was right for fighting each type of fire. There was no time to think, only to act!

A frantic few moments

I grabbed the fire extinguisher from the aft cabin and shot at the companionway to gain entrance. My next shot was the stovetop to extinguish the burners, that were now torches, but they immediately reignited. My third shot fared no better. David came to the rescue by unceremoniously dumping the bucket of water, along with one very surprised and panicked hermit crab, onto the stove. This bought me enough time to reach the master kerosene shutoff valve and throw the fire blanket on top of the burners. My last shot of this extinguisher was saved for gaining access to the second extinguisher that was covered with burning alcohol.

The rest of the time was a blur of shooting dry powder at everything that burned, accompanied by copious buckets of water continually thrown onto everything inside the boat, whether it was burning or not. This was no time for finesse!

The entire event from ignition to extinction lasted less than a minute. Yes, time does slow down during these events. It is just fantastic what can happen in only a minute!

Alcohol inferno

The ignition had set in motion a complex series of events. First, the gallon can of alcohol exploded in Ellen's hands and sprayed flaming alcohol all over her and everything in the main cabin. The ignition itself extinguished the flames of both burners on our kerosene stove and they immediately cooled to below the vaporization point. This resulted in liquid kerosene spraying upward to be ignited by the ambient flames and turning the two burners into blow torches.

Everything in the cabin was covered with burning alcohol that, as it burned away, would set fire to all of the combustible surfaces beneath: varnish, wood trim, books, papers, ship's log, clothing, and plastics. The flames from the floor were sucked up through the louvers of the head door as by the draft

ILLUSTRATIONS BY TOM PAYNE

of a chimney. Anyone who had been inside the head compartment at that moment would have been asphyxiated or burned alive as the flames ignited the toilet paper, wood, and a nylon jacket hanging there. The jacket instantly evaporated into a cloud of invisible hydrogen cyanide. Even the fire extinguisher in the main cabin was on fire!

Aftermath

Ellen had second-degree burns on her face, hands, and fingers. Her hair was singed, her eyebrows burned off, and she had what appeared to be one incredible sunburn. Fortunately, she kept her face in the water throughout the battle, which we believe kept the burns from getting worse. We treated her for shock and kept her under watch, but she had no further complications beyond severe blistering on her hands and fingers. With rigorous attention and care, these faded away after a few weeks with no permanent scarring or other lasting effects.

Incredibly, *Entr'acte* emerged unscathed. Aside from the indescribable mess, the only evidence of this event is the scorched louvers of the head door, which had just started to ignite. To this day when we clean, we look at them and shake our heads.

When we were building *Entr'acte*, Ellen and I had discussed just such an event. We decided that — should a fire occur — it would probably be associated with the stove and the first reaction would be to get away from the fire. It seemed, therefore, that mounting a fire extinguisher close to the stove was not a good idea. Instead, we installed one near the forward hatch and another in the aft cabin. That aft cabin extinguisher saved our boat.

The cause of the fire

We were anchored into the trade winds. The wind scoop was drawing beautifully and provided perfect ventilation. It was actually more like a wind tunnel, but it felt wonderful. Even though Ellen was forward, pouring the alcohol almost 8 feet away from the lighted stove, the wind carried the fumes right through the boat to the burners and . . . BAM!

Could this fire have been avoided? Absolutely! Did we know better? Yes! But this had been a week of sheer chaos and we were off-balance, rushed, and frazzled, trying to entertain company and keep a 9-year-old occupied and happy. Had we been alone in our usual mode, we would never have done anything so abjectly stupid!

What we learned

- Beware of *anything* flammable around *any* heat source, especially if it has an open flame. This includes cooking stoves, but also heat guns, hot-air heaters, hair dryers, candles, and birthday cakes. This sounds like a no-brainer, but in a small space like a boat the danger is greatly magnified.
- Fumes from many solvents are heavier than air and will settle low in the boat. They can be ignited by a hot engine manifold, lighted stove burners, cabin heaters, oil lamps, and

Recipes for disaster

Boats are lost for many reasons, many of which are beyond our control. No matter how diligent a watch we keep, whales, submerged containers, trees, and logs are invisible in a running sea, especially at night. Navigating in low visibility puts many things somewhat out of our control. An onboard fire, however, is perhaps the most "avoidable" of hazards. The real horror is in its suddenness. One minute you are happily living your dream and the next everything is literally going up in smoke.

Here are a few potential fire sources we have experienced first-hand or witnessed over the years, all of them eminently avoidable.

Engine-room hygeine

How clean is your engine?

A clean engine and engine room is not an affectation of a gearhead hot rodder. I am amazed when I look into engine rooms and see greasy monsters lurking there in the dark. Years of buildup from fuel and oil leaks can easily ignite, especially during a long hot run in the tropics. We've seen this time and again.

Do not tolerate any leaks!

Oil is insidious. A little goes a long way to create a mess. Fuel from leaky lines, engine bleeding, and filter changes, and oil from filter changes and leaking gaskets runs along wires. It pools inside electrical tape and the conduit of the wiring harness, building up over time to eventually cause a malfunction of some kind or even lead to a fire.

We blew an oil line on *Entr'acte* two years ago. Despite meticulous cleaning, even now I still find oil in places and in quantities that surprise me. A scrupulously clean engine, engine room, and bilge go a long way toward preventing a fire.

Engine-room firefighting

If you do have an engine room fire, *do not* rush to open the

continued on next page

compartment door. That gives the fire an abundant fresh source of oxygen. You are far better off closing all vents to the engine room and firing the extinguisher through a small opening — perhaps built in and capped for just this purpose. This is a great argument for a built-in automatic engine-room extinguisher.

Stove safety

Alcohol stoves have always been deemed "safe." This is because an alcohol fire can be put out with water. However, alcohol fumes, like gasoline fumes, are heavier than air and are capable of violent explosion. A friend was boiling water for coffee when the burner shut off suddenly because the tank had run out of fuel. Being quick on the trigger, he wanted to refill the tank and continue with his task so he would not lose the prime. As he opened the fill cap on the pressure tank, alcohol vapor — under pressure — escaped from the tank to fall invisibly onto the still-hot burner and BANG! Both of us were blown right across the cabin. All the hair on his arm was burned away and his face and T-shirt were scorched. He should have waited for the burner to cool before opening the fill cap. The fumes in an "empty" tank make it far more volatile and lethal than a full tank.

Beware when priming kerosene and alcohol stoves. Those of us who use pressure alcohol or kerosene to cook must prime the burners with alcohol. If for some reason you "miss the prime" or the burner goes out and needs to be re-primed, beware! Wait for a minute or two to allow the burner to cool down and then prime a different burner. Never attempt to re-prime a hot or warm burner or an adjacent one until the burners have cooled for a minute or two. It's a waste of time and alcohol because even a warm burner will vaporize the priming alcohol long before the burner becomes hot enough to function properly. More important, by pouring alcohol onto a hot burner, you run the very real risk of having the burner ignite not only what is being poured but also flashing back to the alcohol container you're using.

candles. Beware of solvents. (***Note:*** *After writing this, Ed wrote, "Just the other day in Vanuatu, a guy wanted to clean his bilge so he went at it with copious amounts of acetone. After he finished, he used a 12-volt vacuum cleaner to finish up. He started the vacuum and BOOM! The vacuum sucked the acetone fumes into its motor and, horribly, the explosion set off his propane tanks. There was not much left."* ***–Eds.***)

- You can go from a beautiful carefree day to absolute disaster in less than a minute.
- Fire extinguishers should be placed away from areas where fires are most likely to start. At least one should be stored in a cockpit locker.
- You can never have too many fire extinguishers.
- The *only* type of extinguisher to have on board is one rated A-B-C, for *all types* of fires, because you will be fighting all types at once.
- Inspect extinguishers regularly to see that the gauges are in the green. If not, replace them immediately.
- Shake and roll your extinguishers regularly, and especially after long passages to windward. This prevents the powder from settling and compacting over time. We store our extinguishers in a horizontal position so the powder has less tendency to pack tightly.
- The tradition of following a shipboard routine has a practical purpose. Entertaining guests, especially children, distracts you from your normal routine, causing you to do things you would not normally do. Try not to let the presence of guests disturb your onboard routine.
- Heroics go out the window. As hard as I tried to enter that cabin, it was impossible until after the first shot from the extinguisher and the bucket of water. Without the aft-cabin extinguisher, we would have lost the battle.
- Any boat *must* have alternate and *unobstructed* means of exit, both forward and aft. Without the forward hatch, Ellen would have been burned alive.
- Cooking on board a boat is a full-time job, different from cooking ashore. When cooking on board do *only* that! Period! Do not multi-task cooking with entertaining or preparing for some other maintenance task.

Another galley fire

Our second experience with a boat fire was many years later. This fire was more insidious in its cause, something none of us would ever have expected.

We were traveling the ICW in company with another boat heading to the Bahamas. *Nadine* was a 28-foot sloop owned by Fred, Monica, and their young sons, Josh, 11, and Justin, 9.

Like us, Fred was fond of kerosene stoves and he had outfitted *Nadine* for this cruise with a used one he'd found

"They quickly exhausted all of their extinguishers, but the fire kept reigniting."

in a marine consignment center. It was in great shape. He installed it, and off we went.

On a cold Chesapeake Bay afternoon, they were happily cooking dinner when POOF! The entire galley was in flames. Fred didn't panic. He grabbed his rather large extinguisher and gave the fire a solid blast. Out it went. POOF! Another ignition. Another hit. POOF! The fire would not die! They quickly exhausted all of their extinguishers, but the fire kept reigniting. The cabin was now full of smoke and, with the fire raging, Fred gave the order to abandon ship. As I came alongside with two more extinguishers, the kids took to my dinghy while Monica remained behind to take care of Fred, who was exhausted and somewhat overcome by the smoke.

Unlike with our fire on *Entr'acte*, I could enter the cabin. This fire had more smoke but far less heat because it was still confined to the galley area. I took a deep breath and dove into the cabin. I could see the flames, but could not find their source. I knew I had about a minute or so before I had to breathe and would have only one chance. From studying the flames, I determined that the source was associated with the oven.

Opening the door, I saw perhaps the most magnificent pie I have ever seen and, at the same time, located the source of the flames: *inside the framework of the oven itself!*

I had to make a terrible choice: save the pie or the boat and, believe me, I thought about it. That pie was right out of a storybook! But common sense prevailed and I shoved the nozzle of the extinguisher into a vent hole and let her rip, not once but several times with both extinguishers. I kept shooting until I could not hold my breath any longer and bailed out. That did the trick. The fire was dead, but so was that apple pie.

All ended well. No one was injured and we all lived to continue the voyage south.

Lessons learned

- ***Cause:*** The fire was caused by oil-soaked oven insulation. Fred's used stove was an older unit such as you might find on any good old boat. Throughout its years of use, raw kerosene from leaks, cleaning fluids, cooking grease, and food oils had gradually found their way through screw holes and assembly points and accumulated in the fiberglass insulation common to all stoves, even those in our homes. Over time, the fiberglass insulation soaked it all up like a sponge, slowly becoming a giant cigarette lighter. Eventually, the day arrived when there was sufficient oil buildup that the heat from the burners caused it to ignite.
- ***Proper use of the extinguisher:*** All fire-extinguisher instructions say to "shoot at the base of the fire." This deprives the flame of much-needed oxygen. If you just shoot at the flame itself, the fire will re-ignite. It was only when I aimed the nozzle into the vent hole and directly at the source of the fire that I introduced enough powder to smother the flames. I shot *a lot* of powder into a small space!
- ***Check your oven insulation:*** In the days following the fire, we disassembled both *Nadine*'s and *Entr'acte*'s stoves. They were in the same condition. *Entr'acte*'s insulation was a ready candidate for the same event. Over many years, the insulation had soaked up spills made when filling the tank and cleaning burners as well as cooking oils and other oily stuff. For $5, we replaced the insulation in both stoves.

How many times have we seen someone squirt a bottle of charcoal lighter onto the briquettes of a grill before they are lit? Fine, but after they are lit, it is the height of folly. Don't prime your kerosene or alcohol stove this way.

Never, ever, leave your stove unattended. We have seen cooks set a pot to "simmer" while going out spearfishing. You might get away with this in a house but doing it on a boat is asking for trouble.

Electrical-fire sources

Don't overlook electrical wiring. I had an "instant fire" one afternoon as I was installing a new engine-hour meter. It was a very simple operation: remove two small nuts and out comes the gauge, two more nuts and off come the wires, reassemble everything and reattach the panel. That's it! Two minutes later, as we were preparing to go ashore, we smelled smoke and I saw flames behind the instrument panel. I immediately turned the batteries to the "off" position and disassembled the panel. The wiring studs on the new meter were a little bit longer than those of the old meter . . . just enough to make contact with something behind the panel. Even though the studs had rubber boots to cover them, the pressure of the panel being screwed down was enough to dislodge one. Had we left the boat sooner, it would have been a disaster.

Always leave plenty of space between electrical connections and cover all connecting wires securely with rubber boots, tape, liquid electrical tape, or heat-shrink tubing.

Battery charging

Battery chargers are culprits too. Boats have been lost due to battery chargers. Many people leave their boats connected for weeks or months at a time in their absence. We never leave *Entr'acte* connected to a charger when we're away for any length of time. Turn it off and disconnect the boat from the power source. Many marina electrical systems are overloaded beyond

continued on next page

belief. You and the charger are at the mercy of whatever faults occur.

High-output alternators and fast charging systems also cause fires. Battery fires are truly frightening. We have seen several battery fires recently caused by "fast charging." Some fast-charging systems allow the user to regulate the output of the alternator while monitoring and regulating battery temperature and voltage. The danger arises when trying to charge a large battery bank in an hour of engine time. The faster the charge rate, however, the higher the heat buildup.

We have a high-output alternator. It certainly has a place and, when used properly, performs a wonderful service. We like a simple externally regulated system. It fully charges the batteries in its own good time and is much smarter and more patient than I am. It takes longer to charge, but it is far safer.

Handle gasoline with care

You can never be too careful around gasoline. Even boats with "safe" diesel engines carry gasoline for outboard motors and generators. Jerrycans spring leaks. Be careful where you store them and be careful when transferring fuel from them to other containers.

One afternoon while at anchor, I needed to filter a gallon of gasoline. The foredeck was out of the question as I was afraid the fumes would find their way through the forehatch even if was closed. I chose the cockpit instead.

We all learn that when at a fuel dock you should close all hatches and doors until departing. With this in mind, I closed all the doors and the hatches and proceeded to make my pour. It only took 30 seconds and there was more than adequate ventilation. From below, however, came the cry, "Why am I smelling gas in here?" I looked down and, surprise! — I was right next to the open vents to the engine room. I had forgotten to spin them closed. Needless to say, we opened everything up and spent some time blowing out the engine room. Perhaps the foredeck would have been the better place after all.

Remember your outboard motors and generators. Why would we be sensible enough to be pathologically afraid of gasoline yet store outboard motors and generators when not in use or during layup in the head? Sure their tanks are empty, but what about their carburetors? Remember that an empty tank is more dangerous than a full one.

Beware of that jerrycan stowed on deck just outside your open port or hatch. Completely full, it's not a problem, but notice how it bulges on a hot day when it's half full. Can it crack under this pressure?

Be smart with propane

Propane use is also problematic. We were recently in a marina where a boat two boats away from ours had a propane tank sitting in the wheelhouse and the "working tank" clearly visible in the galley below. If that boat ever blew, it would take out the entire marina and us with it. I mentioned our concern to the owner, who was happily standing next to the tank while using a belt sander, sparks flying, to spray powdered fiberglass all over the boat next to him. He was unmoved. We mentioned our worry to the marina management and they also were not concerned. We left the marina.

A few years ago we were visiting the boat of someone who writes for the foreign yachting press. He was using a stove fueled by Camping Gaz, where a gas canister screws directly to the stove itself — inside the boat in his galley! During dinner preparations, the stove ran out of gas. We were absolutely appalled when he lifted a mattress to retrieve a new gas bottle. Under his bunk were no fewer than 20 gas cylinders — some full, others empty, and many of them rusty.

We have witnessed gas explosions on two occasions. In both cases, everything was installed properly, well-maintained, and used with proper care. Obviously something went undetected.

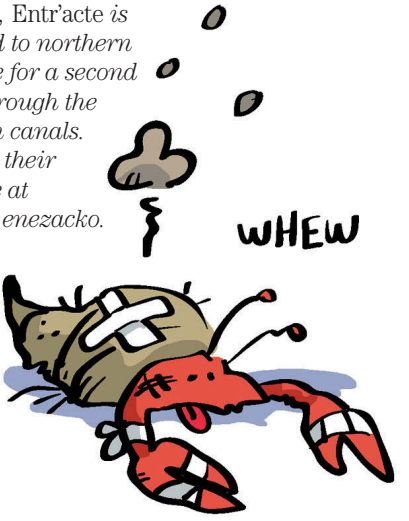
On board a boat we must always play the game "What could possibly happen?" As I move about *Entr'acte*, I always ask myself this question and try to forestall the events I imagine. You never know what might get you.

> **"We had never thought to inspect the insulation."**

Kerosene was not the culprit. While these stoves have long been criticized because of the need to prime them with alcohol and the danger of flare-ups, this fire was not a result of either of those activities. Cooking releases grease and oils that settle on galley surfaces that are easy to see and clean, but they also accumulate in unseen and completely inaccessible spaces, such as our oven insulation. We remove our stove from its mountings annually and clean away an amazing amount of grease buildup, but we had never thought to inspect the insulation. Upon discussing this issue with friends, they disassembled their gas cooker and also found oil-soaked insulation. If a flare-up of this nature had happened with a gas stove, it would have been catastrophic.

No matter what cooking fuel you use, the danger is there. This certainly surprised us. Check your older stove and you may be surprised as well.

Ed Zacko the drummer met violinist Ellen while playing in the orchestra of a Broadway musical. That show ran for only three weeks but their *show is still running after 36 years. Ed was reading* Sailing Alone Around the World *and Ellen said, "Why do you want to go alone?" They built their Nor'Sea 27,* Entr'acte, *from a bare hull and since 1980 have crossed the Atlantic to Europe and back four times and sailed to New England, the Caribbean, and the Bahamas countless times. After seven years in the Pacific,* Entr'acte *is headed to northern France for a second trip through the French canals. Follow their voyage at <www.enezacko.com>.*



Tight and tidy tails

Tame reefing lines with neatly hitched coils

BY ED ZACKO

Mainsail reefing systems vary in detail but have one problem in common: what to do with the excess lines from the reef-clew outhauls.

We have three sets of reef points on *Entr'acte*. The clew outhaul lines are quite long: 12 feet for the first reef, 18 for the second, and 24 for the deep reef. Under full sail, these lines are not a problem but, as the first reef goes in and the clew is hauled out and cleated, three long tails must be coiled and stowed. Not only must that first reef outhaul be adjusted, but the slack must be taken out of the other two outhauls and their excess line stowed as well. That's a lot of spaghetti!

Over the years, I've seen and tried various coiling methods but found them all wanting. While the lines were out of the way, they were either not secure, too secure, not neat and shipshape, or a chore to readjust. What's worse, they always seemed to tangle when I needed to readjust them or shake out a reef.

After much trial and error, I happened upon what I consider to be a nifty way of dealing with this problem. I don't lay claim to inventing this system. It evolved over time and I'm certain a thorough search will discover it in some lexicon somewhere. I believe I managed to somehow reinvent a wheel.

Three reefs in the mainsail means three clew outhauls, above. Under a full mainsail, the outhaul tails are short, but once the first reef is tied in, the tails of all three need to be coiled and securely stowed, below.

My criteria for a good line stowage technique are that it must be simple, fast, secure, neat and, most important, easy to undo without creating tangles.

The keys to making this work smoothly are to have reefing cleats large enough to handle the loop and extra wraps and to practice until you are able to correctly judge how large to make each coil and the amount of tail you need.

The coils certainly *look* shipshape, but the beauty is in the undoing. Remember the old adage about "one hand for the ship, one hand for yourself." While making and belaying the coils, I steady myself by holding the line close to the cleat. Releasing the coil is a one-handed operation, regardless of conditions or light — I don't even need to look at it anymore. Holding onto the boom with one hand, in one motion of my other thumb I release the belaying loop and unwrap the loop from the cleat. The coil just falls apart and drops onto the deck.

Voilà! My reefing lines are ready to be adjusted and re-coiled.

Ed Zacko the drummer met violinist Ellen while playing in the orchestra of a Broadway musical. They built their Nor'Sea 27, Entr'acte, *from a bare hull and since 1980 have sailed thousands of miles on both sides of the Atlantic and in the Pacific. Follow their voyage at www.enezacko.com.*

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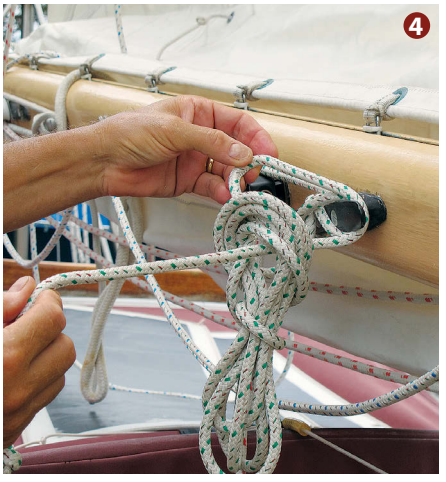


Step 1: Haul the reef outhaul taut and cleat it. Coil the line clockwise, making small loops, and leave a long tail.
Step 2: Take one wrap around the coil with the tail and make a loop in the tail.
Step 3: Pass the loop through the coil above the wrap.
Step 4: Hang the loop over the cleat.
Step 5: Pull the tail to cinch the coil tight against the cleat.
Step 6: Hook the tail around the aft ear of the cleat.
Step 7: Cross the tail over the front of the coil and belay it to the forward ear of the cleat.
Step 8: To release the line, undo it from the cleat. The coil will fall apart and the line will run free as needed.

On watch in all weather

Conduct ocean passages from the Maestro seat

BY ED ZACKO

In the mid-1960s, Bernard Moitessier was in Tahiti preparing his 40-foot steel ketch, *Joshua*, for a "fast return to France" by way of Cape Horn. In a burst of inspiration, he bought a round steel washbasin, cut holes in the sides, covered the holes with acrylic "portlights," then bolted the basin upside down on top of his main hatch, creating what amounted to a ball turret. This turret would give him a 360-degree view from inside the main cabin, keeping him dry and safe from the huge seas of the Southern Ocean. His voyage, which he described in his book *Cape Horn, the Logical Route*, made him an instant hero with ocean sailors the world over. Since then, the washbasin concept has evolved into a full acrylic bubble turret and, to this day, no self-respecting French cruising yacht puts to sea without one.

The first time we saw a boat so equipped, we laughed, saying it looked more like a spacecraft than a proper sailboat. But our first trans-Atlantic crossing (3,000 miles entirely to windward) caused us to reconsider the idea. We now understood the turret's appeal. Devising a way to sit a watch high up where we could see everything, while staying warm and dry out of the wind and weather, became a quest.

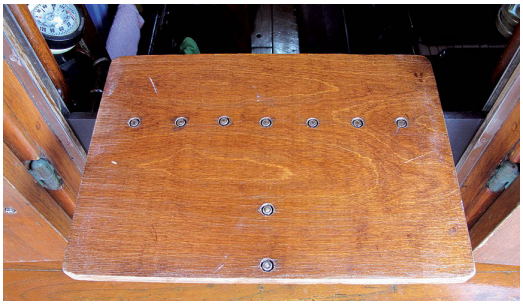
Unfortunately, there seemed no practical way to add a turret to *Entr'acte*, our Nor'Sea 27, without destroying her classic look and compromising our dinghy storage. The idea went to the back burner. During our 2003 winter in Seville, Spain, however, we met the French yacht *Maestro*, which was equipped with a full bubble turret. Her owner, Michele, suggested I "try it on for size." His version employed a simple plywood seat hinged to the companionway sill and supported by two lengths of chain connected to eyebolts on either side of the hatchway — simple and effective. I sat on the seat, looked around, and knew we had to have this.

For days we brainstormed . . . until the light came on.

An extemporized solution

Because of our companionway configuration, *Maestro*'s simple seat would not

Ellen is ready to stand her watch from the comfort of the Maestro seat while sheltered under the dodger, top of page. On *Entr'acte*, the supporting hatchboard is StarBoard and the seat is plywood, at left. Proper foot support is essential for the watchstander's long-term comfort, at right.



Ed hinged the seat off-center to leave room forward of it for standing on the ladder, top left. To ensure the seat was smooth, Ed countersunk all the nuts and cut the bolts flush with the nuts, left center. The support-rod assembly is made up of a threaded rod, compression tube, stopper nut, and a tensioning wingnut, bottom left. With the support rod in place and the limiting strap taut, the seat is ready for use, top right.

work for us . . . but what if we made a seat that slid down into the hatchboard tracks and allowed us to sit upright under the dodger? The seat would have to be secure enough to support an adult body while withstanding the strains it would encounter on a passage. It would also need to be compact and easy to stow when not in use.

The next day, I threw one together with materials I had lying around. It was Jazz! I made it up as I went along. It was easy to construct and turned out far better than I dreamed. The Maestro seat was born! The original version — made from two pieces of plywood — served us for thousands of miles and we came to rely heavily upon it.

The seat is simply two pieces of plywood hinged together. The main support piece is cut to the width of the hatchboard tracks and slides inside the tracks to sit securely on top of the companionway sill. This piece will support Ellen's or my entire body weight. The seat itself is mostly on the cockpit side of the support piece and hinged to it for easy stowage. The support slides easily down the hatch tracks and the seat is ready for use in seconds. The challenge was to make the seat solid and safe.

To make the seat one rigid, stable unit, I employed a "support rod" combined with a "limiter strap." This is the heart of the system and its only complexity. It consists of a piece of ⅜-inch stainless-steel threaded rod with a Nylock nut screwed to one end to serve as a stopper, a short piece of aluminum tubing with one end cut at a 45-degree angle to serve as a "compression tube," a washer, and a wingnut. The support rod slides through the compression tube and fits into two openings, one in the support piece and the other in the seat. The rod sets the seat into a comfortable position and prevents it from collapsing aft.

The limiter strap prevents the seat from folding forward and losing the support rod. This strap is a length of ¾-inch nylon webbing. One end is attached to the seat and the other end to the support piece. Both ends are through-bolted. Once the rod is in place, screwing the wingnut against the compression tube pushes the seat into position and puts tension on the limiter strap, which is set to become taut just as the seat reaches the perpendicular. The strap has to be tight when the seat is in use, so I made it a little short to allow for stretch.

To use the seat, I install the rod and screw the wingnut against the compression tube until the strap is tight, making the seat one rigid unit. I then slide it into the hatch tracks.

To stow the seat, I simply unscrew the wingnut and remove the rod. The seat will fall flat and remain out of the way in the hatchboard tracks, or I can slide it out and stow it as a handy backrest in the cockpit.

I constructed the supporting hatchboard from ½-inch scrap plywood and the seat from 1-inch mahogany plywood and connected them with a stainless-steel piano hinge. The original plywood support eventually delaminated. We replaced it with ½-inch StarBoard, but retained the 1-inch plywood for the seat.

Design for comfort

Make the seat wide enough athwartships that you can sit on it comfortably for long periods of time. At the same time, you don't want the finished seat to interfere with your use of the companionway ladder. You will also want to stand on the ladder periodically and stretch. If the seat extends too far over the ladder it will be in the way.

With the support strut released, the seat folds down for quick stowage, at left. Grinding the groove in the support rod takes patience, center, and safety glasses are essential. A Dremel tool and sanding drums can be used instead of a router to trim the edges of the hatchboard, at right.

So the seat stows conveniently when not in use, you will want to assemble it so it folds flat. I accomplished that by joining the seat to the support with a piano hinge, and I found the right position for the hinge from trial and error with a mock-up by "sitting" on it, placing my feet on the top step of the ladder, and standing up or stepping down as if to go below. In my case, the best position for the seat was with one fourth of it extending forward of the supporting hatchboard.

For quick-release stowage, the fore-and-aft measurement of the seat and the height of the supporting hatchboard should be such that, when you remove the support rod, the seat folds down perfectly flat against the hatchboard.

Construction

When determining the thickness of the supporting hatchboard, bear in mind that the seat will be subjected to a surprising amount of torque as your body moves around in a seaway, so your personal body weight and the width of the hatchboard are factors along with the size of your hatchboard track. At a minimum, the support board should be ½ inch thick, but thicker is better. A close fit in the hatchboard channel is desirable so the board will slip easily into it without binding but not be a sloppy fit — if the seat wobbles, you'll become exhausted trying to sit still. If you use a board that's thicker than the hatchboard channel, shave the edges to the proper thickness with a router or Dremel tool.

If you make the seat of 1-inch-thick material, that will allow you fasten the hinge with through-bolts, which I recommend, and to countersink and recess the nuts.

Make a cardboard mock-up of the seat and its supporting hatchboard. Check that it meets your requirements before you cut any wood.

Before attaching the seat to the supporting hatchboard, think about which side the hinge should be so your weight on the seat is in the direction of closing the hinge and not opening it more. Center the piano hinge on the hatchboard support and through-bolt it in place.

Attach the hinge to the seat with through-bolts and countersink the seat to recess the nuts. I cannot overstate the importance of through-bolting everything. This seat will endure a surprising amount of torque when under way. Screws will pull out in a very short time and that could lead to a nasty fall.

With the Dremel tool and a cutoff wheel, remove any bolt threads that extend from the nuts. You want the entire seat to be as smooth as possible with no protrusions to compromise

Resources

Jamestown Distributors
www.jamestowndistributors.com

MSC Industrial Supply
www.mscdirect.com

McMaster-Carr
www.mcmaster.com

The cushion makes standing (sitting?) a watch so much more comfortable, at left, and the watchkeepers's essentials are close at hand, at right.

your comfort or safety or to interfere with ease of stowage.

I was tempted to use acorn nuts because they would look nice and finished, but the Nylocks are more permanent.

Support system

The support system consists of a support rod, compression tube, limiter strap, and two strike plates. They perform as a unit.

The support rod makes the seat rigid and supports your weight as the boat moves around in a seaway. The limiter strap prevents the rod from falling out as your weight shifts. A wingnut against the compression tube maintains tension on the limiter strap. The strike plates provide a solid metal-to-metal surface against the compression tube at one end and a stopper nut at the other. They also serve as chafe protection where the compression tube and support rod come in contact with the seat and hatchboard.

I made the compression tube "captive" so it would not fall off the rod and get lost every time it was stowed. I used a Dremel tool with cutoff wheels to grind a 2½-inch-long channel into the rod. I then drilled and tapped a small hole in the compression tube and installed a 10 x 24 stainless-steel Allen setscrew with a dab of red Loctite for security. The Allen screw slides inside the channel and stops when it reaches either end of the channel, thus preventing the tube from falling off the rod. The rod, tube, wingnut, washer, and stopper nut become one permanent unit — I have only one piece to find when I want to use the seat.

For strength, I made the the support rod from ⅜-inch stainless-steel threaded rod. Any metal tubing will do for the compression tube as long as it fits over the ⅜-inch rod, but a thicker-wall tube will better accept the setscrew that holds the tube captive.

The most difficult part of this entire project is machining the groove for the compression tube setscrew. With the aid of a small vice, a steady hand, and a little patience, I achieved an acceptable result with the Dremel tool. Safety glasses are a must for this operation.

Strike plates

My original strike plates were simply stainless-steel fender washers drilled out on an angle to accept each end of the rod and screwed permanently in place. I replaced them with 1½-inch lengths of 1 x ⅛-inch stainless-steel bar stock. Mortising out the support and seat to receive the strike plates will prevent the plates from drifting under your weight. I also recommend through-bolting the strikeplates.

For maximum strength and efficiency, position the strike plates so the support rod meets both the seat and hatchboard at a 45-degree angle. Drill the holes in the strikeplates that receive the support rod at a 45-degree angle and a bit over-sized to allow for easy assembly. The hole in the seat should not go all the way through the seat. The hole in the support piece must be

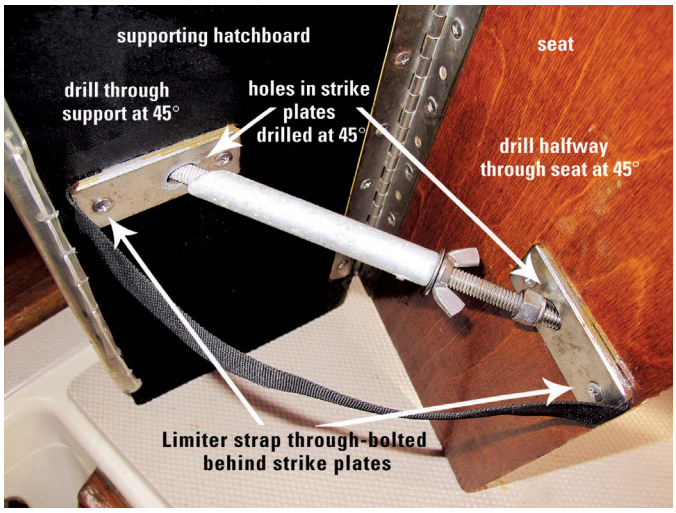
Materials and tools

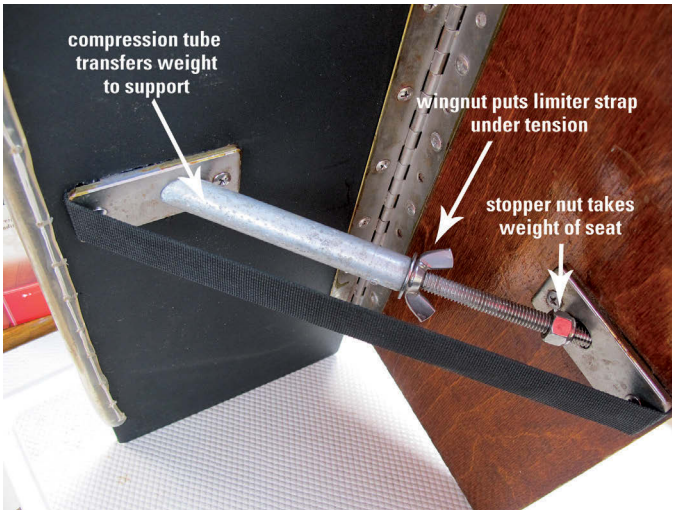
Materials

- Plywood: two pieces, one for the hatchboard (at least ½ inch) and one for the seat (¾ to 1 inch) (StarBoard, a plastic composite that's easy to work with and very strong is a good alternative material.)
- Stainless-steel piano hinge (length determined by width of seat)
- 10 x 24 stainless-steel oval head machine screws, Nylock nuts, washers
- Length of ⅜-inch stainless-steel threaded rod (1 foot), one ⅜-inch Nylock nut, one large wingnut
- Length of ⅜-inch-ID stainless-steel or aluminum tubing
- One 10 x 24 Allen setscrew
- Loctite, red
- Two pieces of brass or stainless-steel bar stock 1½ x 1 x ⅛ inch
- ½-inch nylon webbing (about 1 foot) for limiter strap
- Short length of soft plastic hose for anti-chafe at bottom
- Sail twine and needle to attach anti-chafe hose

Tools

- Saber saw
- Drill, ½-inch countersink
- Dremel tool with cutoff wheels and sanding drums
- Router with ½-inch mortise bit (or use Dremel)
- Hacksaw
- 10 x 24 tap





The Maestro seat is easy to set up: insert the support rod into the holes in the striker plates, at left, and spin up the wingnut against the compression tube until the limiting strap is taut, at right. Fit the seat support into the hatchboard track, below, and get ready to sit your watch.

drilled all the way through to facilitate mounting the support rod.

Limiter strap

Without the limiter strap, the support rod will fall out every time you shift your weight. Worse, the seat will move beyond the limits of its attachments and something will break in short order. The limiter must always be under tension to perform properly, so set the strap to come up short just before the seat reaches 90 degrees. Allow for some stretch in the webbing as the wingnut pushes the compression tube along the rod. You might have to experiment a bit to get the length just right.

Secure the ends of the strap under the strike plates and through-bolt them into place along with the plates.

Final touches

Slice a length of soft clear-plastic water hose and mount it to the bottom of the supporting hatchboard to protect the wood and silence any squeaks. To secure the hose, drill a few small holes through the hose and the board and fasten the hose in place with a needle and waxed sail twine. Slide the seat into the channel and cut off any excess support rod that protrudes inside the cabin.

As a finishing touch, since you'll spend a lot of time on this seat, make it more comfortable by adding a cushion made of closed-cell foam with a laced-on cover. A really cheap source of closed-cell foam is a garden kneeler you can find in almost any hardware store.

Once you have everything assembled, insert the rod, spin out the wingnut and slide the seat into the tracks. Grab some coffee and cookies and enjoy your watch. Don't forget the MP3 player!

Ahead of the game

There is an old adage about hatchboards: when the first reef goes in, so does the first hatchboard. Most of us tend to neglect that until we take the first bucketful of water below. Normally, the hatchboard is in the way, but with this system we're ahead of the game. The first hatchboard is always in the right place at the right time and in a much more useable way.

This has saved us on many occasions. We might not be able to fit an acrylic bubble, but we now have what amounts to the same thing, and perhaps better. It is a favorite piece of our offshore cruising equipment, second only to the windvane steering gear. Ellen recently remarked that of all my additions to *Entr'acte* over the years, the Maestro seat has been the most useful. The watch enjoys a 360-degree view and remains warm and dry in any winds from a beat to a beam reach. Rain? Who cares?

What happens when the wind goes astern? That is the next step. We do have a solution for that eventuality that we call our Bubble of Comfort.

Ed Zacko the drummer met violinist Ellen while playing in the orchestra of a Broadway musical. They built their Nor'Sea 27, Entr'acte, *from a bare hull and since 1980 have sailed thousands of miles on both sides of the Atlantic and in the Pacific. After shipping* Entr'acte *from Noumea to France, they are in Seville. Follow their voyage at www.enezacko.com.*

Entr'acte's

Where the on-watch crew stays warm and dry

BY ED ZACKO

Our Maestro seat proved successful on all counts. From a beat to a beam reach, the watchkeeper remained sheltered, warm, and dry behind the dodger. Once the wind went aft of the beam, however, the shelter of the dodger disappeared and night watches once again became a rather cold experience. Returning to the bubble-turret concept, I came up with a nifty addition that I fashioned from Sunbrella scraps left over from our new sailcover and old plastic from the time Ellen redid our cockpit enclosure.

I dubbed my creation the Bubble of Comfort. It's essentially a see-through curtain that zips onto the aft edge of the dodger and attaches to the sides of the dodger flaps with Velcro strips. The result looks like a giant turret. Inside the Bubble, the watch sits comfortably on the Maestro seat (see January 2014) and enjoys a 360-degree view, but is sheltered from wind, seas, and rain.

Part of our pre-departure preparation is to zip the Bubble onto the dodger and roll it up out of the way until we want it. When we need it, we drop it down, use two lines to secure it aft into the cockpit, and Velcro the sides into place. Everything we need to operate our Nor'Sea 27, *Entr'acte*, is accessible from inside the Bubble: engine controls, autopilot remote, VHF radio, and chart plotter. During long periods of rain, we have even led the Aries steering lines inside the Bubble. No need to go out into the bad weather unless you absolutely have to!

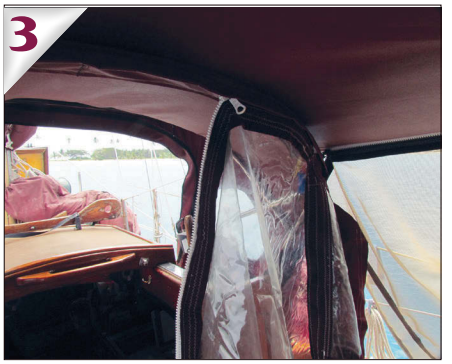
Besides keeping the night watch warm and dry in following winds, the Bubble also prevents cold damp wind and fog from entering the main cabin. Before we had the Bubble, sailing downwind in damp conditions proved to be just as cold and damp below as topside, but no longer. These days, the off watch and cabin also remain warm and dry.

Shelter and security

To exit the Bubble, a simple slice of the hand parts the Velcro and we have instant access to the cockpit. It's an iron-clad rule that our safety harness tethers are snapped on before we exit the Bubble.

A word on the safety harness: between the Maestro seat and the Bubble of Comfort, the watch can become so comfortable that complacency sets in and it's easy to forget where we are. If we must attend to some ship's business in a hurry, it is best to be prepared.

Our harness system consists of two full-length Spectra jacklines, port and starboard, each with its own tether permanently attached. The harness ends of both tethers reside on hooks inside the main companionway.
Our harness rule is simple: no one sits alone on the Maestro seat unless he or she is clipped to the windward tether. If we are both awake, we relax that rule a bit but, at night, or whenever one of us is asleep, the one sitting in the Maestro seat snaps on. Period! If we must leave that seat or exit the Bubble for any reason, we are already clipped on. We know we're the most vulnerable at the moment when we exit the main hatchway, especially when we're



Ellen pops out of *Entr'acte's* Bubble of Comfort to find the sun is shining, top of page. When closed (1), the Bubble protects the watchstander, sitting on the Maestro seat, from weather from aft. A swipe of the hand opens the side for a peep outside (2). The Bubble zips onto the dodger (3).

Bubble of Comfort

half-asleep and in a hurry. The old sages always caution us to "clip on before exiting the companionway." Light conditions are more deadly than heavy weather. It is amazing what can happen in less than a second!

Materials

If you do much canvaswork, you might have some of the materials already. Sailrite can supply everything listed.

Sunbrella or similar fabric – The quantity of fabric will depend on your boat's size. We used less than a yard of what would have been scraps.

Plastic window material – We used 2 yards. Lighter gauge is better for ease of stowage.

Velcro strips – We prefer a 2-inch width of the woolly or soft side on the dodger flaps. The Bubble uses one-inch widths of the sticky or hook side. This makes for easier attachment when the wind's blowing.

Stainless-steel sailcover hooks – Two are needed for the lines going aft into the cockpit.

Zipper – A nylon separating zipper sized to the curve of the dodger.

Edging – The finished edges can be turned over and sewn or covered with edging for a better look.

Construction

The Bubble is constructed in three pieces. The center piece is a rectangle that is mostly clear plastic. Each side is roughly triangular in shape to give the finished Bubble a somewhat circular shape when zipped and Velcroed into place.

The center section has a small grommet on each side at the bottom with a small line attached. The lines attach to hooks set into the sides of the cockpit to pull the Bubble into its circular shape, stabilize it against wind and spray, and add to the amount of usable space inside.

Installation considerations

Entr'acte's sun awning is independent of the dodger, so attaching the Bubble was as easy as adding a zipper to the flap on the aft edge of the dodger. If you have a sun awning that zips onto your dodger, you have two choices. You can unzip the sun top and stow it whenever you want to use the Bubble. (If you need the Bubble, you probably don't need the sun awning.) However, this approach might become a nuisance. Another solution might be to install a small flap with its own zipper just below and inboard of the point where the sun awning attaches to the metal dodger frame.

Stowing the Bubble

Our normal stowage procedure is to roll up the Bubble and lay it on top of the dodger where it becomes sandwiched between the top of the dodger and the sun awning. If our sun awning has been rolled up, we flip the Bubble over the top of the dodger and tie the corners to the handholds until we need it.

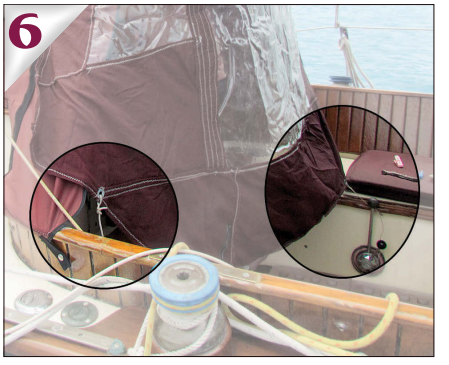
Other storage options would be to add grommets to the flaps where the dodger zips onto its frame and install ties to these grommets. Alternatively, you could unzip the Bubble and stow it. The problem with this approach is that you won't be ready when a sudden squall comes up.

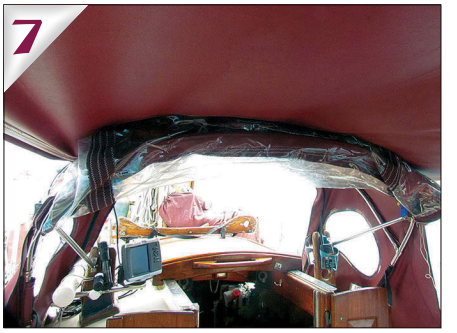
Since we have begun using the Bubble offshore, we have been warm and dry when the wind is astern. The cold night air doesn't bother us. It is indeed a Bubble of Comfort.

Ed Zacko is a Good Old Boat *contributing editor. He and Ellen met while playing in the orchestra of a Broadway musical. They built their Nor'Sea 27,* Entr'acte, *from a bare hull and since 1980 have sailed thousands of miles on both sides of the Atlantic and in the Pacific. After shipping* Entr'acte *from Noumea to France, they are in Seville. Follow them at www.enezacko.com.*

Resources

Sailrite
www.sailrite.com





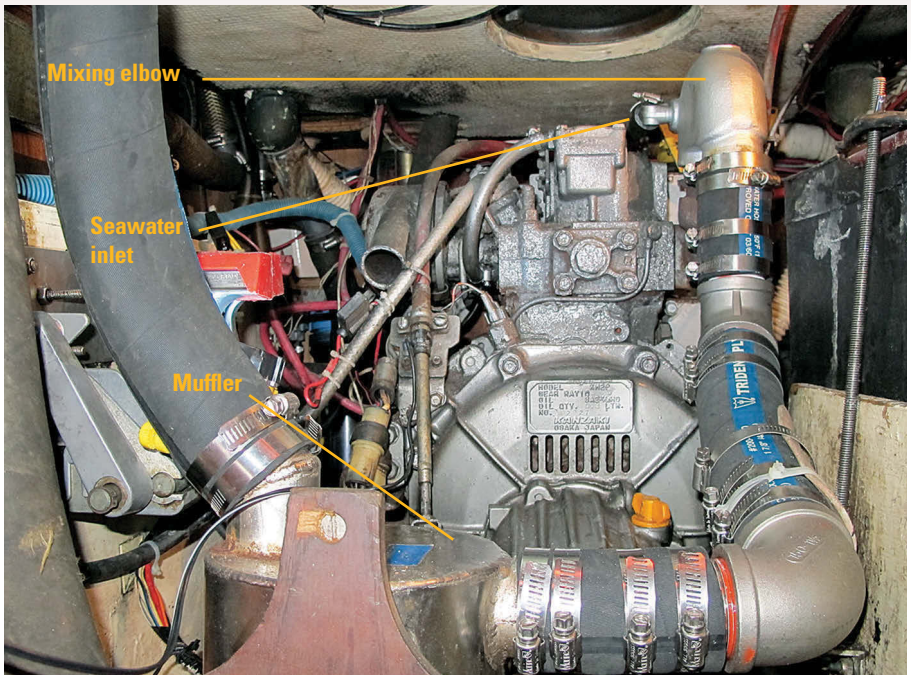
The sides of the Bubble close with Velcro (4). When erected, the Bubble is almost round (5), held in shape by strings that tie the bottom skirt to hooks in the cockpit (6). To stow the Bubble, Ed and Ellen roll it up and stuff it between the dodger and the sunshade (7).

Dead in the water

When a sailboat suffers a heart attack

BY ED ZACKO

It's 0700 on a beautiful April morning in France. Entr'acte, *our Nor'Sea 27, is on the River Seine in 18 knots of wind with 4-foot seas dead astern. We are facing upriver into an opposing 4-knot current. The engine has suddenly stopped dead. Smoke is coming through the engine-room vents along with the definite smell of something burning. All of this is accompanied by the shriek of engine-overheat- and low-oil-pressure alarms. Added to that is a constant stream of AIS danger-proximity alarms going off as fast as we silence them. This is a scene right out of a movie: the airliner is going down fast with alarms going off all at once. The pilot's yelling, "Shut off those alarms! I can't think!" But this is no movie. It's my voice yelling, "Shut off the GPS and AIS! I can't think!"*



A mixing elbow connects to the exhaust manifold on the engine. Since it's impossible to see inside it *in situ*, the only way to inspect it for blockages is to take it off completely.

The silence was deafening. *Entr'acte* had just departed the lovely harbor of Honfleur, bound up the Seine for Rouen and onward to Paris and the French canals. We hadn't a care in the world . . . until that moment.

We had planned most carefully. To prepare the engine, we reset the valves, rebuilt the water pump, and installed a new thermostat, a new impeller, new hose clamps, and all new engine belts. The engine had been meticulously maintained and had been running perfectly. Yet there we sat. What was going on?

A finely timed trip

The Seine is a powerful river with treacherous currents and is not to be trifled with. It is a major shipping artery, and pleasure craft are allowed to operate solely in the hours between one half-hour after sunrise and one half-hour before sunset. They are not permitted to anchor at all. Even if anchoring were permitted, outside the channel is a deadly maze of underwater anti-erosion dykes, rocks, and reefs. The result of all these restrictions is that we had to make the 60-mile trip from Honfleur to Rouen in one daylight run. This is difficult but, with the proper planning, not impossible.

That particular Sunday morning promised the perfect combination of good weather, low water just after sunrise, and current change one hour later. Sunrise was at 0530, and the plan was to enter the lock at 0545 and exit it at 0600, one hour before low water, with just enough water under the keel (we hoped) to gain the main channel. The first hour, bucking the 4-knot current until the time of current change, would be slow, but that was unavoidable as we would need every minute of inflowing tide to carry us all the way to Rouen by sunset.

Our plan unfolded perfectly. Exiting the lock was a bit tense. Would we hit bottom outside the lock? We kept the engine rpm to 2,200 in case we touched. We had sent *Entr'acte*'s mast and rig on ahead to the Mediterranean and without it, her motion was dreadful, but three minutes later we turned upriver, entered the traffic pattern, and all was well.

At 0610 with wind and seas finally astern, we breathed easier and radioed Port Control for clearance to Rouen.

"Bonne journée, *Entr'acte*. Please keep to the port side of the river."

The current seemed to stop us dead as we made an agonizingly slow 2 knots over the bottom, but in an hour it would change and the 10-knot sleigh ride to Rouen would begin.

The best laid plans . . .

I increased the throttle from 2,400 to 3,100 rpm, the engine responding beautifully as always, and off we went. As the control tower very, very slowly slid astern, we shouted, "We made it! Perfect timing! Are we *good*?"

Ten minutes later Ellen said, "I smell something burning." We decided the smell was coming from the ship loading grain at the pier off to starboard.

Suddenly, I stopped smiling. The engine sounded fine, but there was an extra sound, something I could not pin down. I went down into the cabin to listen more closely, and as I turned around to tell her so . . .

WHHHRRrummff!!!!! In less than two seconds, the engine went from a solid, healthy 3,100 rpm to stone cold *dead*. Silence! That is, until all the alarms went off.

Without mast and sails, *Entr'acte* was helpless. The dinghy and outboard were no match for this current and sea. Besides, there was no time to set that up. There was a constant parade of 1,000-foot container ships moving in both directions as well as a working dredge just ahead. We were in the way big time!

In 35 years of boating, we had never felt the need to call for assistance, but this was our day. This was no time for pride, heroics, or hesitation. I radioed to Port Control that we were without engine and requested assistance.

Aside from the shipping traffic, we were safe enough. The smoke had stopped and we were not on fire. *Entr'acte* behaved beautifully. The wind against current balanced each other perfectly, allowing us to keep her head into the current and steer to the very edge of the channel and to maintain a predictable position while the current slowly set us back toward the lock. For the moment it appeared that it could be a very short tow, but once the current changed we would be unceremoniously swept upriver out of control.

King Neptune was kind. Members of the local chapter of Les Sauveteurs en Mer — a French volunteer organization dedicated to the rescue of mariners and vessels in distress — just happened to be inside the lock servicing their boat. The lock doors opened and out came Les Sauveteurs to perform the fastest, most seamanlike "snatch and grab" we have ever seen. By 0720, *Entr'acte* was once again safely tied up in Honfleur and, after coffee and croissants with the crew of the towboat, we set to work.

Searching for the cause

Entr'acte's Yanmar 2GM20 had performed flawlessly for 18 years and 3,500 hours without so much as a burp or hesitation of any kind. It had also been assiduously maintained since its installation.

Ellen was convinced that she already knew the cause of the problem, but a few simple checks were in order first.

I began by checking the prop. There was no large plastic bag to disentangle, as I had hoped. Besides, what of the smoke and smell? Next, I turned the engine over carefully by hand. It turned very easily, each cylinder coming up nicely on compression, indicating no water in the cylinders, no blown head gasket, and no broken valves.

I checked the oil for water contamination. It was the same beautiful amber color it had been two days before when I changed the oil. I hit the starter, voilà! She started right up . . . but did not sound right. No cooling water was being discharged with the exhaust.

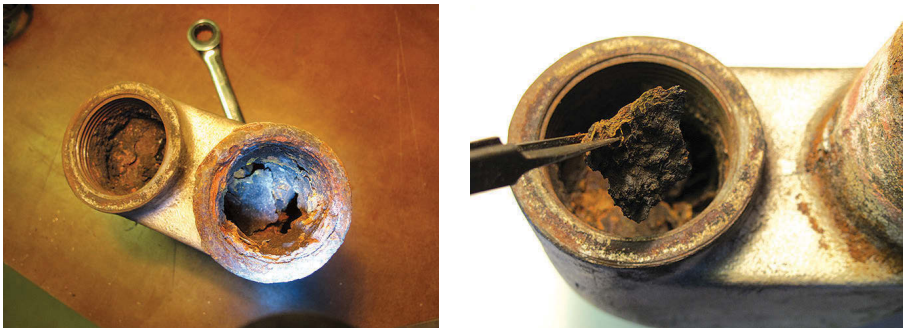
I looked at Ellen in the galley. Before I could say anything profound she bent down, rummaged around for a moment, and — from the galley, mind you — produced a shiny brand-new exhaust mixing elbow and said, "Maybe you should install this!"

A water-cooled diesel engine has a mixing elbow. Its shape and configuration varies depending on engine type, but it is there and is a critical part of the engine's exhaust system. Most boat owners are not aware that they have one, and many confuse it with the water-lift muffler that is mounted low down, usually aft of the engine.

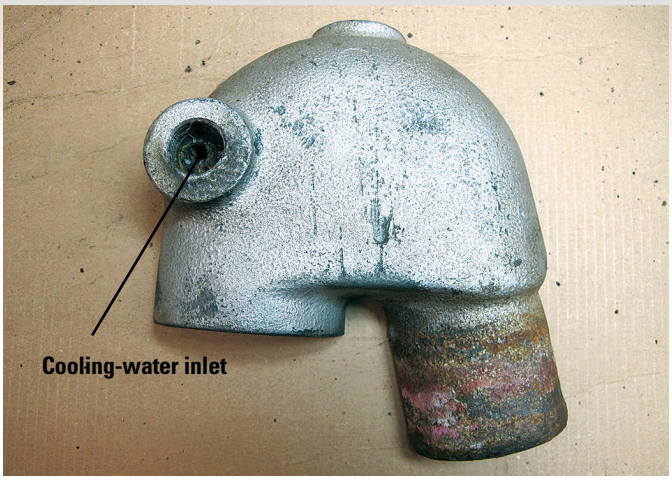
On *Entr'act*'s Yanmar, the mixing elbow is a large casting bolted to the side of the engine just below the cylinder head. The large rubber exhaust hose that leads from the engine to the muffler begins at the elbow.

Hot exhaust gases exit the engine through the exhaust manifold. For these gases to be conducted through the boat

The water passage inside the new mixing elbow is clearly visible, at left. It's the smaller hole. The exhaust inlet on the old elbow was clogged with rust and carbon deposits, at right.



When the rust clot lining the elbow broke away, it completely blocked the passages for both the water and the exhaust gases, at left. Ed removed the debris for show and tell, at right.



The water inlet on the mixing elbow was almost completely clogged, at left. Splitting the elbow revealed the extent of the blockages, at right.

to the customary exhaust discharge at the stern, they must be cooled. This is done with the raw water used to cool the engine.

The Yanmar elbow is a casting built with two internal passages, a large one for the exhaust gases and a smaller one for water. After passing through the heat exchanger, the cooling water is injected into the elbow, where it mixes with exhaust gases and cools them to an acceptable temperature. The mixture then passes through the muffler and on to the overboard discharge. It's a very simple process.

A potential trouble spot

The manual for the Yanmar 2GM20 specifies checking this elbow after every 500 hours of operation and changing it "if necessary." This is important because a clear exit route for the exhaust gases is essential for any engine to perform well. All hot-rodders know that a large clean exhaust pipe means more power and a restricted exhaust pipe means less power. They spend inordinate amounts of time, energy, and money to have the largest, *cleanest* (on the inside) exhaust systems possible.

Since one byproduct of diesel exhaust is soot (carbon), this goal is difficult to achieve on a diesel engine. Over time, deposits build up inside the elbow and gradually reduce the diameter of the exhaust, degrading performance. When the engine is running, the exhaust and water are mixed inside the arteries of the exhaust elbow and passed on. After shutdown, the residual heat from the engine dries out the moisture and leaves behind solid carbon that dries to a very hard "plaque," especially around the turn of the elbow, where it cannot be seen during a cursory inspection. Likewise, inside the water passage, the liquid water evaporates and leaves behind solid salt, minerals, and rust. As the engine hours accumulate, so do these deposits. Eventually, the engine becomes more difficult to start, and for the lucky sailor, it will refuse to start before he leaves the dock, as opposed to suddenly shutting down at a critical moment . . . say, in the middle of the River Seine.

We have changed this elbow twice over the years. This new one would be our third replacement. We purchased it in advance specifically for this canal trip. Since the engine was starting and running so well, however, while it *was* on the to-do list, it was not at the top.

It took only 10 minutes to remove the old elbow and it was immediately apparent that *Entr'acte* had suffered a massive heart attack. Don't laugh, that is exactly what it was. I looked down into the elbow and could see no opening of any kind. Nothing! Both "arteries" — the exhaust and the water passages — were completely occluded by a large clot of rust.

As I removed the clot, I could see that the insides of both passages were almost completely blocked with carbon, rust, and salt buildup. This was a perfect example of a massive "myo-exhaustical infarction." The engine had appeared to function normally at regular rpm day after day, just like the guy who appears to be in perfect health under normal conditions until the day he runs to catch the bus and dies of a heart attack.

The trigger

Even though our engine appeared to be functioning normally, we had planned to replace the elbow in Le Havre before the start of our canal trip. However, because of rainy weather we put it off until Honfleur. Then, with the prospect of perfect conditions on that Sunday, we decided to put it off until "tomorrow in Rouen" — one day too long!

While we were departing the lock at 2,200 rpm, all was well, but when we increased the rpm to 3,100 and "ran for the bus," the engine suddenly began to force much higher volumes of exhaust gas and water into the almost completely blocked passages. This created what is called back pressure. If this pressure builds and has no place to go, eventually something has to give. In our case the exhaust manifold gasket blew. The burning smell and smoke came from the exhaust gas blowing past the manifold gasket and filling the engine room with exhaust. This was the sound that caught my attention. The death blow came when a rust clot, dislodged by the sudden acceleration, completely sealed the exhaust port, triggering the shutdown. The engine suffocated on its own exhaust.

Telltale signs

There are symptoms of a blocked elbow. The aforementioned hard starting/non-starting is one, although our engine started easily and ran like a clock. There was, however, one symptom we did notice but misread: smoke. On the short trip from Le Havre to Honfleur, we commented that our exhaust was making quite a bit of white smoke . . . but we dismissed this

as condensation. After eight years in tropical climates, we had forgotten what sailing in cold weather was like and, since April on the English Channel is very cold, we wrote off the smoke to condensation. How wrong we were.

The color of exhaust smoke tells a great deal. Normal exhaust is colorless transparent gas and water vapor and is practically invisible. Black smoke results from incomplete combustion or a low operating temperature producing carbon inside the engine and exhaust. Blue smoke means the engine is burning oil. White smoke is usually unburned fuel, but water vapor condensing in the air as it exits the exhaust indicates insufficient cooling water in the exhaust. A large amount of white exhaust is a warning that should be investigated.

When discussing the presence of white smoke, had we looked closely at the exhaust discharge, we would have noticed that it was discharging nowhere near the amount of water that we normally see and we would have discovered the problem in time.

A passage resumed

With the new elbow installed, our engine started easily and ran smoothly, and the exhaust discharge contained a very healthy amount of water. We had to wait in Honfleur another 10 days for that perfect combination of conditions to reoccur, but the trip to Rouen was extremely pleasant and without incident. From Rouen to Paris, however, was another matter altogether, and that is the subject of an article that will appear in a future issue. We weren't quite done with the side effects of our engine's heart attack.

Ed Zacko is a Good Old Boat *contributing editor. He and Ellen met while playing in the orchestra of a Broadway musical. They built their Nor'Sea 27,* Entr'acte, *from a bare hull, and since 1980 have sailed across the Atlantic four times and the Pacific once. Ellen and Ed now split their time between* Entr'acte *and playing in the jazz clubs of Spain, France, and Morocco. Follow them at www.enezacko.com.*

Mixing-elbow maintenance

The best way to avoid the conditions that result in a clogged mixing elbow is to treat your engine well.

A diesel needs to be run under load, but not under excessive load. Do not run your engine in neutral for long periods, such as at anchor to charge batteries or run a watermaker. This accelerates carbon buildup inside the engine. If you must perform these functions at anchor, engage reverse gear and run the engine at medium rpm, and try not to do it too often or for too long.

Run your engine hard and in gear for at least 20 minutes every time you run it, preferably just before shutdown.

Make certain that your propeller is properly sized. A too-large prop will overload an engine, and that will lead to increased carbon buildup inside the engine and the exhaust.

Tune in to the sight and sound of your engine's exhaust. What sounds normal? How much water discharge do you normally see? Watch for smoke. Quantity and color are dead giveaways.

Examine the mixing elbow at the required intervals or, preferably, more frequently. If you see a buildup of deposits, you might be able to chip out some of it near the opening, but this will be only a short-term solution as the innermost parts of the elbow will be inaccessible, especially in the water passage. I have not found a chemical capable of satisfactorily dissolving these deposits. In most cases it will be easier to replace the elbow than to clean it.

When replacing the elbow, you may have to heat the joint to break it free. Do not get overly enthusiastic lest you crack the manifold. It may be necessary to cut off the old elbow with a grinder, but be careful not to damage the threads of the union or the manifold itself where the elbow is attached.

Materials and tools:

- New exhaust manifold gasket. These can never be reused. Carry one or two as spares.
- New mixing elbow.
- Threaded union (if your engine has one) that joins the elbow to the manifold.
- High-temperature thread sealant.
- Large securely mounted vise.
- Large pipe wrench with a 2- to 3-foot piece of pipe to use as a lever. (*Be gentle!*)
- Butane torch in case the wrench and lever are not enough.
- High-speed grinder for severe cases. Be careful not to ruin the threads on the union if you have one.

AN ENGINE WITH A FEVER

The diagnosis was elusive and surprising

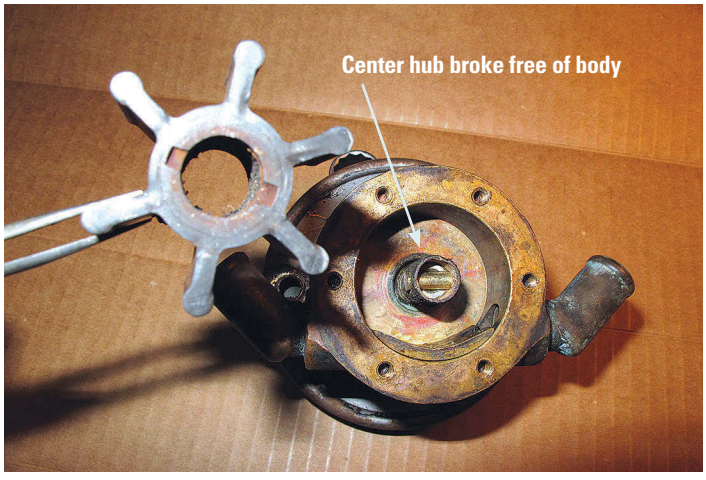
BY ED ZACKO

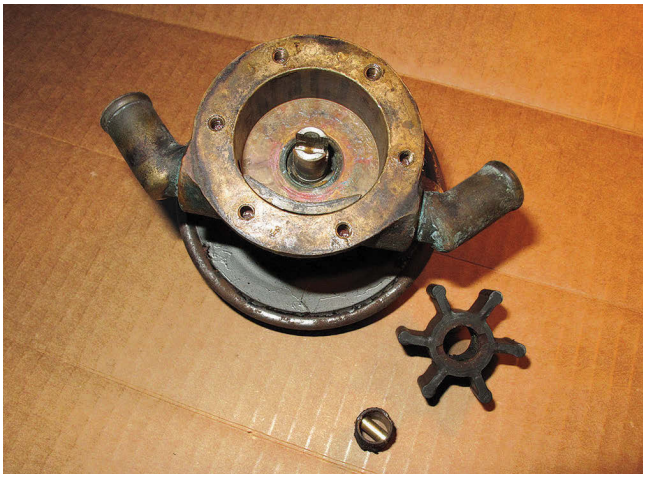
Our passage up France's Seine river from Honfleur to Rouen was uneventful. We ran all day with *Entr'acte*'s engine humming along at 3,100 rpm. With 180 miles yet to travel before we would leave the current of the Seine River behind and enter France's tranquil canal system, during our stay in Rouen I inspected the engine very carefully to avoid further problems with blockages (see "Dead in the Water," January 2015). Then off we went toward Paris.

At Amfreyville, we entered the first lock. As we prepared to exit the lock, our temperature alarm sounded. No water was coming from the exhaust, and my heart sank as I immediately shut down the engine. The lock keeper pointed to a large mass of cut grass and weed that had floated into the lock from upstream. We warped *Entr'acte* to the head of the lock away from the weed, re-started the engine and — voilà! *Beaucoup de l'eau!* False alarm! Off we went in the company of *Dolphin II* out of the UK, with whom we had shared the lock. Hour after hour, we both slugged along at 3,100 rpm making a slow 2.5 knots over the bottom. It was late May and the Seine was still in flood. Paris seemed a long way off.

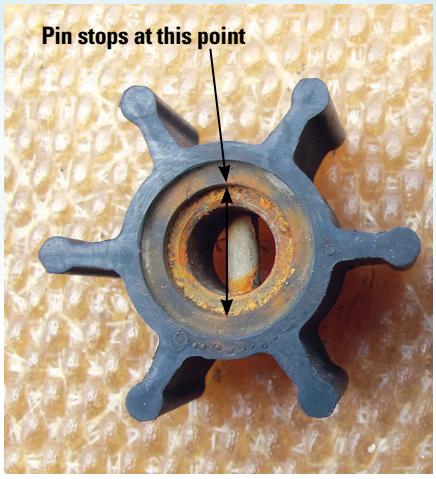
The cruising guides show many opportunities to tie up between Rouen and Paris, but these are widely spaced, hard to find, and in some cases — despite what the guides claim — no longer exist. By late afternoon, the crews of both vessels were becoming anxious. The sun was going down and the promised tie-ups did not appear. We had only two options left: a set of steel pilings set among the trees close to shore or a "promised" marina just half a kilometer ahead on the left among a small group of islets. Due to current, traffic, and water depth, anchoring was not a safe option.

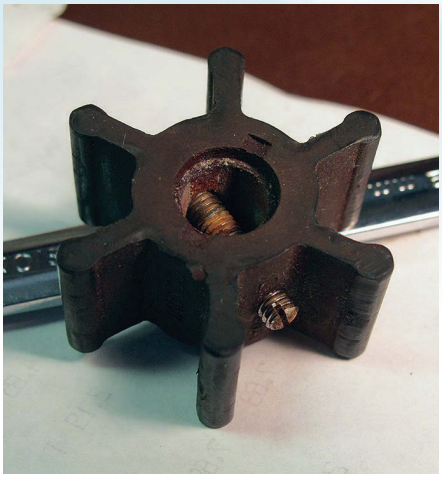
We could see boats tied up behind the island, but neither the chart nor our three cruising guides showed any way in. The charts and guides do not show any depth information and there were no channel markers anywhere. As we cleared the headland, *Dolphin II* headed directly toward the boats and immediately ran aground. At that moment, our alarm sounded again and, sure enough, we had stopped discharging water. I shut down the engine and we drifted downriver out of control back toward the pilings. *Dolphin II* got off the bottom quickly,





Ellen expresses glee and relief at *Entr'acte*'s arrival in Paris, at top. On the way, the engine had overheated frequently due to a damaged impeller in the raw-water pump, above. The center hub, which held the pin that engaged the drive shaft, broke loose — but gradually.





In the new style of water-pump impeller, far left, the retaining pin does not extend past the metal hub. In the old design, near left, the pin passes completely through the body of the impeller to hold it captive.

towed us to a piling, and disappeared into the dark in search of deeper water.

No apparent cause

First thing in the morning, I removed the water pump and, to my surprise, the impeller was completely intact. I reinserted the impeller, and on starting the engine was relieved to see a healthy water discharge. We hung onto the pole for 20 minutes with no problem and decided that we must have picked up more river debris in the intake — a common occurrence on rivers and canals. We disconnected from the piling and set off into a beautifully crisp, clear morning toward Paris and in search of *Dolphin II*.

Three hours later the alarm went off again. We moved toward shore and let go the anchor, right next to a large, very descriptive sign that said: "No Anchor!"

Here we sat in a 4-knot current out of everyone's way and in no danger as barge traffic passed from both directions. The no anchoring sign was a bit unsettling, but we made a pact that when we went to jail I would get the upper bunk, and I calmly set to work to solve this problem.

Again, I removed the water pump and inspected the impeller very carefully. It had seen less than 20 hours of service. It looked and felt perfect, supple rubber, no cracks, no broken blades, no deformity in any blades, perfect! I next removed the thermostat. New though it was, sometimes you get a bad one. I was surprised to find it *open*! To cause overheating, it would have to be stuck in the closed position. As a gamble, I re-installed the old one. On starting the engine, we could see the usual abundant discharge of water at the stern. After idling for 20 minutes, we were cautiously under way, keeping the rpm to a modest 2,200 and traveling as close to shore as possible. At the lower speed, it was a slow go of only 1.5 knots against the current, but we were making progress . . . until 1400 when we heard the sound of the exhaust change from the usual "whoosh, sploosh" of water to the metallic "pong, pong, pong" of a dry exhaust.

This time, the anchor bit just as the alarm sounded and we shut down the engine. This was no longer fun. I had a spare water pump I had just rebuilt. I installed the spare and we were off again. By late afternoon, we found *Dolphin II* tied to a floating pontoon. They motioned us to tie up astern. As we went into reverse to back down, that now familiar and unwelcome "pong, pong, pong" sound returned and just as we made fast to the dock the alarm sounded once more.

This was embarrassing! *Entr'acte* had become "the catastrophe boat," badly maintained and always in trouble. Were we now the boat to avoid? I was getting angry!

A more thorough probe

Somewhere inside the cooling system there had to be a blockage. Slowly and purposefully, I removed every hose from the cooling system and pulled a dockline through each hose to clean out any salt deposits (and there was indeed much to remove.) I did not stop there. I next removed both engine zincs, the thermostat, and its cover. Probing the depths of the cooling system with my fingers produced no debris that might clog the system.

I next took a hose and poured water into and through every opening in the cooling system, first from the top down and then from the bottom up. I exercised the greatest care to not pump water into the cylinders. That would have been a disaster. I was pleasantly surprised to see water running freely through all the openings of the engine block. There was no evidence whatsoever of any blockage or obstruction inside this engine. Finally, using a piece of stainless-steel wire, I probed and cleaned the orifices of the thermostat cover and again found nothing amiss. Leaving no stone unturned, I once again opened the water pump to check for possible debris, but saw nothing untoward in there.

And then King Neptune smiled on my efforts. Just before replacing the cover plate on the pump, I turned the pulley as I was looking at the inside of the pump and was stunned to see that, although the pulley was turning, the impeller blades were not. I rotated the pulley once again. The blades remained motionless while the center spindle of the impeller was turning.

I pulled out the impeller. Lo and behold, the rubber blades came apart from the center spindle, leaving the spindle behind. I have never been so relieved. But how could this be?

Our new batch of impellers differed substantially from the former design. In the old design, the drive pin passed all the way through the body of the impeller, much like the shear pin on an outboard motor's propeller. The new design has a much shorter drive pin that

only passes through a center hub that is somehow bonded to the outer body. It was this bond that had broken loose.

Everything was suddenly clear to me. The problem was a direct result of the event several weeks before when both passages of the exhaust mixing elbow became clogged. With the water passage blocked, when we pushed the engine to 3,100 rpm, the stress on the water pump impeller must have been severe enough to weaken the bond between the center spindle and the outer body of the impeller. The bond, although weakened, still had enough friction to turn the blades once the blockage was cleared. Eventually, the spindle began to slip at high speed, although it could still maintain traction to work normally at lower rpm . . . until the bond failed completely. There was no way to foresee this type of fault without looking and testing specifically for it. Since I had never seen or even heard of such a failure, I did not look. I will be watching for it in the future.

Paris at last

Our final two-day run toward Paris was tense. With a new impeller, the engine was back to normal, but we were gun-shy, traveling close to shore at a low rpm and always on the lookout for an emergency anchorage. Local advice was to enter Paris just after sunrise to avoid the chaos of workboats, barges, and tour boats. Our plan was to stop for the night five miles outside Paris just after the final lock. If we got under way at 0600 the next day, we could enjoy a leisurely entry into Paris, snap some great once-in-a-lifetime photos, and arrive at the Paris Arsenal Marina by 0800, before everyone else was awake. It was great plan but, alas, this was not to be. Despite the numerous locations shown in the guides, we could find no place to stop. Every available space boldly displayed "No Tie Up" or "No Parking" signs, so we carried on, always on the alert for the sound of the engine alarm.

Entr'acte passed the Eiffel Tower exactly at noon amid as much river traffic as can be imagined: boats of all sizes zooming around from every possible direction, each on its own mission. It was truly a spectacular sight. One mile from the marina, we approached the final hurdle, a "one-way-traffic" bridge. Traffic is controlled by signal lights that switch from red to green at set times every hour. If you miss the green light for your direction, you must wait. We drove hard against the current but — just as we reached the bridge — our light turned red and the downstream traffic began. We moved off to starboard and spent

Lessons and caveats

Never reuse an impeller

It sounds absurdly wasteful, but to reuse a water pump impeller is false economy. Our normal practice has always been to change the impeller every season. When cruising full time, we change it once a year.

Also, remove the impeller when the boat is laid up. Left inactive for months, the blades will sit in one position and "take a set." When returned to service, the impeller might not provide the same vacuum, especially at higher rpm.

Be mindful of collateral damage

When something fails, do not address the failure only. Think about what impact that failure might have on other components.

Upon replacing our exhaust mixing elbow in Honfleur, I should have changed the impeller. Even though the water pump and its impeller were not in any way the cause of the blockage, the resulting back pressure inside the pump severely compromised the impeller in a way that could not be seen, even upon close scrutiny. I had never seen nor heard of an impeller failing in the manner we discovered. Throughout this entire saga I continued to reuse the same impeller because it was "new" with few hours on it. Had I changed the impeller along with the mixing elbow, the rest of the problems would not have occurred.

In the aftermath of the impeller failure, I resolved to find replacements of the "old style" where the pin passes completely through the impeller. This, after great effort, I accomplished, but apparently to no avail. Even this seeming foolproof design is prone to exactly the same sort of failure. Over a period of six months I saw three such failures and they were of both designs. The moral is to change your impeller often and carry spares. They just don't make them like they used to.

Stress plays a role

Keep your cool, no matter what. Try not to allow ego and emotion to get the better of you. This is not an airplane falling out of the sky. On a boat, you have time to have a cup of coffee and think carefully about the problem and how to address it . . . in most situations!

Never run an overheating engine

If your engine's temperature alarm goes off, shut down the engine immediately. To run an overheating engine for even 30 seconds is courting disaster. The excess heat will warp the cylinder head, resulting in a blown head gasket. There is also significant risk of cracking the cylinder head or even cracking the engine block itself. You can then kiss your engine good-bye. If the engine runs in this state for several minutes, the metal will eventually expand so much that the engine will seize and stop. Most of this is terminal.

Keep an ear tuned to the sounds of your exhaust. If you no longer hear water being discharged overboard, shut down the engine immediately and investigate.

Read the manual

Everyone should have on board the manufacturer's manual for their model of engine. Read it before and during any repair or maintenance job. I know our engine inside out and upside down and still missed something simple. The arrow on the thermostat cover is clearly mentioned in the manual. Referring to the book while making a repair, even a familiar one, might remind you of something important and save you hours and days of frustration.

a very long hour holding station in the current just off a stone wall from which protruded a large, ancient, and inviting steel ring. At the first sign of trouble, we agreed, we would grab that ring no matter what. An eternity later, our light turned green, and *Entr'acte* crept under the bridge and locked through into the marina without further drama.

Into the canals

Two fabulous weeks later, *Entr'acte* departed Paris, leaving the river and current behind to enter the Canal Lateral à la Loire. On board were our friends John and Paula of the yacht *Mr. John*, who were taking a break from their Pacific wanderings to make this canal trip with us. John is a retired container ship captain and a good man to have on board.

For two days *Entr'acte* made a steady 4 knots through flat water at a sedate 1,600 rpm. I related the drama to John and confided that I had been ready to spring for a new engine at the first opportunity . . . but since discovering the bad impeller, I told him, "Everything is now OK and our engine troubles are a thing of the past." The words were barely out of my mouth when the alarm sounded again. Fortunately, the canal was narrow, and it was a drift of only a few yards to the bank and an easy tie-up.

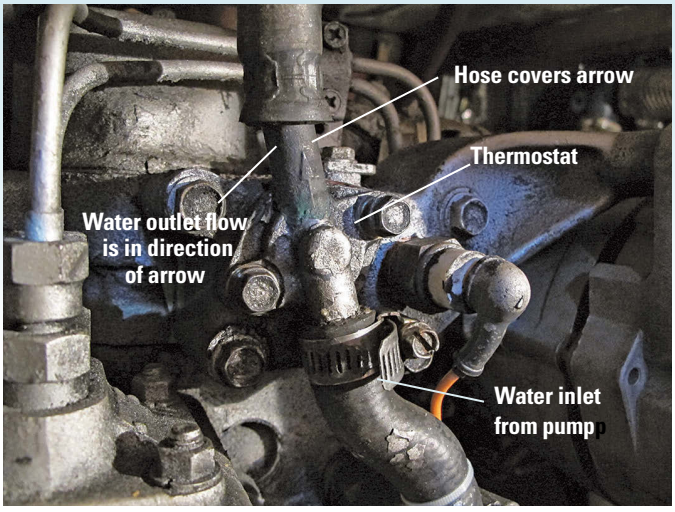
> "... most problems have very simple solutions, but this one was baffling!"

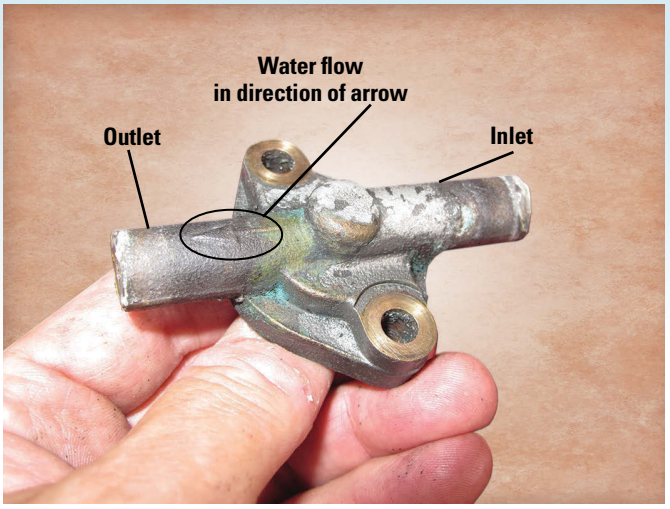
After a long lunch while the engine cooled, I removed the thermostat from the engine. This was the last trick I had up my sleeve, the only move I had left. If this did not work, the engine would go over the side. It's not good for the engine to run it without a thermostat, but it is far better than constant overheating. For the next five days the engine performed flawlessly, but I was going crazy. Why was this happening?

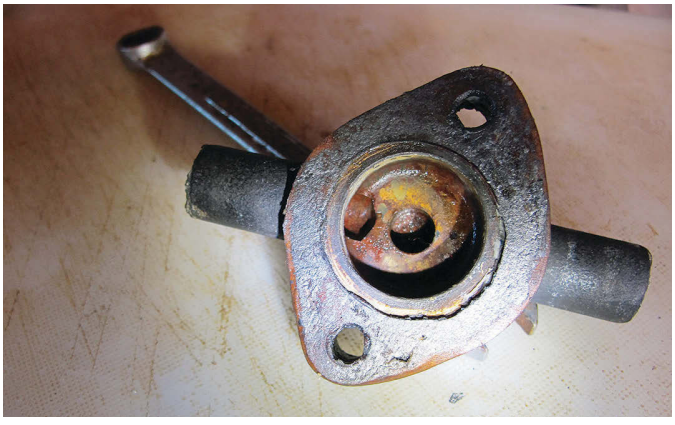
I could not believe that our engine went from extremely reliable to completely unreliable overnight. Over the years, I have discovered that most problems have very simple solutions, but this one was baffling! I had done everything, tried everything, cleaned everything, changed everything. There was nothing left! By then I feared that, even if I were to change the entire engine, it would probably still overheat.

Minus the thermostat, things seemed to settle down as we drifted calmly across France, but I knew it was a short-term solution. It nagged at me day and night. I was missing something fundamental.

One gorgeous afternoon, *Entr'acte* sat 5,000 feet above sea level in the most picturesque setting imaginable. Wild horses grazed in the field next







An arrow on the thermostat housing indicates the direction in which water should flow, but this arrow is covered when the hose is installed, above left. The thermostat housing is symmetrical in appearance, above, and will fit the wrong way just as easily as the right way. Inside the housing it's a different story, at left. The inlet and outlet clearly must not be reversed.

to us. On the other side of the canal, acres of grapes stretched forever toward a magnificent chateau in the distance. All was right in our world. We had just finished lunch and the afternoon entertainment was moving both thermostats from hot to cold water, timing them and watching them open and close. No problems there!

Inspiration and a solution

It must have been the relaxed atmosphere, because that night I finally slept like a log. Suddenly at 0200 (why is it always 0200?) I bolted awake. *I had it!* I was so excited I had to fight to keep from tearing into the engine room right then. It was so simple. What a dunce I had been.

After breakfast I dove into the engine room, praying for all I was worth. I removed both hoses from the thermostat cover and looked closely at the cover itself. Yes, yes, *yes!* Sure enough, embossed quite clearly on the cover but hidden under a hose was an arrow to indicate the proper flow of water. The cover should be mounted with the arrow pointing up. I had mounted it upside down.

The thermostat cover has two ports, an inlet and an outlet. Viewed from the outside, the hose barbs appear identical. Inside the cover, however, the orifices are not only of a different size, but each is oriented differently to the flow of water. The water is supposed to flow through the open thermostat into the engine. With the cover inverted, the water pump was pumping seawater into the outlet and directly onto the top of the thermostat, rather than through it. This restricted water flow into and through the engine. Some water could flow, but only enough to cool the engine at low rpm for a short time. The temperature would gradually rise and finally set off the alarm, especially if we raised the rpm for any reason. As far as the engine was concerned, the thermostat was constantly closed.

When dismantling the cooling system to clean out the hoses, I had been under quite a bit of stress and inadvertently installed the cover upside down. The cover can be installed easily in either orientation, hence the arrow. But in the heat of battle, that arrow is very easy to miss, especially when it's completely covered by the hoses.

Confession: I knew about the arrow and that the cover had to be mounted with the proper orientation. Over the years, I have even reminded others to watch out for it, but through a simple confluence of events, circumstance, and stress, I assembled it backward and paid the price in frustration.

Now all is well. *Entr'acte*'s engine is back to normal and runs for hours and days on end as happily as it did before. It's magic!

Ed Zacko is a Good Old Boat *contributing editor. He and Ellen met while playing in the orchestra of a Broadway musical. They built their Nor'Sea 27,* Entr'acte, *from a bare hull and since 1980 have sailed across the Atlantic four times and the Pacific once. Ellen and Ed now split their time between cruising in* Entr'acte *and playing in the jazz clubs of Spain, France, and Morocco. Follow them at www.enezacko.com.*

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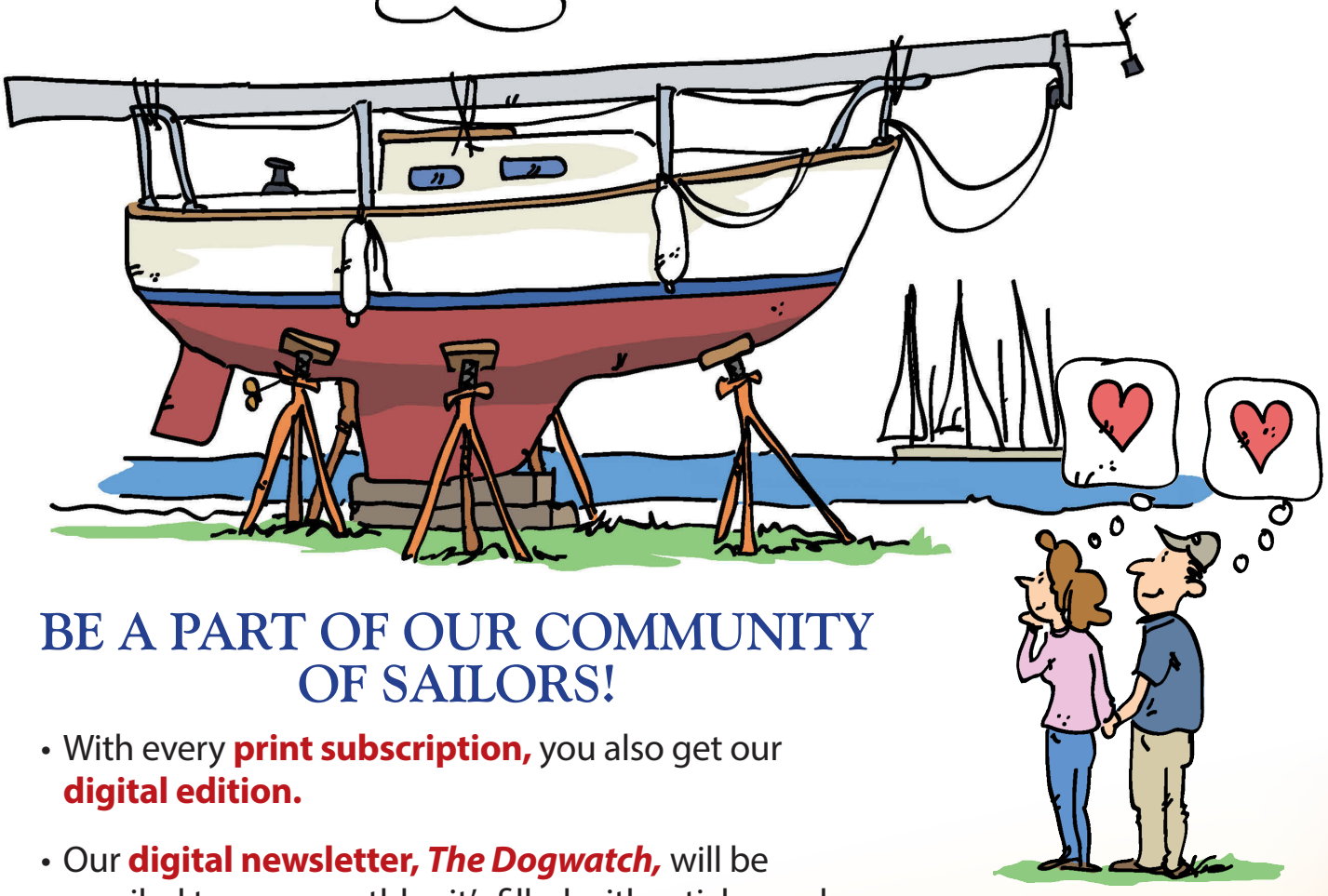

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See, be seen, and talk about it

BY ED ZACKO

"This is sailing vessel *Entr'acte* WYR 3025 — at latitude 24 degrees 16 minutes north, longitude 97 degrees 14 minutes west — calling the cargo vessel astern. Do you see us? Over."

Silence.

The sun has just set. *Entr'acte* is running dead downwind in a moderate sea making 6 knots, genoa poled out to port, main to starboard, boom vang set, and preventers in place. Rolling along without a care, we now have a "situation." A large container ship has just appeared among the waves some distance astern and to port. Her lights indicate an almost parallel course, overtaking and possibly converging. Continuous bearings appear to remain constant but there's so much motion, it's hard to be certain. She might pass well to port and safely ahead but we just . . . don't . . . know!

With the radio silent, we have no idea what he's thinking or if he even knows we are here, so it's up to us to remain clear . . . but how? Crossing her bow is out of the question. It's dark and any other move will involve a lot of foredeck work and lost time.

We call again: "This is sailing vessel *Entr'acte* . . . blah, blah, blah."

More silence. The only safe decision is to jibe the main, lower the pole, come onto the wind and sail off on a course perpendicular to the ship's track.

Two hours later, sails re-set, we are safely back on our course, but Ellen's off-watch rest has been destroyed. With a little more information, our actions might not have been necessary.

These days, thanks to the Automatic Identification System (AIS), such scenarios are becoming less common. AIS is an anti-collision tracking system

AIS for the rest of us

that locates vessels electronically and exchanges navigational information between vessels. A simple, continuously transmitted VHF radio message shares critical navigational info about each transmitting vessel.

Be seen or see only

There are three basic forms of AIS: Class A and Class B transponder units, which send and receive information, and receive-only units with no class designation. AIS receivers display contacts (called targets) on a screen with your boat in the center, much like a radar display. Thus it is sometimes referred to as AIS radar.

Class A is for commercial vessels. Since 2002, all commercial international vessels exceeding 300 gross tons, non-international vessels exceeding 500 tons, and all vessels carrying passengers for hire regardless of size, must be fitted with Class A transponders. Class A is the most expensive because it transmits at a higher power and more frequently (every 2 to 10 seconds when under way depending on speed and every 3 minutes at anchor). It has all of the functionality the law requires of commercial vessels and requires operator intervention during use.

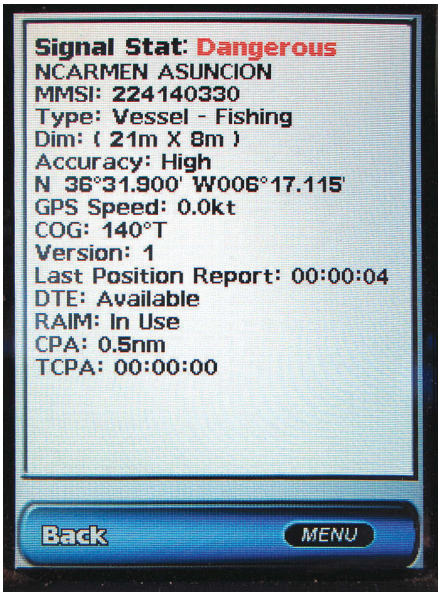
Class B is for the average boater who does not carry passengers for hire. Introduced in 2006, Class B transponders are fully functional but less complicated, far less expensive, and within reach of the average pleasure boater. Class B units transmit at lower power and do not require or allow user intervention. Once initially programmed, they're fully automatic, broadcasting every 3 minutes when the boat's speed is less than 2 knots and every 30 seconds at greater speeds. Class B is not inferior or lacking functionality in any way. Many transponders now include WiFi to connect with computers, tablets, and other iOS devices.

Receive-only units, the simplest and least expensive, are available as stand-alone units with screens or as "little black boxes" minus screens that fit almost anywhere and connect to your chart plotter or computer charting program through NMEA 183 or NMEA 2000. Some VHF radios now include an AIS receiver. Older single-channel units see only Class A targets. Newer multi-channel units process both Class A and B vessels plus a wide selection of other available targets. Since you want to see everyone who is transmitting, regardless of class, check specifications carefully before you buy, especially if buying a secondhand unit!

Using AIS

AIS targets appear as icons on the display. When you place a cursor on a target, a text box shows the vessel's name, MMSI number (an ID number unique to that vessel), type (pleasure,

A stand-alone receive-only AIS display, above, shows headings of transmitting vessels and their relative positions, taking much of the stress out of close encounters at sea.



On an AIS display, all targets are ranked by proximity, at left. Selecting a target brings up the information page for that vessel, at right, which includes the critical CPA and TCPA.

sail, or cargo), course, speed, destination, and the two important figures: closest point of approach (CPA) and time to closest point of approach (TCPA). Press a button to see a target list of every vessel within range, usually ranked according to proximity.

If AIS does nothing more, it gives you a vessel's name to hail. This eliminates the need to transmit coordinates, which can be confusing. English may be the international language for navigation, but it is usually the second or even third language spoken on board. Those on the ship's bridge can communicate in English "face to face," but over the radio the more words spoken the greater the chance of confusion and of being ignored, so come right to the point: "*Da Vinci*, *Da Vinci*, this is sailing vessel *Entr'acte*. Over." We have never hailed a ship by name and not received a response.

If your VHF has Digital Selective Calling (DSC) capability (in the U.S., that's any non-handheld VHF radio sold since 2000), you can send a DSC priority call directly to the vessel's MMSI number. You will get a response . . . and fast!

With AIS, however, if the ship appears on your screen at a range of 15 miles, you have plenty of time to adjust your course and probably won't need the radio at all. Many times, the less said the better.

AIS is not just for world-cruising yachts. A click on www.vesselfinder.com shows that just about every body of water in the world is covered with AIS targets. Zoom in and the number of targets multiplies. If your boating activities put you into contact with large ships, ferries, or day-charter boats — basically any large commercial vessels — your life will be easier and safer if you can at least *receive* AIS.

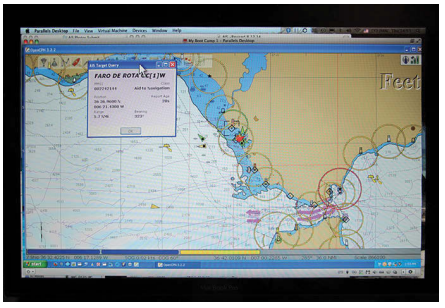
In the opening scenario, even if we'd had receive-only capability and nothing more, we would have seen the ship on screen an hour before visual observation and would have been relieved to know the CPA would occur 10 minutes after he had overtaken and safely passed us one mile to port and a mile ahead of us. We could have maintained course and speed or changed course slightly to open CPA even more while watching the CPA closely and planning well in advance of problems.

Whenever you're dealing with multiple vessels, this information will reduce tension. You immediately know which targets are dangerous and which are not. The dangerous target is not always the closest one. You no longer have to spend tedious hours trying to dodge a ship that poses no threat at all.

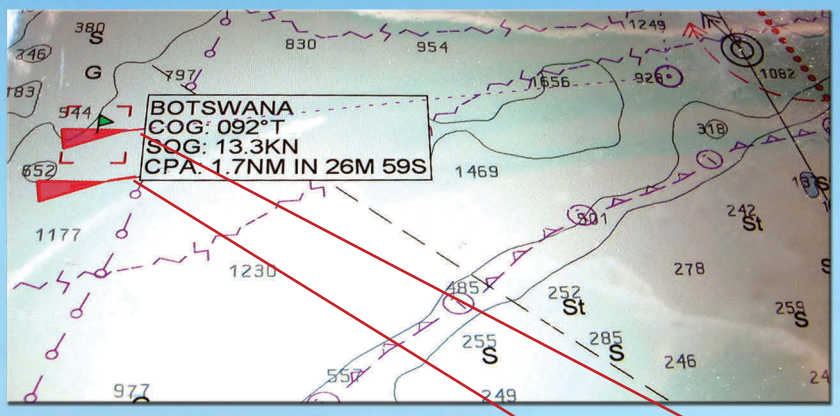
On rivers, you won't be surprised by a tug towing six barges rocketing suddenly from behind a headland down-current toward you. Your proximity alarm will warn you well in advance of a visual so you can position your vessel to remain clear.

AIS aids navigation

In addition to ships, AIS also receives signals from Aid to Navigation beacons. AtoN beacons broadcast AIS signals showing their position on



In the old days, the scene unfolding at left would have been extremely stressful. With all of the motion of a small boat, it's difficult to judge the situation accurately by eye. Even though the AIS showed we had an acceptable CPA of .25 nautical miles, prudence dictated that we alter course to port and increase our margin of safety. The danger is not always obvious, center. Despite how it looks, only one of the many targets posed a collision risk. WiFi capability gives the added advantage of using AIS AtoN beacons for navigation, at right.



Before AIS this would have been a heart-stopper. It does not look like it but *Botswana*, on the right, is at CPA (1.7 nautical miles). We saw both of these vessels on screen one hour before we saw them visually. We knew who they were and that we would be able to cross in safety while watching carefully for any changes.

a chart. AtoNs can be real and fixed (lighthouse), floating (buoys and fishing nets), or virtual (transmitted from a shore station). They can indicate temporary emergency channels, alternative passages, danger zones, fishing areas, racecourses . . . almost anything.

Even if you can't see that lighthouse due to fog or a malfunctioning light, you will see it as a magenta diamond on your electronic chart and a target contact on your plotter screen and target list. You'll also have its range, bearing, CPA, and TCPA. We receive AtoNs at 200 miles. Pretty cool! Now we have a fighting chance to avoid those large fishnet areas.

AIS and MOB

AIS can serve as a man-overboard locating device. Several manufacturers, such as McMurdo, offer personal strobe/locators that attach to a life-jacket or safety harness and transmit AIS. In the event a wearer goes overboard, the strobe will flash and the unit will transmit an AIS signal. The person in the water will appear on screen as an actual AIS ship target, visible on any vessel with an AIS receiver.

The nuts and bolts

Costs – AIS is affordable. The technology changes almost daily resulting in more units with more features at lower prices than ever before. Our original black box receiver and antenna splitter cost less than $300. Our new transponder/splitter with built-in WiFi network for iPad connectivity cost less than $900.

Antenna splitter – AIS is a VHF signal just like that from your ship's radio. The effective range is determined by the quality of your antenna and its height above the water. Since two masthead antennas will interfere with each other, the antenna splitter was developed. This small box allows your VHF radio and AIS unit to share one masthead antenna. It works seamlessly in the background and automatically connects the proper device as needed.

It's important to be aware that a particular antenna splitter might not be universally compatible with all devices. A splitter that works with a receiver may not work with a transponder. Do your research.

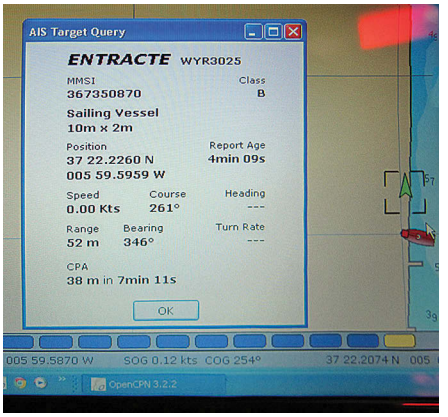
Licensing – For a recreational vessel in U.S. waters, no FCC license is required to install or use a VHF radio or AIS receiver. However, if you wish to install a transponder and do not require a license, you still must obtain an MMSI number. Without formally applying for an FCC radio license you can obtain this all-important number through the BoatU.S. website (see "Resources" on page 43). An MMSI obtained through BoatU.S., however, is not valid for use outside U.S. waters.

For international travel, including to Canada, Mexico, or the Bahamas, you must have a station license for

***Entr'acte*'s first AIS, a receive-only Digital Yacht "black box," at left, was simple and inexpensive. *Entr'acte*'s new transponder, above, transmits, as well as receiving Class A and B vessel signals and AtoN beacons. It has built-in WiFi and GPS and it connects to chart plotters and computers via NMEA and/or USB and to iOS devices via WiFi.**

your boat. This license assigns to your *vessel* (not to an individual) a call sign and MMSI number that cover your VHF, EPIRB, SSB, and AIS transponder should you choose one that transmits. There is no exam. Complete the paperwork, pay the fee ($155 for a 10-year license), and you're done.

Programming – Transponders must be programmed with your vessel's length, beam, and MMSI number. In the United States, it is illegal for end-users to program AIS transponders. Before buying our Class B transponder, we had to complete a form listing all our vessel's particulars and provide documentation of our MMSI. Our new Vesper XB-8000 transponder arrived pre-programmed, tested, and ready to use. If you purchase a used unit, it will be programmed with the former vessel's MMSI. Before installation, you must have the unit reprogrammed with your vessel's number. Check with the manufacturer to determine how this can be done and at what cost.



***Entr'acte*'s vessel information as it appears on the display on a large passenger vessel.**

AIS filtering?

Filtering is the Pandora's Box of AIS. Do the big boys filter out Class B signals? If yes, then why install a Class B transponder?

The rationale for filtering is to de-clutter the screen while entering or leaving a harbor where speed is low, everyone is exceedingly careful, and all threats are plainly visible and easily avoided. Theoretically, the filter would be turned off when entering open water. However, even a filtered target will appear if it enters the Danger of Collision Zone. When I asked the captain of the container ship, *Matisse,* if he filtered Class B targets, he looked at me in amazement and said, "Why would the captain of any ship do something so stupid? It would destroy his career!"

We have personally experienced the confusion and annoyance of entering a harbor and being overwhelmed by targets and alarms from ships and yachts that are left to transmit continuously while hanging on moorings, at anchor, and in marina slips. The screen became so cluttered and the alarms so distracting that we finally shut down the AIS so we could see the chart. Some units can now be set to automatically filter out targets that pose no danger of collision (more than a mile away) to reduce screen clutter.

As I write this, it has been six months since we installed our Class B transponder. We have been sailing daily along the north coast of Morocco and the southern coast of Spain as well as in, near to, and through the Strait of Gibraltar, one of the most heavily trafficked areas in the world. We have seen no evidence whatever that we were filtered out and not seen. Quite the contrary. In our encounters with ships, we routinely see definite course corrections of perhaps only 2 or 3 degrees but enough to increase the CPA. This shows that the ship has seen us. One ship captain congratulated us for installing the transponder.

To see an ongoing discussion about filtering, visit the Panbo website, which is a trove of information about all aspects of marine electronics: www.panbo.com/archives/2010/04/the_class_b_ais_filtering_myth_revisited_arrrrrgh.html.

If you live outside the U.S. and purchase an unprogrammed transponder and program it yourself, beware! You get only one chance to input the MMSI. If you err, you must, in most cases, return the unit to the manufacturer, not the dealer, to have it corrected.

Transmit or receive-only?

Does a small yacht need an AIS transponder or is receive-only good enough? Our encounter with *Argos*, a 130-foot superyacht, got us thinking about this.

We were 8 miles from an entrance buoy to a reef passage in 25 knots with large seas. Our receive-only AIS alarm alerted us to "a dangerous target" barely visible among the waves. *Argos* was making 14 knots and our CPA and TCPA indicated that we would arrive at the buoy simultaneously.

"*Argos*, *Argos*, this is *Entr'acte*."

Despite our two radar reflectors, *Argos* had not seen us visually or on radar. Even before we signed off, however, our readout showed that she had slowed to 12 knots, enough to increase CPA and allow us both to enter in safety. Had *Entr'acte* been transmitting AIS, *Argos* would have received a solid contact, seen our destination, and reduced speed.

As passengers on a recent transatlantic crossing aboard the 1,000-foot container ship, *Matisse*, we each stood two proper 4-hour watches for 12 days and had ample opportunity to observe the crew and study the ins and outs of AIS reception. We saw firsthand how our boats appear to these big boys. It was not encouraging, except for those yachts that transmitted AIS.

While radar contacts vary with the size of the vessel and sea conditions, AIS target icons are identical regardless of the size of the vessel. The contact icons for a 5-foot rowboat, the 27-foot *Entr'acte*, and a 1,000-foot container ship are all the same size, a comforting thought! AIS greatly enhances your "electronic footprint."

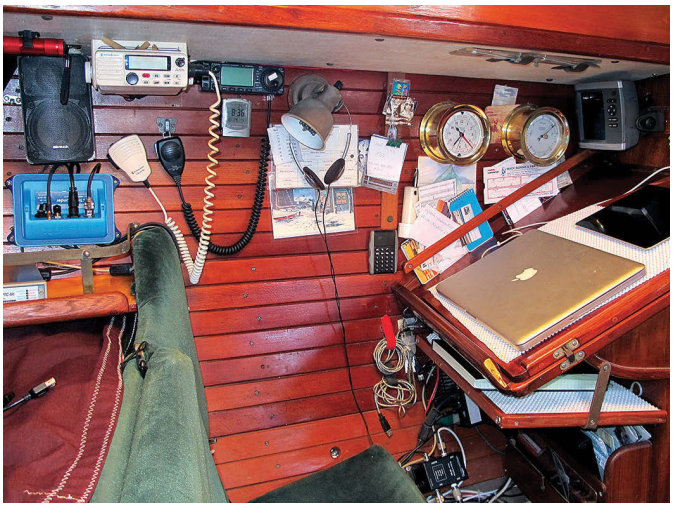
AIS feeds the contact to your chart plotter. A "dangerous target" triggers an alarm followed by a target query.

CPA and TCPA determine the action required.

Unfortunately, the maximum AIS threat alarm zone for chart plotters and charting programs varies considerably. On open CPN, the threat alarm zone can be set at 20 miles or more, but my Garmin plotter's maximum threat zone is only 2 miles. In low visibility with only a 2-mile warning, you will never get out of the way in time.

For the singlehander, an AIS transponder can save a life . . . mine! We were almost run down by a singlehander who was sleeping. An AIS transponder is like having an extra crewmember constantly announcing your presence.

As of this writing, several countries (such as Singapore) are beginning to mandate that all vessels transmit AIS. The UK is also making noises along these lines.



The AIS transponder and antenna splitter are compact devices and both fit neatly and easily even in *Entr'acte*'s navigation station.

The bottom line

The latest receive-only units will receive signals from both Class A and Class B transponders.

If you install a Class B transponder, your signal and information will show up on both Class A and Class B receivers. In short, you will both see and be seen by the big boys.

The catch

There is one snag: the lag between the rapidly evolving AIS technology and the capability of existing GPS units. Ship transmissions are slightly different from AtoN transmissions, and even though AtoNs are received by your AIS unit and relayed both over WiFi and NMEA, your chart plotter might not process them. There are 26 different types of AIS sentences (signals), each one slightly different and each serving a specific purpose (ship, AtoN, MOB, and so on). While the latest AIS units will process most of them, your chart plotter may not. For example, our Vesper transponder receives and processes ship, AtoN, and MOB sentences. We read them easily on Open CPN and on the iPad, but our Garmin chart plotter will only display Class A and B ship targets. If you plan to use AtoNs, you may want a WiFi-capable unit connected to a computer or iPad. According to McMurdo, their MOB device will show on a plotter, but as a ship contact rather than an MOB. To be certain, check with the manufacturer of your particular device.

AIS is not perfect

We should never rely on just one navigational device. Do not blindly assume that because you are transmitting and receiving AIS, you no longer have to keep a good watch. That would be a tragic mistake. Nothing replaces a good pair of eyes and sound judgment. Never assume the "other guy" is alert and conforming to the law. We are the little guys and, "right of way" notwithstanding, our survival dictates that we keep out of their way.

Throughout this season we have been continually impressed by, and have found new ways to employ, this great new technology. With AIS, good sense, and reasonable care, your navigation and encounters with the big boys will be far less tense. Forewarned is forearmed.

More online . . . Ed has added further technical information about purchasing, installing, and powering AIS devices at www.goodoldboat.com/reader_services/more_online/AIS.php

Ed Zacko is a Good Old Boat *contributing editor. He and Ellen met while playing in the orchestra of a Broadway musical. They built their Nor'Sea 27,* Entr'acte, *from a bare hull and since 1980 have made four transatlantic crossings and one across the Pacific.* Entr'acte *is now based in Seville, Spain, where Ellen and Ed are happily sailing in and around the Mediterranean and playing in the jazz clubs of Spain, France, and Morocco. Follow them on www.enezacko.com.*

The author is grateful to Jeff Robbins at Vesper Marine, Doug Miller at Milltech Marine, Paul Sumpner at Digital Yacht, Captain John Wolstenholme, and Deborah Ray for providing technical information and clarification.

Resources

AIS basics
www.vesselfinder.com
www.vespermarine.com/virtual-beacon/virtual-ais-beacon.html
www.amsa.gov.au/forms-and-publications/Fact-Sheets/AISB_Fact.pdf

Devices
www.milltechmarine.com
digitalyacht.co.uk
www.vespermarine.com
gcaptain.com/overboard-sarts-devices
www.mcmurdomarine.com/ais-mob-devices (Personal MOB device)

Licensing
www.fcc.gov
www.offshoreblue.com/communications/fcc-license.php
www.offshoreblue.com/communications/radio-station.php

MMSI Number
www.boatus.com/mmsi/instruct.asp
www.boatus.com/mmsi

Compatibiity of devices
www.panbo.com/archives/2012/06/ais_over_nmea_2000_the_shame_sheet.html

The Ship's Log

A daily duty records a lifetime of memories

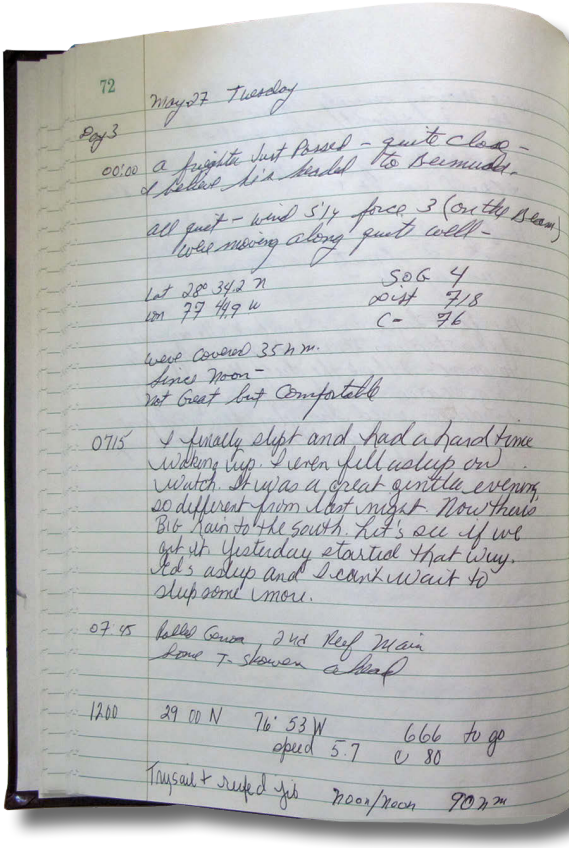
BY ED ZACKO

I am sitting in front of the fire doing research for an upcoming ocean passage. I like to study the passages of others. What routes did they take? Which months? Did they make good choices and, more important, did their planning result in a good passage? I am lost in this book . . . fascinated. I have made this passage several times, but the account I am reading bears little resemblance to what I remember. Yet it is our very own log of *Entr'acte* from 2005, our passage from Gibraltar to the Azores. It is our boat, our book, our writing, but these words seem to have been written by someone else. Seemingly innocuous entries trigger the memory. The blanks fill in and the past comes alive as the scenes become once again familiar. I look up to the bookshelf and smile. *Entr'acte*'s log, which began on her launch date April 1, 1980, and has continued uninterrupted to the present day, now fills 37 beautifully bound volumes.

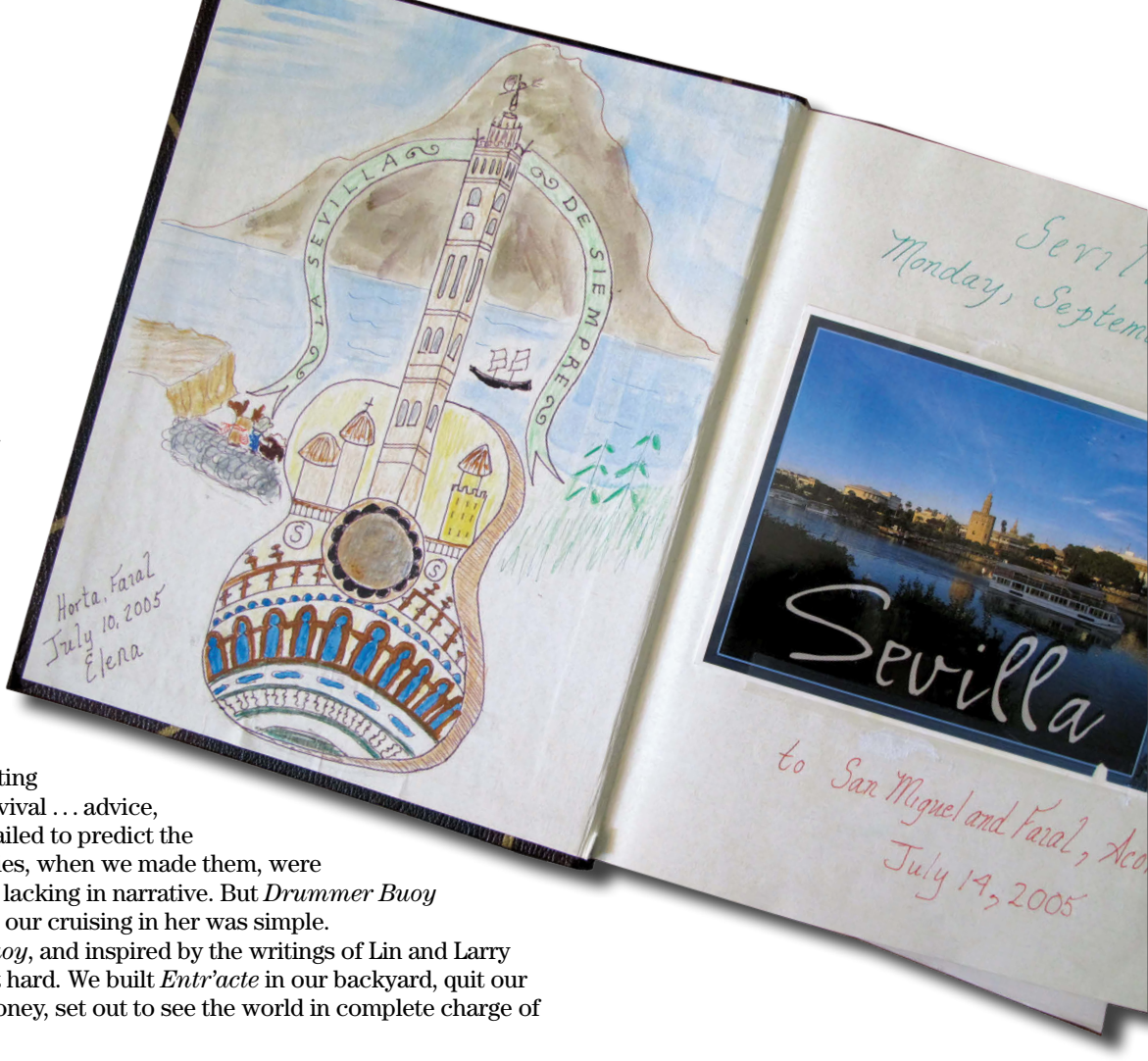
At first glance, these books seem to be a useless compilation by someone with an obsessive/compulsive disorder, or perhaps simply the affectation of a romantic. We were in our mid-20s when we began the Log of *Entr'acte* and we joked that these journals would be fun to read by the fire when we "got old." Well, we're approaching 70 now and we, along with *Entr'acte*, are still under way. I pause to think about logs. What are they really? What treasures do they hold? What should a log contain? Are they really necessary?

Modest beginnings

The log from our first 18-foot catboat, *Drummer Buoy*, was a simple all-in-one book, each page an identical form with columns for every



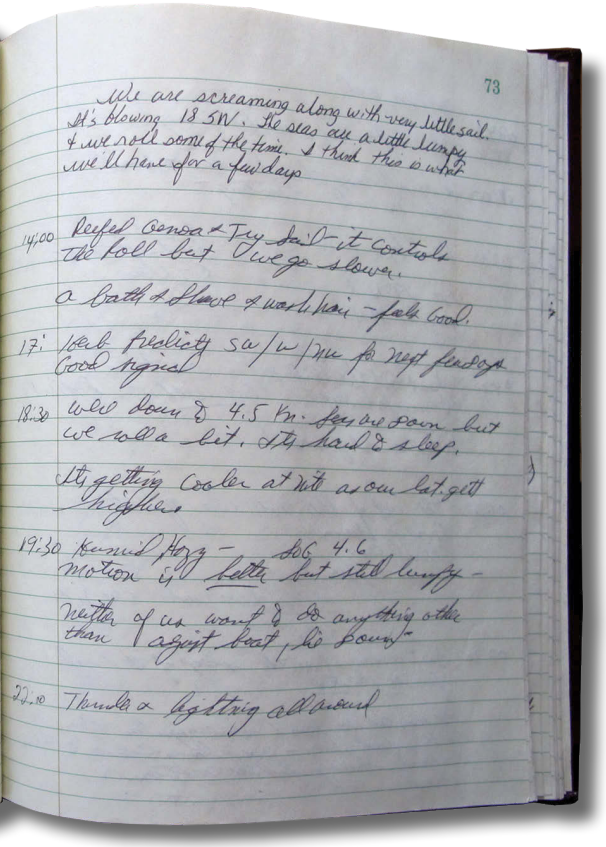
Thirty-something years of cruising fills a yard or so of bookshelf in Ed and Ellen's pied-a-terre in Arizona, at top. *Entr'acte*'s ship's log is a simple 10½ x 8, hard-bound, lined office journal. Ed and Ellen buy several at a time to ensure uniformity and make certain they do not run short. Their inside pages, at right, are filled with details of every day that passed on board.



Each volume's cover page is a work of art depicting the destinations covered in that particular book.

conceivable phase of boat operation, maintenance, and navigation. Just fill in the blanks as you sail on. Included in this book was a guest log, basic piloting instructions, a Beaufort Scale to judge the wind, barometer instructions for predicting weather, and hurricane survival . . . advice, presumably, for when we failed to predict the weather properly. Our entries, when we made them, were simple and to the point but lacking in narrative. But *Drummer Buoy* was a very simple boat and our cruising in her was simple.

Thanks to *Drummer Buoy*, and inspired by the writings of Lin and Larry Pardey, the cruising bug bit hard. We built *Entr'acte* in our backyard, quit our jobs and, with very little money, set out to see the world in complete charge of our boat and our destiny.



A Nor'Sea 27, *Entr'acte* may have been a more sophisticated boat, and our goals were certainly more ambitious, but we still did not take log-keeping seriously.

I select volume one and open to 10 August 1981, departure day when we set out from Haverstraw, New York, to see the world: 0700 — "Left right on time!"

We have laughed a lot about that entry over the years. Just *what* were we on time for and why was it so important to leave "on time?"

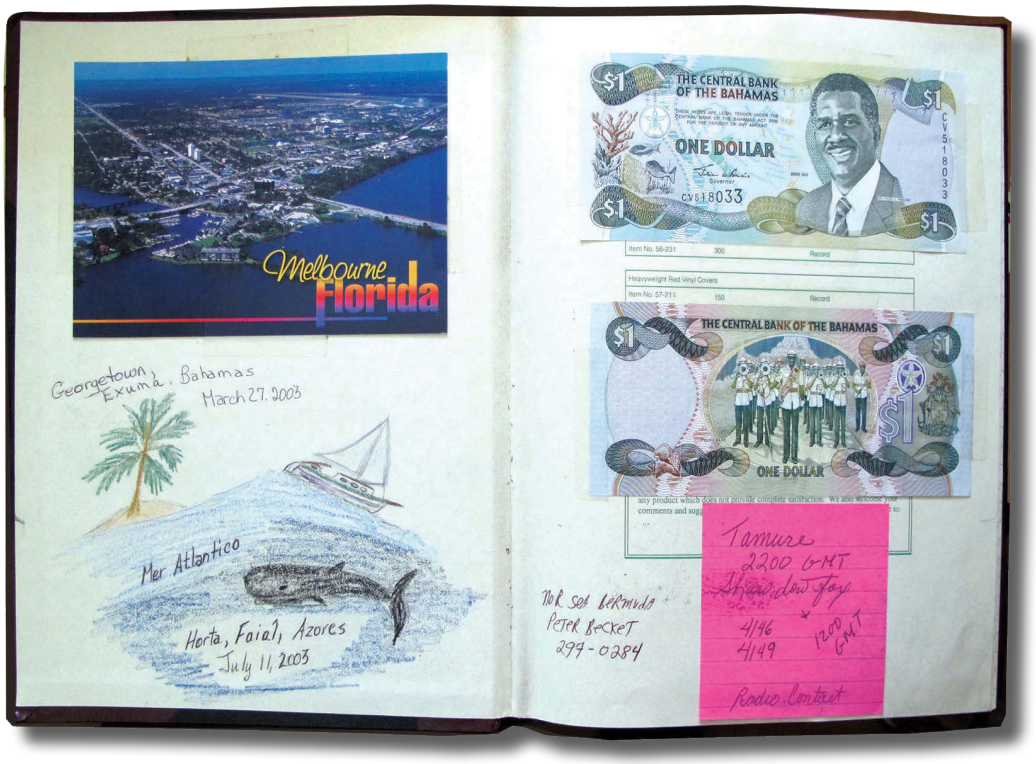
One week and a hundred miles east on Long Island Sound, we made our next entry. In our defense, we were excited, completely exhausted from our preparations, and very familiar with Long Island Sound. Still, in retrospect, the lack of log-keeping was irresponsible.

Our first serious offshore passage from Block Island to Chesapeake Bay was chastening. Being a bit cavalier with our navigational entries, we mistook a lighted drilling ship for the New York City skyline and wasted hours in frustration and confusion. These were the salad days before GPS and all navigation was a combination of coastal piloting and celestial navigation using the sun, moon, stars, and planets. We learned in dramatic fashion the absolute necessity of maintaining a good, *written* DR (dead reckoning).

As we traveled farther, we met the serious cruisers, those "long-timers" with tens of thousands of miles under their keels. We were "the kids" who clearly needed some help and we absorbed all the advice that was offered. Foremost of their suggestions was the obligation to "keep a proper log."

Inspecting the logs of these pros was impressive, not only for their regularity but for the detail. Hal Roth's entries were those of a military vessel and the rest of the book a veritable time capsule.

I select volume three and begin a delightful walk through *Entr'acte*'s history and our life with her. I open to a random page



***Entr'acte*'s log pages are filled with postcards, stamps, local currency, receipts from restaurants with prices, quotes from friends along the way, and any other information Ed and Ellen deem of interest and might wish to remember for future reference.**

and am reminded what it was like to cruise on a shoestring: a "night on the town" in Spain when we split one beer and one tapa (60 cents) between us. We stretched it out for three hours before drinking up and going home. The entry also mentioned how happy we were. In another volume, we are suddenly in Tonga playing with The Hausia Brothers Band before the King of Tonga. I move to another that details a particularly vile night beating up the coast of Panama and still another that, in one short paragraph, has captured the absolute wonder of our first celestial island landfall: "Perhaps this was not wasted energy after all!"

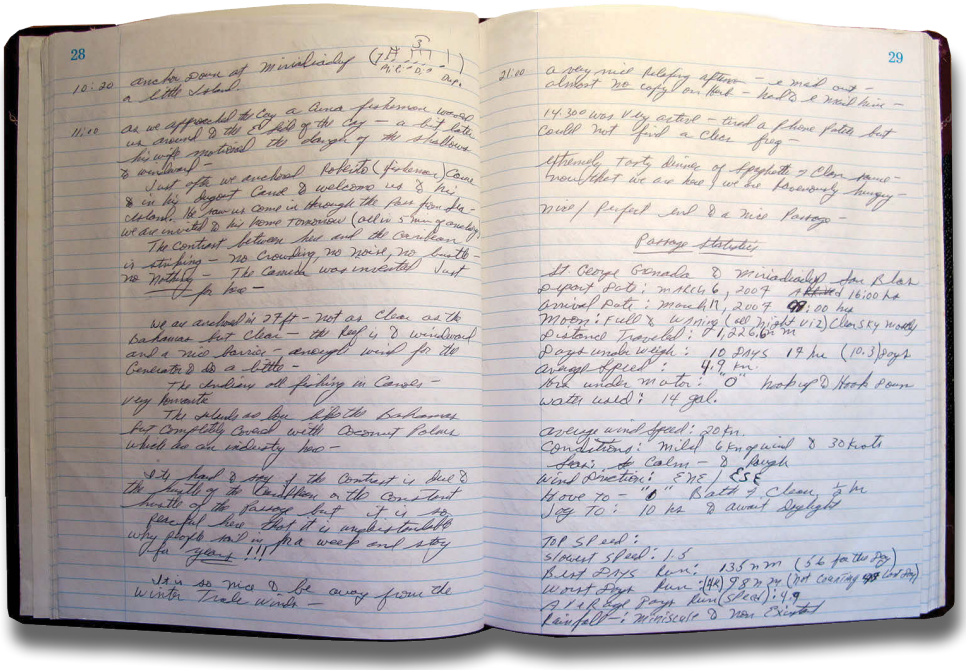
As we sailed on, we gradually matured into responsible sailors and our log evolved as well. It bears little resemblance to that all-in-one book from *Drummer Buoy*.

Logs for everything

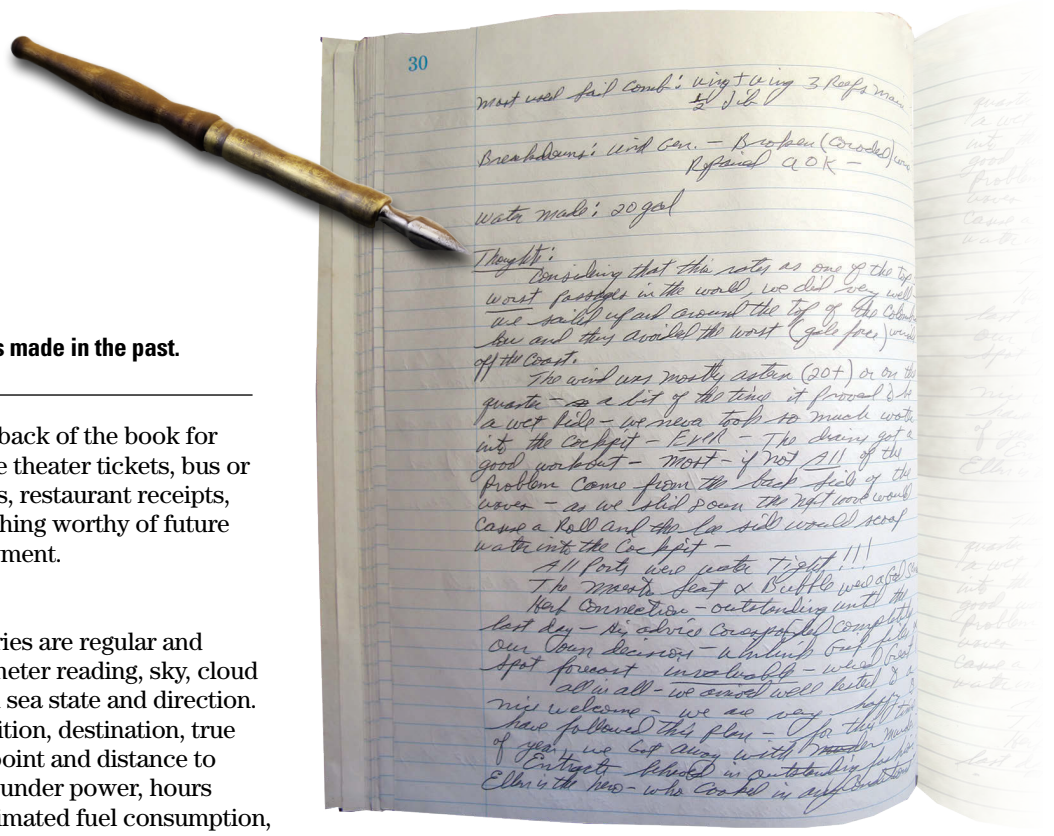
Entr'acte's log now comprises three separate books. The primary volume is the actual ship's log. The second book is a dedicated engine log. The third is a maintenance log. At first, all of the information was in one book, but it proved far too difficult to find critical information when we needed it. Two years into our voyage, we met with a container ship officer and discovered the benefits of separate, dedicated logs. Now, finding critical information is a snap.

Without fail, we make a log entry every single day that we are on board. Each entry represents a day in the life of *Entr'acte*.

The morning entry begins with a weather synopsis, harbor conditions, and overnight events. The next entry usually outlines the plan for the day on board or ashore. The evening entry is made just before bedtime and summarizes the day on board as well as significant activities ashore such as social events, concerts, and sightseeing. If an official comes on board, we always request that he sign the log noting the date and time. This book also serves as our journal to record thoughts and impressions on where we are, how we got there, what we did that day, and locals we met and their contact information.



The summary written at the end of every passage is extremely useful, even years later, for planning future passages.



It is so much fun to read about passages made in the past.

Several pages are reserved at the back of the book for "significant postings." These could be theater tickets, bus or train schedules, program cover pages, restaurant receipts, menus, marina bills, and almost anything worthy of future reference, memories, or proof of payment.

Passage entries

When under way, our navigation entries are regular and complete. For weather, we list barometer reading, sky, cloud cover, wind direction and speed, and sea state and direction. Navigation information includes position, destination, true course, speed, distance to next waypoint and distance to destination, sail combination, rpm if under power, hours accumulated while under power, estimated fuel consumption, and estimated hours of fuel remaining.

We keep proper watches and make log entries during the watch. These entries begin with our current position at the start of the watch and include true course, course to steer, barometer reading, weather, wind strength and direction, sea state and direction, and taffrail log reading. Headsail changes and reefing changes are also noted, as are sightings of ships, whales, or anything else of interest.

Our DR is constantly maintained, updated, and plotted on a paper chart. Every significant course change is logged and plotted along with the time of change. Despite the use of GPS, experience has taught us that electronics fail suddenly and without warning at very inopportune times, so it is vital to have written down the compass course you are trying to steer. We note changes in wind speed and direction as well as sea state and direction. If we take in or shake out a reef, we note it in the log along with the time.

At the conclusion of each watch, the watchkeeper writes a summary of the watch along with specific instructions for the new watch, such as cautions pertaining to events past and instructions for resolving present events like ships on the horizon or impending landfall. Verbal instructions are not remembered well by the new watch coming out of a sound sleep; written instructions are best.

Once the anchor is down and secure, we note the exact position along with bottom conditions and a brief description of the effectiveness of the anchorage in case we choose to visit it again someday.

At the conclusion of each passage we write a passage summary. What went well? What went wrong? Did our tactics work? What percentage of time did the wind blow from each direction and what point(s) of sail were we on? What percentage of the time was under power? How much fuel was used? How much remains? Which sail combinations did we use and which were most/least effective? What would we do differently? Anything of significance is noted while it is still fresh in our minds.

With the above data, we can reconstruct the entire passage, either while under way or years later. These pages have proven extremely valuable in planning future passages.

The engine log

The engine log is dedicated solely to the maintenance and operation of the engine. This has been the subject of good-natured ribbing over the years. ("You keep an *engine* log?")

Yes, we have a small hardbound journal that documents the engine from its initial installation in 1994 to the present day. The inside front cover shows the engine's make, model, and serial number along with the date and place of installation; the transmission brand, serial number, and gear ratio; the shaft size; propeller size (diameter and pitch) and brand; and the size and part number of the Cutless bearing.

The inside back cover lists various settings: valve clearance, torque settings and notes, specifications, and pages of the service manual most commonly referred to.

The final pages list commonly replaced parts by name along with their catalog number. These include fuel filter, oil filter, water-pump impeller, belts (brand, size, and number), thermostat, and so on. This format minimizes a lot of digging through the manuals when it's time to do maintenance.

The body of the engine log details actual engine events. Every part installation, belt change, and repair is documented by date and hour-meter reading, and every part number with place of purchase, address, phone number, and cost.

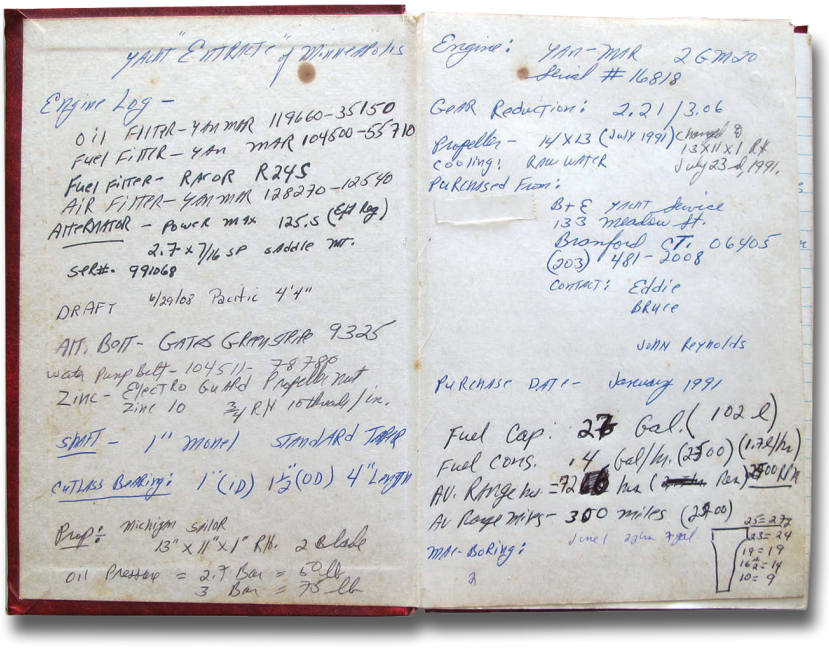
Fuel is logged according to engine hours with hourly consumption noted and compared to past runs. Likewise with oil: the weight and brand are noted and consumption or lack thereof is compared to previous runs. We log how much battery water was added and how many hours elapsed between battery top-ups.

If any of the above figures show a marked change, that's a reason to look into things to avoid surprises.

Thanks to these records, we know exactly how much fuel we use at various rpm settings and conditions. We can accurately gauge our consumption throughout a passage, reducing the chance of running out of fuel before we arrive in port.

Maintenance log

This book is a simple tabbed journal. Each section is dedicated to various items on board: watermaker and survival watermaker, galley, rig, dinghy and outboard, sails, winches and deck gear, charts (which are on board and which are needed), computer, life raft, and ditch bag. The maintenance log holds a record of repairs due to breakdown and also documents dates of preventive maintenance.



The engine log's inside cover is a trove of data . . .

An irreplaceable reference

Nostalgia aside, there are other less obvious uses for a log.

Research

Perhaps you wish to repeat a passage or return to a harbor you visited some years ago.

Before departing for Europe in 2003, we read our log from the 1983 passage, which helped us correct our past blunders and have a much better trip. We knew exactly where we were going and who we wanted to see when we arrived. Where was the Bermuda Customs office? It is in many ways like having our own personal cruising guide.

Memory is inaccurate. Promises made at sea are soon forgotten in harbor. Many times we spoke of a passage where "nothing happened," yet after reading the log of that passage we were surprised to find that it was not quite as uneventful as we remembered it.

Buying or selling a boat

When buying or selling a boat, a set of detailed logs will invariably be an asset. I would want to inspect the logs of previous owners, especially the maintenance logs. Here you will discover how and where the boat was used and how she handled and performed under various conditions. Detailed accounts of her passages show how the vessel was sailed and treated. By reading the comments in the log you gain important insight into the actual performance characteristics of a vessel. Were her miles easy or hard? The maintenance logs speak for themselves. No log, no proof, and possibly no maintenance.

Legal

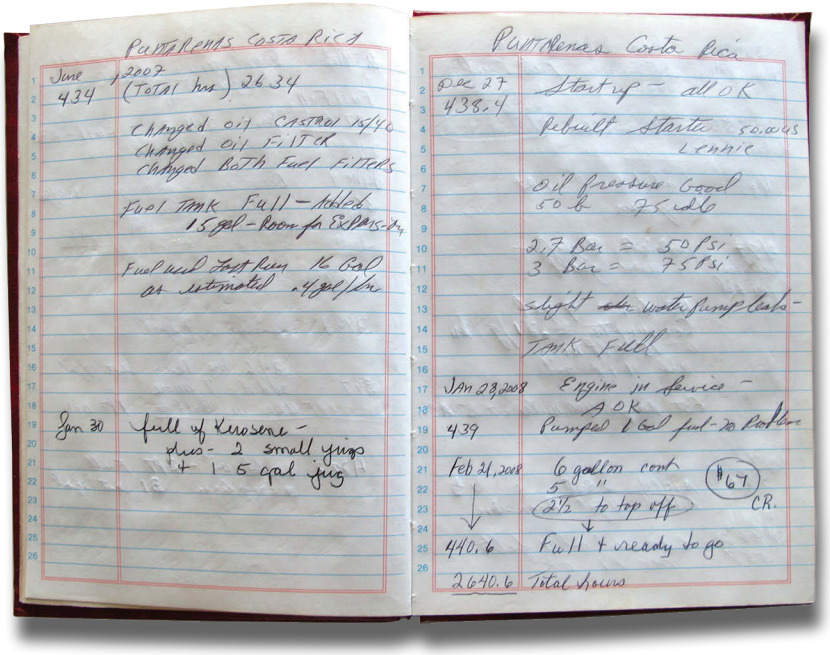
The ship's log provides legal documentation of events. A U.S. Customs officer tried to charge us import duty on a new engine that was installed in a foreign country. The burden of proof was on us and our engine log saved the day.

Fiji Customs actively prosecutes boats that anchor in Fijian waters before officially clearing into the country. The day we arrived, three boats were fined and our officer was out for blood. "Did you stop and anchor anywhere along the way before you arrived here?" I presented our logbook. He looked at it carefully, smiled, and said, "Thank you."

A yacht collided with a tugboat and several people were killed. The port officials decided that our friends had caused this collision, but their detailed log proved that they were hundreds of miles away from that location at the time the incident occurred.

A yacht is allowed to stay in Europe duty-free for a maximum of 18 months. Sail over to Morocco and return to Europe and you get a new 18 months. Likewise, if the crew are in Spain for more than 183 days, they become liable for income tax. With Europe being by and large a free-travel zone, passport stamps into and out of each country have become a thing of the past, so your log might well be the only proof that you did not overstay your time. Passports and clearance papers are sometimes not enough. As one official cautioned us, "Sometimes you can never have enough proof."

Will your log actually be believed? The more regular, consistent, detailed, and professional your entries, the more likely it is your log will be accepted.



. . . and the inside pages detail every maintenance task performed and the date.

Our anchor windlass is an example. The aluminum warping drum is mounted onto a steel shaft. Dissimilar metals combined with endless saltwater dunking present a real danger that the drum could become permanently corroded to the shaft. With the drum seized to the shaft, I would be unable to dismantle the windlass for repair and it would become a total loss. After a few close calls, I concluded that to take 10 minutes each year to remove, grease, and remount the drum is good insurance. It helps to be reminded to do it.

The same goes for aluminum cleats fastened to the mast with stainless-steel machine screws. These screws should be removed and re-installed periodically to prevent them from becoming permanently welded to whatever they touch.

When was the emergency watermaker last serviced? What is the expiration date on the flares? When did we last fill the tank for our cooking fuel or end-for-end the anchor rode? The list seems endless. With hundreds of things to maintain, how does one keep track? Time passes swiftly, and the timing of events and routines gradually blends together. Without a written record, these small but vital jobs can be neglected.

Treasured memories

Thanks to our logs, all of our adventures are documented. Now, as we approach the golden years and can manage a little time to sit by the fire, we read the stories to each other. We are reminded of the wind in the sails, the landfalls, and the excitement of arriving in a new port and meeting locals who became dear, lifelong friends. These volumes are real books, not a virtual computer or tablet file. We tried to keep an electronic log, but as we made the same entries, they seemed to disappear. No, we prefer books we can see, touch, feel, and smell . . . complete with the occasional old saltwater stains. Or might they possibly be tears? Our logs remind us of what cruising should be. Each page is a day in the life of *Entr'acte*.

If you maintain a log for your good old boat, it will be a treasure.

Ed Zacko *is a* Good Old Boat *contributing editor. He and Ellen met while playing in the orchestra of a Broadway musical. They built their Nor'Sea 27,* Entr'acte, *from a bare hull and since 1980 have made four transatlantic and one transpacific crossing.* Entr'acte *is now based in Seville, Spain, where Ellen and Ed are happily sailing in and around the Mediterranean and playing in the jazz clubs of Spain, France, and Morocco. When not on board* Entr'acte, *they heave-to in Phoenix, Arizona, where they maintain a busy concert schedule throughout the Southwest U.S. Follow them on www.enezacko.com.*

BY ED ZACKO

The storm trysail

A faithful and forgiving foul-weather friend

Ellen is on top of me! Our legs are entwined! We are lying against the starboard wall of our cockpit footwell. It is horizontal, parallel with the sea, and seawater is pouring over us from the lee side cockpit coaming. Without any warning, *Entr'acte* has been knocked down by a ferocious gust of wind and is on her beam ends, mast and spreaders in the water. To reach the mainsheet is now a vertical climb against gravity and the wind. Finally, one of us manages to let the sheet fly but the line jams. By this time, like a panicked tightrope walker, I am crawling forward through the water along the starboard lifelines, all the while praying for the mainsail to "please blow out" and end this thing. Does anyone actually wish for a sail to blow out? Well, it's not every day that a sailor gets to see his cabintop rising vertically from the sea.

I reach the mast, the reefed mainsail a white leaking roof above me, and release the halyard. Climbing out of the lee against the wind and around to the windward side of the still horizontal mast, I lie flat along it and manage to claw the sail down toward me. Then several things happen simultaneously. *Entr'acte* rights herself instantly, the wind seems to stop completely, and torrential rain begins . . . rain like no one has seen since Noah's flood, not even in the movies.

We drifted under a waterfall, laughing hysterically, just a half mile from the marina and our date with the travel lift. Neither one of us was hurt. We saw no damage, until we looked below. *Entr'acte* was dry and all was absolutely perfect except for an incredible mess in the galley where the sink drain had regurgitated the morning's offerings.

"I guess we should have used the trysail," I said.

Ellen looked horrified. "The last time I saw it, it was rolled up in the bag next to the handhold. Is it still on board?"

I assured her that it was quite safe and dry below . . . ready for storage.

We had broken one of our cardinal rules and paid for it. In my defense, this was our final sail for the season and I had washed and dried our trysail carefully for long-term storage. The wind was a steady 20 knots, but we were sailing in the trade winds in the lee behind Fiji's Big Island, Viti Levu,

For reaching and downwind courses or for heaving-to, Ed and Ellen sheet the trysail off centerline using one sheet for each tack, top of page. The sheets must be long enough to cross over the boom. Lazy-jacks, if fitted, would require them to be longer.

and through sheltered, flat, shallow water. I reasoned that for such a short trip a double-reefed mainsail was quite adequate. After all, it was only 13 miles!

Mystery sail

Flashback to the winter of 1973 when, Thanks to the Arab oil embargo, I was spending the longest winter of my life sitting at home awaiting the delivery of my first boat. Throughout that winter I devoured every sailing yarn I could find: Chichester, Moitessier, Knox-Johnston, Pigeon, and more. The stories were delightful and I absorbed all the lore. But one term constantly eluded me. They all spoke of "the storm trysail." Everyone mentioned it but never explained what it was.

When we built *Entr'acte*, our full-keeled Nor'Sea 27, we still had not unraveled this mystery, but decided that — even though we did not know what a trysail was — if Sir Francis and all the lads carried one, we should have one as well. How we would use it was still unknown. The trysail is still somewhat of a mystery to many sailors.

The trysail is a small storm sail hoisted during heavy weather in place of the normal mainsail. It can be flown by itself or in conjunction with a partially unfurled headsail, a dedicated storm jib, or a staysail. When it's needed, you lower the mainsail and raise the trysail to either carry on or to heave-to while you "go below and smoke your pipe." At least, that's what Captain Voss did.

When I talk about trysails, other sailors say, "I have reefs in my mainsail. A trysail is complicated and not worth the expense and space on board."

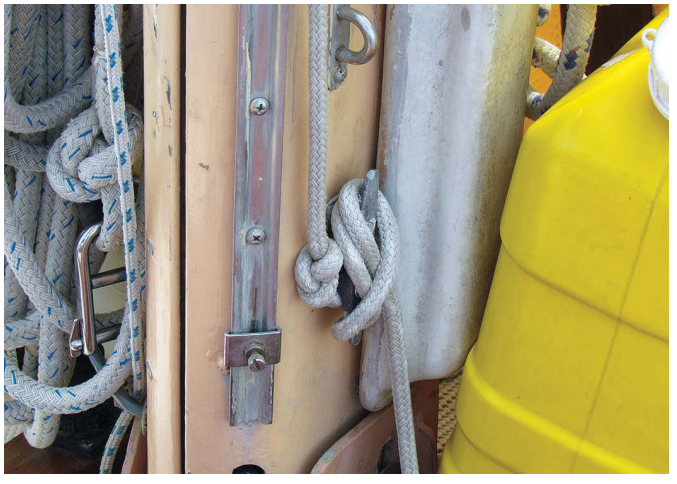
Yes, I agree, a reefed mainsail is fine, up to a point. But look at the mainsail and all we typically ask of it.

The multitasking mainsail

The mainsail is first a light-air sail that spends endless hours slatting and banging in calms while waiting for wind (*see Ed's article on the light-air Mainster, January 2010* –***Eds***.). As the wind fills in, the main becomes a working sail as it begins to pull and drive the boat. The wind increases and we take a reef, then two, and then maybe a third. By now the wind is really howling. The waves are slamming into the boat, the lower shrouds are now working under greater load, and hard water is actually hitting that exposed bit of what has now become a storm sail.

When the wind finally increases another notch we heave-to under the deep-reefed mainsail and, while we are down below praying, a mere corner of the entire mainsail is taking the full force of that wind and sea. It seems unfair and somewhat unrealistic to ask so much of one piece of gear.

Think for a bit about reefing a mainsail. As reefs become deeper, the



***Entr'acte*'s trysail track runs parallel to, and independent of, the mainsail track, upper photo. To ensure the sail will always rise and fall smoothly, the sections were welded together, the joints polished, and the track installed as one unit. The screw heads were chosen so they will not bind on the sail slides, at left, and a stopper at the bottom of the track keeps the slides captive. The tack is attached to a dedicated cleat; the knot determines the proper height for optimum sail shape. One knot is for centerline sheeting and a second knot brings the tack lower for sheeting to the quarter. The track ends just below the spreaders, at right, and the stop at the top is essential!**

shape gradually changes and the mainsail loses efficiency, just when it's needed the most. The very upper part of a mainsail was never meant to be a storm sail. Lin and Larry Pardey's *Storm Tactics Handbook* covers this topic quite well.

Setting a trysail in heavy weather is not only about taking off sail area, it's also about getting rid of the boom. In big seas and strong winds, the mainsail boom becomes a wild beast that flails dangerously, crushing fingers and slamming into heads with stunning force. A boom well lashed down into a gallows becomes a source of security rather than a liability.

When you reef the mainsail, you do not reef the boom. The sail may get smaller, but the boom remains the same length. On a reach or a run in large seas, the boom is a very long lever that induces rolling. As the boat enters the trough between waves and rolls to leeward, the boom drags in the water and, if vanged down as it should be, poses a very real danger of snapping or causing a broach.

One day, after offering the above advice to someone, I decided that perhaps I had been a bit too dogmatic about this business of eliminating the boom and decided to test my theory. The Fiji trades were well established and blowing upward of 20 knots. Rather than fly the trysail, I elected to tie in my deep reef. It would be a good and simple experiment. Besides, it was only 30 miles to the next harbor. *Entr'acte* took the bit in her teeth and was off like a shot. As we came out from behind the barrier reef into open water, we were beam-on to the waves and the excitement began. Within five minutes, I knew I had been right all along. *Entr'acte* rolled boom down. Then she rolled upward, giving the boom a good wind-up lead to pull us down again . . . which it did. By the third roll, the boom was dragging in the troughs, pulling against the preventer. We were really flying, but not at all comfortable . . . not with the wild motion or the anxiety of watching the boom dip into the troughs on the roll. I was pleased to realize that I was not crazy after all.

"Well, we're not doing this again anytime soon," I said and off I went to the mast. In less than two minutes, the trysail was drawing and the roll had ceased. *Entr'acte* accelerated and found her groove. We continue to agree that eliminating the boom is one of the most positive moves you can make in severe conditions.

No matter which reefing system you employ, reefing is a process and is not automatic. To tuck a reef into a mainsail when it's blowing 12 to 15 knots is rather easy and good sport. You feel like a real sailor! Between 15 and 20 knots, it can be a bit of a challenge and now you feel like a hero, especially if you are Mrs. America doing the reefing while Mr. America is asleep down below. Beyond 25 knots, that third reef can be a real bear in the seas and wild motion that accompany such wind. It isn't fun anymore; what was once good sport is now downright dangerous, particularly at night. On my watch, I can have the trysail raised and drawing and be into a cup of coffee far faster than I can set up a third reef in the mainsail.

Be Walter Mitty for a moment and imagine setting that deep reef in 30 knots and above. In 30- to 40-knot winds I would never *ever* have the mainsail raised — no matter how many reefs — especially if the wind is aft.

Enter the trysail

The trysail offers several distinct advantages over a deeply reefed mainsail.

First – It is a simple solution and fast. Down main. Up try. Done! This is an over-simplification to be sure, but if you have the proper setup and are proactive, it really is simple. Designed specifically as a heavy-wind sail, it is well up to the task and saves your precious mainsail and rig from needless extreme wear and tear.

Second – The mainsail's vast amount of wet sailcloth is rolled up tight and lashed to the boom. Securely out of the way, it does not collect water that could destabilize the boat.

Third – It removes the boom from the equation. This makes it very different from a "Swedish mainsail," which is basically a storm mainsail that looks like a regular mainsail but is much smaller, has no battens, is cut to have some draft, and needs the boom to function properly.

Fourth – The trysail provides a safe option of setting a substitute mainsail without the constant fear of an accidental gybe that can dismast your boat.

Fifth – With the trysail set, you can carry on with much less worry. If you desire to heave-to, just furl your headsail, put down the helm, and allow the boat to settle in.

Trysail construction

The Sailrite book, *Stormsails: Their Design & Construction*, states that because the trysail is so small, it need not be made out of inordinately heavy cloth. It recommends using the same weight cloth as your mainsail. It is a very simple sail, basically a small triangle cut flat with very little draft; a bit more reinforcement at the head, tack, and clew; and extra tabling along the luff, leech, and foot. You could easily make a trysail yourself if you have a machine capable of sewing multiple layers of sailcloth.

The shape of the triangle is what is unique. The odd shape is designed to keep the center of effort low and close to the mast to reduce heel and not induce excessive weather helm. With no belly in the sail, in very strong gusts the wind just slides off the sides of the sail, lessening the chance of a knockdown.

Entr'acte's first trysail was 7.5-ounce cloth and served admirably for years. Upon replacing it, we took

The trysail lives on deck hanked on to its own dedicated sail track and ready to hoist at a moment's notice, at left. When they need it, Ed and Ellen hoist the trysail directly from the bag, at right. The sheet is marked and pre-trimmed to prevent the sail from flogging wildly.

the advice of the Pardeys and had the new one made from storm-orange material for better visibility in large seas. This was a great move. However, storm orange comes only in 9-ounce and 12-ounce weights. Thus, *Entr'acte*'s new 9-ounce trysail is quite heavy relative to the size of the boat. When new, it was quite stiff and repacking it after use was like wrestling with sheet metal. Eventually, as it softened, it became more compliant.

I have heard discussions about incorporating reef points in the trysail. On the surface it seems like a good idea, but I cannot imagine going to the mast in terrific storm conditions, lowering the sail, tying in a reef, and hoisting the sail again. The moment that sail comes down you immediately lose whatever benefit and safety it provides. If you are hove-to under trysail, the moment you lower the sail to reef it, you will no longer be hove-to but lying a-hull, absolutely the most dangerous position to be in under those conditions. I say that if your trysail is sized properly to your boat, there should be no need to reduce sail further.

Trysail track

The trysail must have its own dedicated sail track and sheets. Period. Having to remove the mainsail slugs from the track and feed trysail slugs into that same track in heavy weather is a needless complication. The sail should live on deck in an easy-to-open bag, its slides attached to its own track, and ready to hoist directly from the bag, like a parachute. We have violated this rule twice over the years and both times we have paid the price.

Sail track is sold in 6-foot lengths. It is absolutely vital that these sections meet perfectly to eliminate any possibility of snags when hoisting the trysail. This is difficult to achieve and especially so when installing the track from a bosun's chair. To ensure a fair run, the sections should be welded together, all the joints ground smooth and polished off site, and the track installed as one continuous length.

The trysail track runs parallel to the mainsail track and is typically fastened to the mast with either stainless-steel pop rivets or tapped machine screws. The track should begin about a foot above the coachroof and extend to a point just below the spreaders. The track and fastenings should be installed with appropriate bedding compound.

Be advised that the standard pop-rivet tool is hopelessly inadequate for the installation of even one stainless-steel rivet! The appropriate tool can be rented cheaply from most tool rental companies. Avoid aluminum rivets as they will eventually corrode and fail — at an inopportune time. If using machine screws, make certain that the screw heads do not jam against the sail slides.

Sheeting arrangements

When we first took delivery of our trysail, I asked the sailmaker how to lead the sheets. He replied, ". . . attach the clew to the boom and use your mainsheet or . . ." (I love this one!) ". . . just tie the sheet to a handrail someplace." I pictured our beautiful newly cut teak handrails, through-bolted as they were, being mercilessly jerked and attacked by a wildly flailing sheet. Even with my lack of experience at the time, I knew better than that.

We tried the clew-to-the-boom idea and it almost cost me my life. One dark night in a Gulf Stream squall, we hove-to under trysail and for safety lashed the boom down into the gallows. All seemed well enough until a ferocious gust hit, knocking *Entr'acte* well past 50 degrees. The sudden force of the wind against the sail caused the boom to stretch the lashings, leap from

Resources

Stormsails: Their Design & Construction by Jim Grant is part of the Sailmaker's Library from Sailrite.
www.sailrite.com

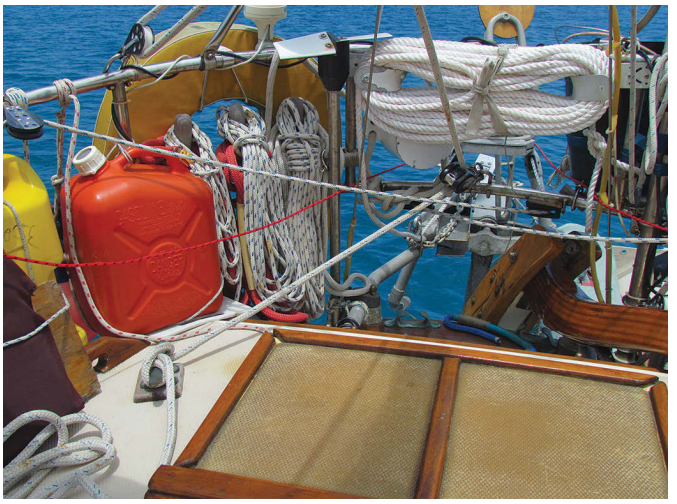
After Fifty Thousand Miles
by Hal Roth

How To Sail Around the World
by Hal Roth

Storm Tactics
by Lin and Larry Pardey (book and DVD)

For storm avoidance
A Sea Vagabond's World
by Bernard Moitessier

Mariner's Weather Handbook
by Steve and Linda Dashew
(This is the finest weather book we have ever read.)



The block for the single trysail sheet used for centerline sheeting is mounted on the center of *Entr'Acte's* stern rail, at left. The sheet leads through the block to a dedicated trysail cleat. The sheet is marked for "pre-trimming" the sail so it doesn't flog wildly while it's being hoisted. Blocks on either quarter are used for sheeting the trysail off centerline (to a dedicated cleat), at right, and also for a spinnaker.

the gallows, and travel just far enough to slam me on the side of the head, driving me down to leeward.

It was one of those "movie moments." *She reached for me, I reached for her. Our fingers brushed just out of reach and, as the lightening flashed, our eyes locked and I was gone!* The starboard lifelines saved me, but it was a drop of 4 feet to those lines and an extremely painful experience. I had two cracked ribs, but remained on board.

The trysail should *never* be attached to the boom. In these conditions, the boom should never be under load.

On *Entr'acte* we employ two sheeting arrangements, depending on our heading and conditions: one at the centerline and another on either quarter. Centerline sheeting requires only a single sheet and allows the boat to be sailed on either tack. Sheeting to the quarter requires one sheet for each tack but offers better sail control when far off the wind. For heaving-to, we have used both, depending on conditions and how *Entr'acte* was behaving at the time.

We added an extra cleat on the cabintop and coaming dedicated to the trysail sheet. The sail lives in the bag, hanked on. The sheet is stowed on a pinrail at the stern pushpit next to a permanently mounted block. To raise the try, we lead the sheet through the block and cleat it at a pre-marked position. We then carry the other end up to the bag, unzip the bag, and attach the sheet to the clew with a bowline, drop the main, switch the halyard from the mainsail to the try (the most difficult part), and hoist the try. Because it has already been "pretrimmed," there is no flogging. We make all final trim and course adjustments from the safety of the cockpit.

Flying a trysail

Experience has led us to conclude that a trysail is not a "survival sail." Rather, it is, or should be, a fundamental part of a cruising boat's sail system. We employ it regularly as an alternative to deep reefing. It is not at all unusual to see *Entr'acte* sailing along between thunder squalls under trysail and full genoa. When the next squall approaches we simply roll in the genoa, scoot along under trysail and, when the big wind has passed, unfurl the genoa and carry on until the next go-round. It looks kind of dumb, but it works. If we had used this procedure that day in Fiji, we would never have been knocked down and thus would have had no opening paragraph for this article.

Where does the trysail fit into our reefing program? *Entr'acte*'s mainsail carries three sets of reef points and they are used as follows:

The first reef – We tie this in when the wind gets to 12 knots to keep the steering gear happy. If we are hand-steering, we wait until 15 knots.

The second reef – This usually goes in at 20 knots. Whenever the second reef is tied in, we watch the conditions carefully. If all seems stable, we leave well enough alone. If we are thinking about this reef and night is approaching, however, or we think we might want a further sail reduction, up goes the trysail and that's that. That day in Fiji was at the end of the season and the trip was short. We let down our guard and paid for it. Lesson learned.

The third reef – This is our emergency get-home reef in case, say, an upper shroud let go, the mast broke above the spreaders, and we need a mainsail to make safe harbor. We have also used this reef when running dead downwind wing-and-wing in the trades.

The trysail can be easily hoisted in any wind, on any point of sail, and in any conditions — but you must be proactive. Remember the old adage on reefing: "If you are thinking about reefing, it is past the time to do it."

Hoisting a trysail is easy. Getting the mainsail down in heavy wind is the problem, especially if you're running dead downwind and the sail has full-length battens. Wait too long and you have a tough, sometimes dangerous, fight. Hoist your trysail as part of a sailing plan, not as a matter of survival. Ellen and I are "set it and forget it" people. We like to implement a solution early and relax knowing that the hard work is done. We save the heroics for when we must perform them.

We are not racers. We are "mom and pop" trying to sail our little plastic boat to the best of our abilities. We like to have *Entr'acte* sail well and to

When sheeted on the centerline, the trysail sets a little higher on the mast to obtain optimum sail shape. Ed and Ellen set the sail in this position in moderate wind conditions. The boom can be lashed securely either in the center notch of the gallows or to either side, depending on the requirements at the time.

make smart passages, but the safety of the vessel and the crew comes first, comfort of the crew comes next. Our goal is to arrive, to arrive safely, and to arrive well-rested — ready to party! All other considerations and tactics are subordinated to these goals.

The name of the game is *plan ahead*. Anticipate conditions and set up for them in advance. If employed properly, the trysail takes a tremendous load off of your mainsail, your rig, and you.

Ed Zacko is a Good Old Boat *contributing editor. He and Ellen met while playing in the orchestra of a Broadway musical. They built their Nor'Sea 27,* Entr'acte, *from a bare hull and since 1980 have made four transatlantic and one transpacific crossing.* Entr'acte *is now based in Seville, Spain, where Ellen and Ed are happily sailing in and around the Mediterranean and playing in the jazz clubs of Spain, France, and Morocco. When not on board* Entr'acte, *they heave-to in Phoenix, Arizona, where they maintain a busy concert schedule throughout the Southwest U.S. Follow them on www.enezacko.com.*

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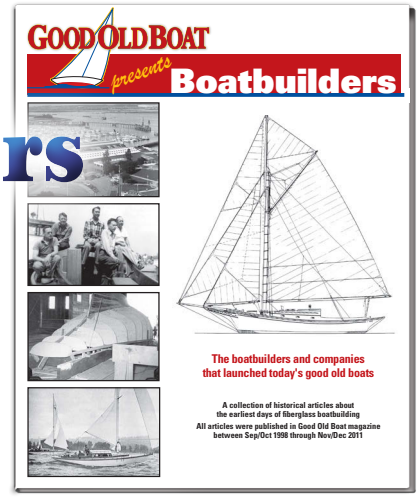

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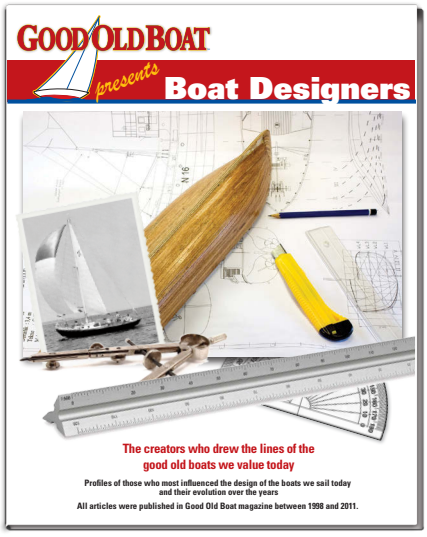

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Roll, roll, roll my boat no more

A flopper stopper makes untenable anchorages amenable

BY ED ZACKO

We were anchored in Resolution Bay on the island of Tanna, Republic of Vanuatu. Although we had arrived only that morning and had just had lunch, our friends were busily preparing to leave.

"This anchorage is awful! We're rolling so much we can't sleep or eat," John said, "We have to try someplace else."

"John, there *is* no place else," I told him. "If we want to climb the volcano, this is where we have to be."

On a chart, Resolution Bay appears to be completely protected from ocean swells, but if the wind has the slightest northerly component, as it did that day, a very slight swell finds its way around the point and ricochets into the harbor. There was another unsheltered anchorage 6 miles away. If this one was bad, that one would be impossible. Besides, the walk from there to the volcano would be far too long.

In fact, we had not encountered five surge-free harbors throughout our entire Pacific voyage, or so it seemed. On this day the swell, while almost imperceptible to the eye, was causing every boat in the anchorage to roll severely. Every boat but *Entr'acte*, our Nor'Sea 27.

Entr'acte rose gently as each swell passed beneath her almost unnoticed. Thanks to our flopper stopper, Ellen and I were quite comfortable. It had taken us a long time to develop and refine this indispensable piece of gear, and it was certainly earning its keep that day.

Roll-damping devices have been around for centuries. They are simple baffles that, when hung from the boat, resist being lifted through the water and thus dampen the roll. We could have purchased a flopper stopper, but we could not bring a commercially made one on board. The deterrent was not cost but, rather, size and weight. The lightest damper we could buy was made of aluminum and weighed 15 pounds. It made all sorts of noise as the baffles opened and closed and it was too large to stow on our little plastic boat. Even the milk-crate design Lin and Larry Pardey described in *The Self-Sufficient Sailor* was difficult to stow.

The trigger

The day comes to all sailors when, for any number of reasons, their idyllic anchorage or mooring is no longer tranquil and their good old boat's roll throws them out of their comfort zone. Things came to a head for us in Black Point, Bahamas, when we rolled for three nauseatingly vile days waiting for the Police Force Band to perform. Every boat in that otherwise wonderful anchorage rolled horribly as, for no apparent reason, a surge had found its way around to the back side of the cay and into what appeared to be a secure all-weather anchorage. Half an hour after the band completed its performance, we were gone. We were far more comfortable at sea than we had been in that harbor.

When we departed, we left with a plan. We would develop our own flopper stopper.

Cost was not a factor. Our requirements for our flopper stopper were in this order:

- It had to work.
- It had to be light, compact, and stowable in a minimum of space.
- It had to be fast and easy to deploy.
- We had to have it immediately.

We set to work. The entire project took less than 3 hours to complete. When not in use, our flopper stopper takes less than 1 inch of vertical space and can be stowed invisibly on top of the coachroof under the dinghy.

***Entr'acte* lies quietly to her anchor even in the presence of a swell, main photo, thanks to the simple contraption Ellen is displaying that she and Ed made largely from materials they had on board.**

Construction materials

We didn't have to look far for materials. With the exception of the PVC sheet that we added later, we assembled our flopper stopper from bits and pieces we found on board.

One plastic milk box or bottle crate – Milk boxes come in various sizes, the most common being 13 x 13 inches. Bottle crates measure 13 x 19 inches. Our measurements reflect the use of the 13-inch-square box, which proved quite adequate for 27-foot *Entr'acte*. A larger boat might need the larger crate. Adjust your measurements and the number of fasteners to suit your box.

The condition of the sides is unimportant; you'll use only the bottom, which must be sound and without cracks.

Robust fabric – A sufficient amount of fabric for four 13- x 9-inch panels for the sides and two 11- x 9-inch panels for the flaps. We used scraps of Top Gun fabric left over from the dodger we'd constructed. Dacron sailcloth is also a good choice. Allow for a hem around the perimeter. If you don't have access to a sewing machine, you can seal the edges of sailcloth with a hot knife. It might not be elegant but it will work.

PVC sheet – Two 10½- x 8-inch pieces of ⅛-inch-thick PVC for use as flap stiffeners. We did not use PVC sheet in our original version because we did not have it on board at the time. Cloth flaps worked well enough, but we could see that stiffening the flaps would be a definite improvement.

Fasteners – You need 16 10 x 24 stainless-steel machine screws with washers and Nyloc (nylon-insert) nuts and four 1-inch-diameter stainless-steel fender washers with 5⁄16-inch holes.

Spur grommets and cutter and die – Eight #2 spur grommets and 16 #0 spur grommets. You can build and use a flopper stopper without the grommets if you are truly desperate but the sides will last much longer with grommets.

Nylon line – You need approximately 12 feet of 5⁄16-inch nylon line. Nylon acts as a shock absorber and is preferable to Dacron or polypropylene as it holds knots better and can be more easily stowed.

Weight – A dinghy anchor or 6 pounds of divers' weights.

Sewing kit – Sail twine, needle, and palm.

Resources

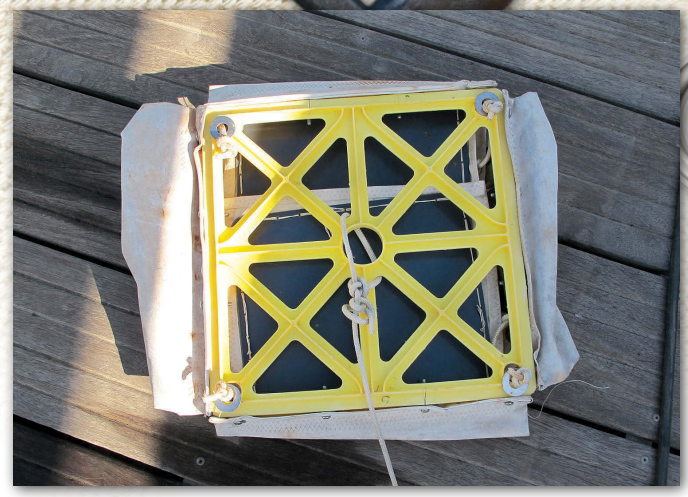
McMaster-Carr
PVC Sheet, Product Number: 8747K112
www.mcmaster.com

Sailrite
Grommets, grommet tools, Top Gun fabric, and sailcloth
www.sailrite.com

Machine screws passed through grommets secure the canvas sides to the milk crate base, at top.

Two canvas flaps on opposite sides control the outflow of water as the flopper stopper rises, middle.

The flopper stopper is suspended from two equal lengths of line doubled, then tied to form a loop and four ends, at left.



The support lines pass through the milk crate base and are knotted beneath it, above. Fender washers spread the weight.

To first set up the flopper stopper, the knots on the four support lines must be adjusted so it hangs level and the sides are able to open fully, at right.

Stiffening the flaps with PVC sheet improves the way the flopper stopper functions, below.

Construction

Cut the bottom off the box and discard the sides. Sew four simple 13- x 9-inch rectangles for the collapsible sides and two 11- x 9-inch rectangles to serve as internal flaps. Set a row of brass #0 spur grommets along the bottom of each of the sides (for attaching the sides to the milk crate bottom) and a #2 spur grommet into the upper corner of each side.

Attach the sides – Do not sew the sides together to make a watertight bucket. You want the water to flow out freely through the corners, dampening your roll.

Using the grommets as reinforcement for the canvas, attach two opposite sides to the bottom with the machine screws, washers, and nylon-insert nuts.

Attach the flaps – Sandwich the flaps between the other two sides and the base of the box. Grommets are not necessary on the flaps as they are not used for lifting.

Suspension loop – Begin with two equal lengths of 5/16-inch line and double them. Tie the doubled ends together to form a loop and tie a figure-eight knot in each of the four resulting lines about 12 inches from the end (you will adjust these later). Pass a line through both grommets at each adjoining corner and tie a second figure-eight knot just under the "lower" grommet on each corner. If placed properly, the knots will fully extend the sides to open the "bucket" while allowing water to flow out freely through the corners.

Bottom – Pass the ends of the lines through the corners of the milk crate bottom. Slip a stainless-steel fender washer over the end of each line and tie a final figure-eight knot under the bottom at each corner. The washers take the load.

Adjust – Suspend your flopper stopper and adjust all the knots so it hangs level and the sides are completely extended. It needs ballast. Two 3-pound divers' weights or a small dinghy anchor suspended from the bottom should be adequate.

Improved flap – Originally, our flaps were just fabric. This worked reasonably well but they tended to collapse when in use. A rectangle of 1/8-inch PVC sheet hand-sewn to each flap provides more rigidity.

The pole needs a topping lift, a foreguy, and an after guy, at top. The flopper stopper is suspended from the trim line, which leads via a snatch block to the deck where it is adjusted and made fast.

Theory of operation

The flopper stopper is not a watertight bucket. The idea is not to lift the water, but rather to use a controlled flow to slow the boat's motion. Trying to lift any volume of water will induce needless stress on the lifting rig and actually increase your roll.

As the boat rolls, the device rises and the flaps close to restrict, but not trap, the flow of water that flows freely through the four corners where the sides would normally meet. The horrible gunwale-to-gunwale roll is damped and converted to a more gentle, predictable, and tolerable up-and-down motion which will be restricted to the actual height of the swell or wave.

Deploying the flopper stopper

The first time you use the flopper stopper you will have to make a few adjustments to get it working just right. It needs a few pieces of rigging:

- Trim line with snap shackle attached
- Foreguy
- After guy
- Snatch block or single block with a snap shackle
- Boom, or a spinnaker or whisker pole with a topping lift

Attach the trim line to the eye of your flopper stopper. Lead this line through the snatch block. Attach the snatch block to the end of your pole or boom. Adjust the topping lift to set the pole parallel to the water and swing the pole abeam until it is perpendicular to your hull. Cleat the foreguy and after guy to maintain that position. If you run the after guy through a genoa lead block and position the car just right, this line will also act as a vang.

Launch your flopper stopper and adjust the trim line for the device to cycle from just below the water at rest to just above the surface at maximum rise. You do not want the device to lift completely out of the water and splash around; it only needs to break the surface and drain.

Life aboard will be a little quieter if you tie the lines to the pole with bowlines instead of using shackles. Once you have the flopper stopper properly adjusted, mark the lines to speed up deployment on future occasions.

Prudence dictates attaching a light to the end of the boom for overnight use.

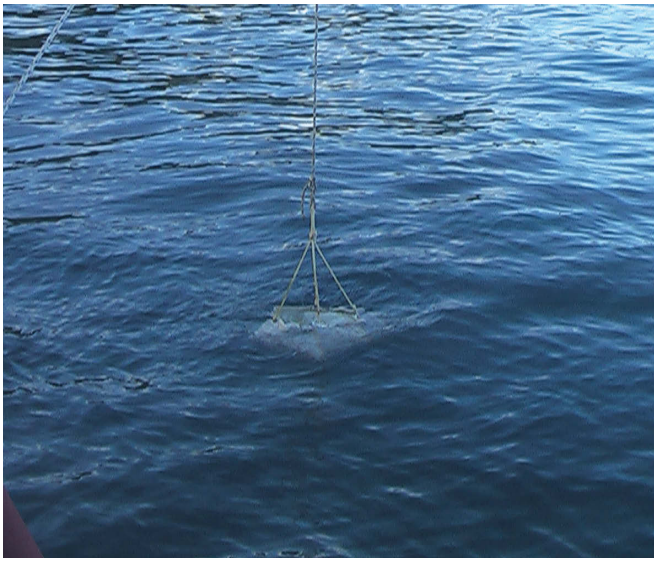
Suddenly steady

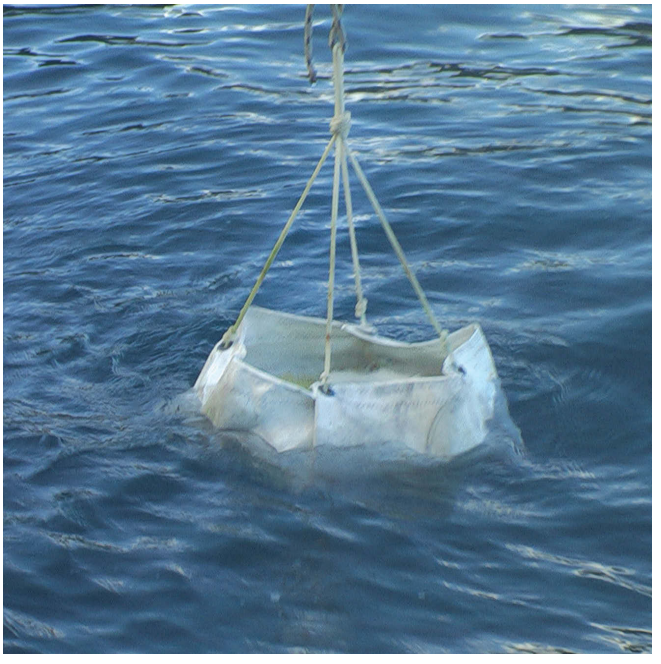
The first time we deployed our flopper stopper the effect was instant. Even before we had trimmed it properly, it had calmed the wild roll into a gentle up and down motion with a reduced and dampened sway that our bodies could adjust to.

We have found no evidence whatever of stress on the mast, rig, or boat while using our "comfort machine." After 15 years of duty, our good old box is beginning to show signs of stress cracking. The time for replacement is near.

Flopper stoppers are not just for those who cruise to far-off Pacific Islands. We have used ours in Chesapeake Bay creeks, Long Island Sound, the Intracoastal Waterway, the Bahamas, and the Hudson River. There is no reason to be chased out of a beautiful anchorage by an unruly swell. When we start rockin' and rollin' we know relief is only minutes away. Black Point, here we come!

When the boat is at the bottom of the surge, the flopper stopper should be just beneath the surface, below. At the boat's maximum rise, only the top few inches should leave the water, lower photo. Water is able to flow freely through the open corners.





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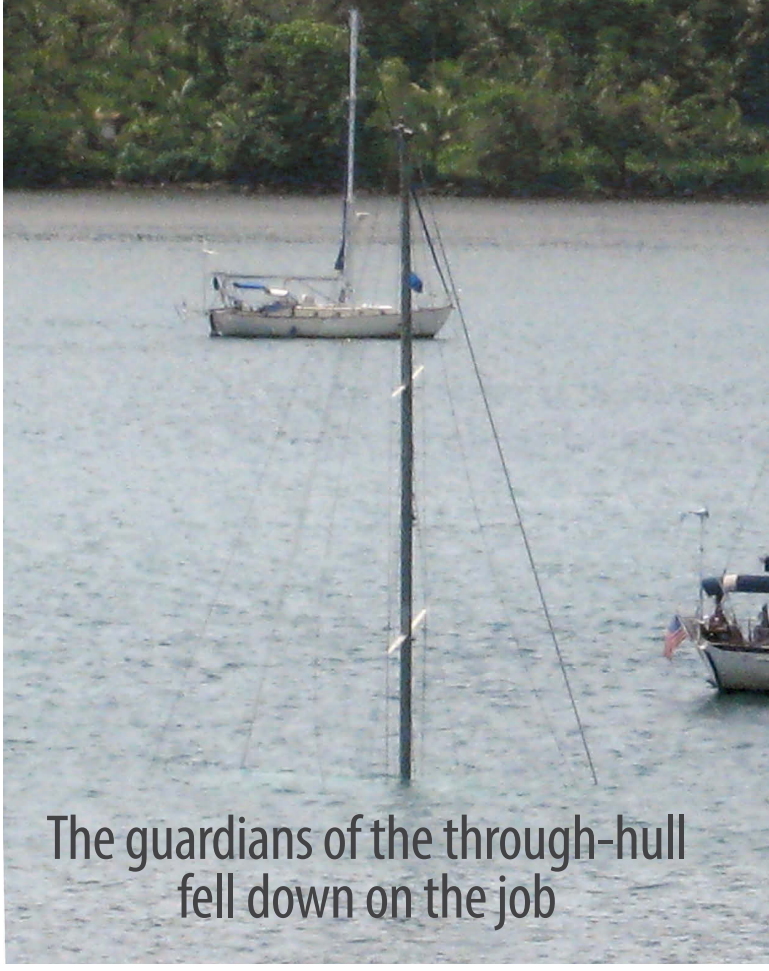
Battling with ball valves



The guardians of the through-hull fell down on the job

Fifteen years of world cruising and my wife, Ellen, and I were now gliding along the Sassafras River on Chesapeake Bay's Eastern Shore aboard our Nor'Sea 27. It was good to be home. After tying *Entr'acte* securely in the marina and closing all the seacocks, we hit the road to reunite with family and old friends.

Upon our return two weeks later, I went to re-open the seacocks. Every valve turned smoothly as always, except for one. It would not budge. Tired after the long trip, I decided that, despite the inconvenience — it was the seacock on the head intake — I would deal with it the next day.

For two solid days, I experienced the sailor's version of hot yoga, contorted into shapes and positions beyond all recognition as the Bay's infamous August heat and humidity took its toll. I tried hammers, levers, and every trick I'd ever learned, but I failed to open the seacock. It was as if it was filled with epoxy. I continued battling that valve but gave up after two weeks and we hauled *Entr'acte* two months before we'd planned to.

Fast forward to Arizona, 2016. *Entr'acte* has been hauled across the continent and is stored close to our home, her planned refit well under way. The first job on my list was to remove that seacock and find out what happened. I secured it in a large vise, but no amount of coaxing would move that handle.

This would now be the *third* time this seacock had failed in 15 years. But why this seacock and not any of the other four on *Entr'acte*?

Good intentions

When we built *Entr'acte*, before the advent of ball valves, we installed five of the finest tapered-cone bronze seacocks available.

One month before our launch date, we read with horror an article about "the hazards of the tapered seacock," how it was going to seize solid to become inoperative and tear itself out of the hull when we tried to close it in an emergency. The author admonished everyone to replace these dangerous fittings with the new latest-and-greatest ball valves that were not prone to such catastrophy-causing failures.

Despite having already spent a ton of money, we immediately ran in search of these new lifesavers. They were not to be found anywhere. The hype had evidently outpaced the supply. Dejected, we launched *Entr'acte* and put to sea with the promise that we would install "proper ball valves" at the first opportunity.

Five years and 13,000 miles later, we returned home with all five seacocks still in perfect working condition. We did not sink even once! So much for the horror stories.

When we undertook a subsequent interior alteration, we needed to relocate the head seacock and . . . yes, we replaced that beautiful still-functional tapered-cone seacock with a new ball valve. It boasted a bronze body, a stainless-steel ball riding on Teflon seats, a stainless-steel shaft, and a steel handle. Steel?

We hated it from day one. It was horribly stiff; a real chore to open and close. The manufacturer insisted this was normal and no, unlike our tapered seacocks, handle tension could not be adjusted. Throughout our next long voyage, opening and closing that valve was a burdensome task. Ellen simply could not operate it. Had I become incapacitated when closing that valve

Ed tried ever-longer levers in his attempts to open the ball-valve seacock, but to no avail. He had to disassemble it.

BY ED ZACKO

The submerged mast belongs to a boat that was left on a mooring with all its seacocks open, at left. The old and worn sink-drain hose developed a leak while the boat's owner was on a two-week trip inland to a rain forest.

was paramount to survival, *Entr'acte* would now be on the bottom.

Three years into the voyage, the steel handle broke off and I adapted the bronze handle from the late tapered-cone seacock. At the six-year mark, without warning, the valve refused to close. One day it closed smoothly as always, and the next time I tried to close it, the handle and shaft merely spun in a circle leaving the ball immovable. The only replacement we could find was another ball valve.

Several years later, halfway across the Pacific, we were launching after a haulout when the bilge pump activated. Water was leaking profusely through the shaft of the ball valve. I tightened what was supposed to be a packing nut to no avail. During the long layup, the stainless-steel ball and shaft had become so corroded that water flowed past the ball and into the boat via the shaft, even with the valve closed. Had *Entr'acte* been laid up afloat with all the seacocks closed, she would have sunk. We aborted our launching and replaced the valve with yet another ball valve. Considering where we were, I felt lucky to find a valve of any kind.

And now, here we were again, fighting the third "battle of the ball"! What, exactly, had happened?

Insidious corrosion

All three ball valves failed due to the corrosion of stainless steel used in an oxygen-absent environment and in the presence of seawater. Placing stainless steel in an oxygen-absent environment is like giving Kryptonite to Superman. With no oxygen present to maintain its protective oxide coating, stainless steel gradually corrodes, in this case accelerated by the presence of chloride ions in seawater. The metal appears to be superficially perfect until, struck with something hard or stressed in some way, it breaks into pieces.

Studying the ball in the latest offender, I noticed a spiderweb of tiny cracks. I disassembled the valve and was stunned by what I saw.

When I last closed this valve, the ball rotated in the direction of the crack flow. When I attempted to open the valve, the ball rotated against the crack pattern while the rotating shaft imparted a wedge action on the ball, forcing the pieces apart to jam tightly against the Teflon seat. The more force I applied, the tighter the ball became. Disassembling the valve released the pressure, and what used to be the ball easily fell out into my hand.

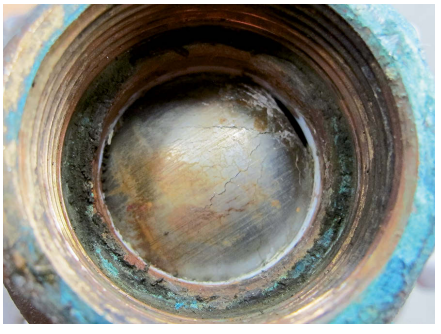
What is a seacock?

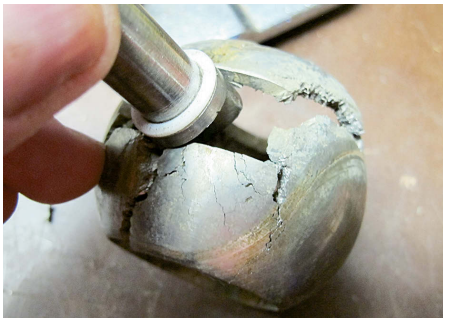
A seacock is a valve attached to a through-hull fitting. When open, it allows water to pass into or out of onboard systems. When closed, it is the barrier between your boat and the sea. Every through-hull close to or below the waterline should be fitted with a seacock.

Not just any valve is suitable for use as a seacock (see "Valve Varieties," page 42.) To be acceptable to the American Boat & Yacht Council and marine insurers as a seacock, the valve and its installation must meet certain manufacturing standards.

The threads on all through-hull fittings are National Pipe Standard (NPS). A valve designed as a "marine seacock" uses NPS threads that will mate properly with through-hull fittings. The inboard port might have either NPS or NPT threads, depending on the manufacturer and the model.

The threads on all gate valves and on all ball valves not specifically designed as seacocks are National Pipe Tapered (NPT), which, when connected to other NPT fittings, become tighter as the pieces are screwed together. NPT and NPS threads should *not* be





When he began to disassemble the ball valve, Ed could see fine cracks in the stainless-steel ball, at left. When he extracted the ball, it fell apart, center. Ed thinks that turning the stud strained the weakened ball, forcing it apart to jam inside the body of the valve, at right.

mixed. The two fittings will indeed fit tightly together, but water will always weep between the fittings, even when the valve is closed. Because of the thread mismatch, the parts will become very difficult, perhaps impossible, to disassemble, especially after a period of several years.

To qualify as a marine seacock, the valve must be made out of the highest-quality and strongest marine-grade corrosion-resistant material. Bronze alloy 85-5-5-5 has always been the standard, although some seacocks today are made of high-strength plastic composites.

Valve varieties —EZ

Three basic types of valve are used to control the flow of liquids: gate valves, tapered-cone valves, and ball valves. All three valve types can be found in any plumbing supply, hardware store, or marine chandlery. They are available in various grades of stainless steel, brass, bronze, or plastic. All have appropriate applications.

Gate valve

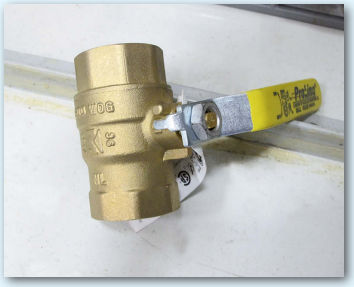
Gate valves are used throughout the plumbing industry. In the 1970s, many boatbuilders used bronze gate valves as seacocks. How wrong they were!

Gate valves are extremely prone to corrosion, stripping, and jamming, and opening or closing them takes several turns of the handle. The American Boat & Yacht Council (ABYC) has long disqualified gate valves from use as seacocks, but they still abound on older boats. Regardless of quality, gate valves have no place on board a boat. Any competent surveyor will tell you they are not safe.

Tapered-cone valve

The tapered-cone design eliminated all the problems of the gate valve and for more than 100 years was considered the safest for seacocks.

A tapered-cone valve has only two major parts: a tapered plug that fits perfectly into the tapered opening of the body and a nut that draws the plug into the body to create a watertight seal. It has no threads to strip or gates to jam and requires a mere quarter turn to perform its function. If adjusted properly, greased annually, and operated regularly, a tapered-cone valve will last for decades and will not leak whether open or closed.



Ball valve

Inside the body of a ball valve, a ball rotates on Teflon seals. The valve opens and closes completely with only a quarter turn. Ball valves represent a quantum improvement over the gate valve for boat plumbing systems and have become the standard of the boating industry.

It's best if the valve has a broad mounting base that allows the seacock to be through-bolted directly to the hull. The base, set on a backing plate, spreads the load against the hull and also prevents the valve from rotating during use and maintenance. The through-hull fitting is screwed into the mounted valve. It is not considered safe to rely on the through-hull fitting as the sole means of attachment to the hull.

The valve must have NPS threads to correctly accept the through-hull and must require only a quarter turn of the handle to open or close completely.

Whether tapered-cone or ball valve, if a valve lacks any of the above features, it will not be safe for long-term use below the waterline as a seacock.

Seacock savvy

Seacocks, perhaps the most important fixtures on a boat, seldom receive the attention they require. Often, they are installed in inaccessible places, left open and ignored for years until the day a rodent eats through the sink-drain hose, a clamp or pump fails, or a cheap brass fitting finally succumbs to de-zincification (corrosion) and the boat heads for the bottom. If anyone happens to be on board at the time, a simple quarter turn on the seacock will prevent disaster — if that seacock is readily accessible, the valve, of whatever type, has not seized solid from years of neglect, and the handle or the entire valve does not break off.

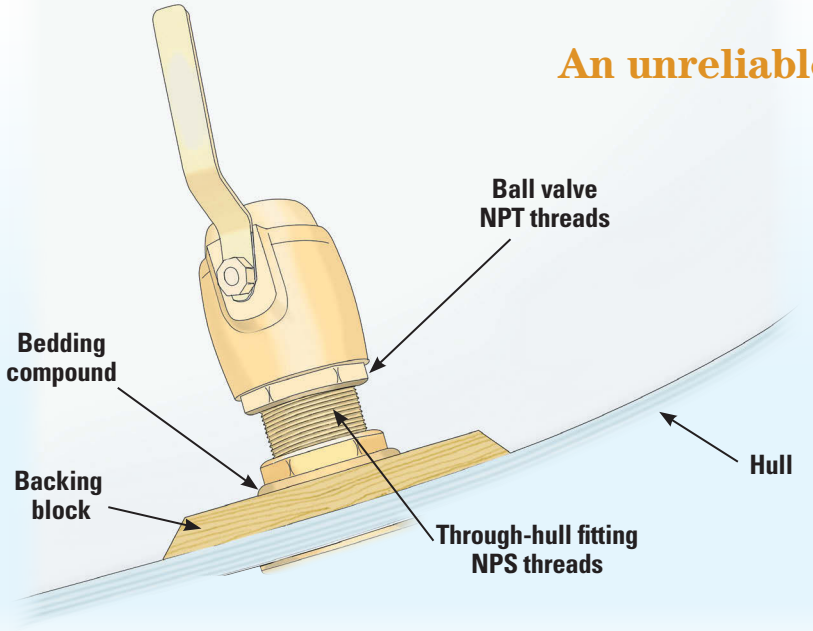
A one-inch-diameter hole one foot below the waterline, such as a small engine intake, will pass 150 gallons per hour, and a bilge pump will only function until the batteries give out. This is not the time to learn that your insurance policy does not cover loss due to rodent damage or corrosion.

Every boat owner needs to know how many seacocks the boat has, where they are located, and what type they are, and should convey that information to everyone on board. A prudent owner will also test the seacocks regularly to ensure they are functioning properly.

Seacock maintenance

Seacocks live in an extremely hostile environment and should be scheduled for regular maintenance. Every two years, we disassemble, clean, grease, and adjust our seacocks so they work

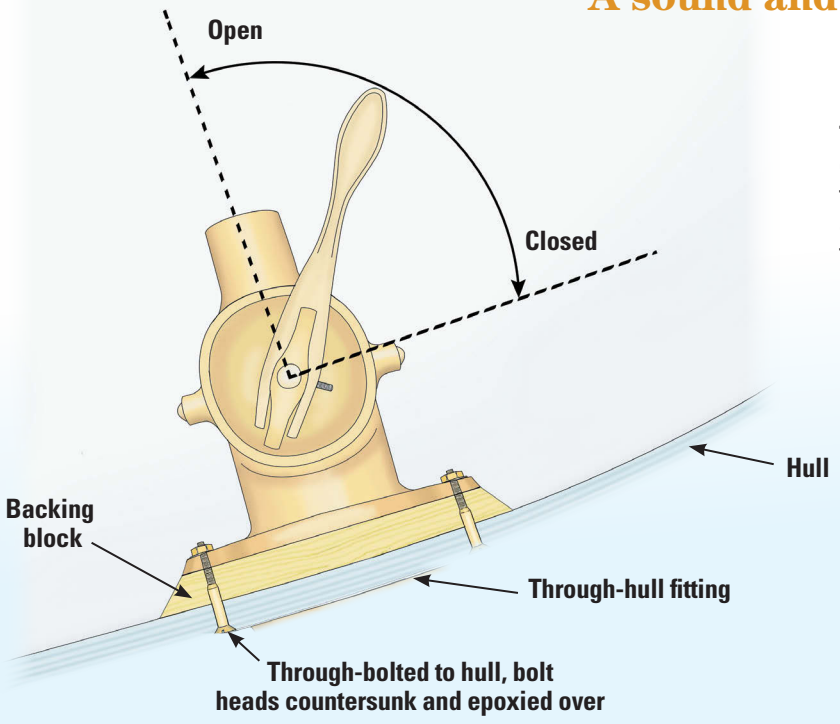
An unreliable installation



Using a ball valve with NPT threads on a through-hull fitting with NPS threads is not an acceptable assembly for a seacock. Also, in this seacock installation, the valve is supported by the through-hull fitting only, and is not fastened directly to the hull.

ILLUSTRATIONS BY FRITZ SEEGERS

A sound and reliable installation

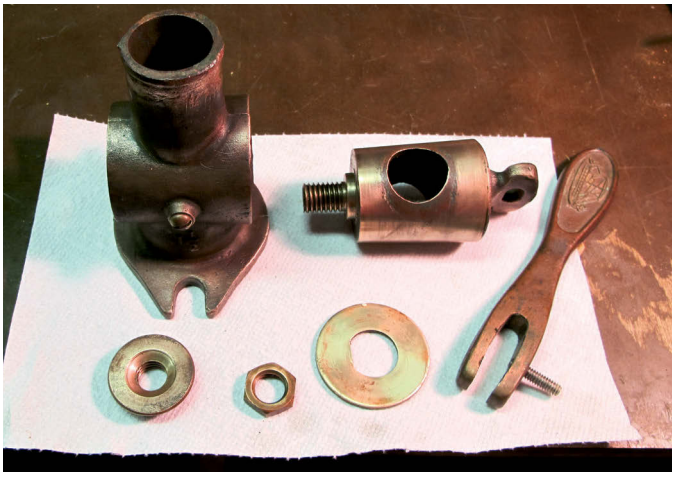


The wide base integral to the seacock carries any load on the seacock to the hull. The through-bolts prevent the assembly from twisting when the hull flexes or the handle is turned. The valve, not the through-hull, is the ultimate barrier between the sea and the boat.

smoothly. We regularly cycle them — turn the handle from open to closed and back several times. When *Entr'acte* is afloat and we plan to be away overnight or for more than a day, we close all the seacocks.

A tapered-cone seacock is very easy to disassemble and maintain (see "Servicing a Tapered-Cone Seacock," page 45). It is usually possible to do all this maintenance with the seacock still mounted in the boat — but with the boat out of the water!

Ball valves have more parts and are a bit more complicated. They are manufactured by several different companies, each with its own philosophy on construction, materials, and maintenance. While the seacocks all have bronze bodies, the choices of ball and shaft materials differ. Groco uses stainless steel; Apollo, chromed bronze; Buck Algonquin, chromed brass (below the waterline?); and Perko, a hard polymer ball. Apollo, Groco, and Perko allow for disassembly and offer rebuild parts



A tapered-cone seacock has very few parts, at left, all of them high-quality bronze. Ball valves tend to have more parts, at right. While some ball-valve manufacturers do offer rebuild kits, the valves can be difficult to disassemble when they are in place in the boat.

that include balls, shafts, seats, and packings. Buck Algonquin does not.

Make no mistake here, your chances of disassembling any ball valve to replace internal parts are slim while that valve is attached to your hull. Disassembly usually requires a solid vise, a large pipe wrench, a long lever, some swinging room, and sometimes a little heat to break the top nut free. It's best that the valve be removed from the boat for servicing.

Our first ball valve was not designed to be maintainable. We could disassemble the valve but could do nothing about what we found inside.

The Apollo marine ball-valve seacock has the right combination of features for me. It has a wide-flange body made of 85-5-5-5 bronze, a bronze ball riding on Teflon seats, and a bronze stem. It incorporates a side plug for winter draining and a separate lug for a bonding strap. The handle and nut are stainless steel. There are no mixed metals in critical places. Apollo makes valves for a variety of applications, but only the marine ball valves are suitable for seacocks.

If I were installing ball-valve seacocks for a multi-year cruise, I would assemble a complete rebuild kit (ball, stem, seats, and shaft packing) for each size of seacock on the boat. It might seem a bit expensive, but when, not if, one of these fittings fails in some remote part of the world, I want to be able to help myself.

The case for bronze

In my opinion, a brass valve or fitting has no place on a boat. Due to its high zinc content, the brass will de-zincify (the zinc will corrode away), weakening the fitting, which could fall apart and sink your boat.

Many sales people are unaware of the difference between brass and bronze and fewer still are conversant in the various bronze alloys, only a few of which are suitable for marine use below the waterline. Here are a few that are commonly encountered:

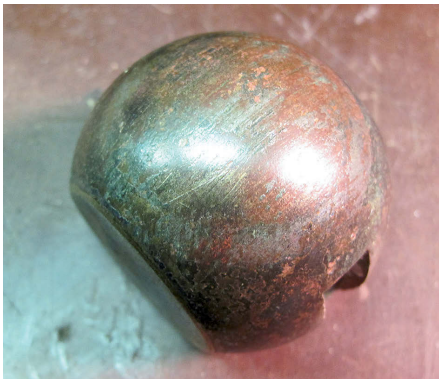
85-5-5-5 (aka 85-three-five) – The alloy most widely used for seacocks, it contains only 5 percent zinc and is the least prone to de-zincification. (Confusingly, it's also known as leaded red brass.)

Silicon bronze (Everdure) – This is the finest high-strength alloy for boat fastenings. It has also been used for seacocks.

Phosphor bronze – This alloy machines easily and is mainly used for springs and bushings, but not for valves.

Naval bronze – Despite its name, this alloy contains an astonishing 39.2 percent zinc. Used to manufacture military grave markers, it would not be my choice for use below the waterline.

For older bronze seacocks and through-hull fittings, a simple test for de-zincification is to scrape the surface down to bare metal with a sharp knife.



The reddish color on this brass or bronze ball from a ball valve, at left, is a sign of de-zincification. Pitting can also occur, center, when a ball valve is made of a mixture of metals. Polishing a ball might extend its useful life, at right, but it will eventually need replacing.

Servicing a tapered-cone seacock —EZ

Routine maintenance

Remove both nuts, give a slight twist or light tap with a mallet, and out comes the cone. Clean all the parts with kerosene, apply a new coat of grease, reassemble, and adjust. Doing this every two to four years should suffice.

If the mating surfaces become worn and permit seepage, a simple lapping procedure with a special lapping compound will solve the problem in all but extreme cases.

Lapping

Disassemble the seacock and clean all surfaces well. Rotate the plug against a straightedge and look for gaps. In all but the most severe cases, gaps can be lapped out with valve-grinding (lapping) compound and the plug restored to like-new condition. If you see any cracks, replace the seacock.

Spartan Marine sells a lapping compound and grease formulated specifically for its seacocks, but you can also purchase lapping compound from most auto-parts stores. Choose the finer grits available (320/400/600).

Coat the plug with lapping compound, insert the plug into the body, tighten the nut to achieve some tension while allowing the plug to turn. Rotate the plug completely around (not back and forth) twenty rotations. Clean all surfaces and apply the straightedge.

Repeat this process (turning the plug in the opposite direction) until the plug appears true, but don't overdo it. You can always remove more material but you cannot put it back.

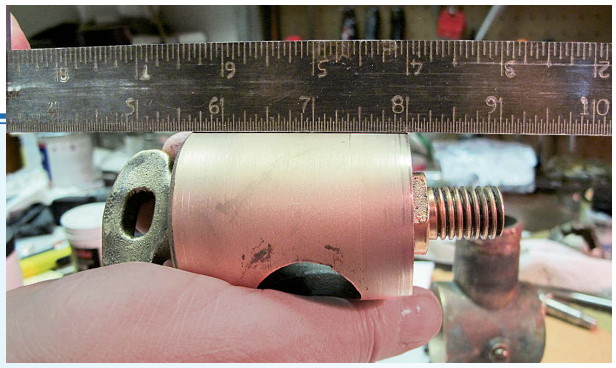
Thoroughly remove every trace of the compound, then apply grease to the mating surfaces. Spartan's specially formulated thick seacock grease is preferred over automotive grease. This job is easier if you remove the drain plugs and temporarily install zerk grease fittings. Be very careful to match the threads. Replace the drain plugs when finished.

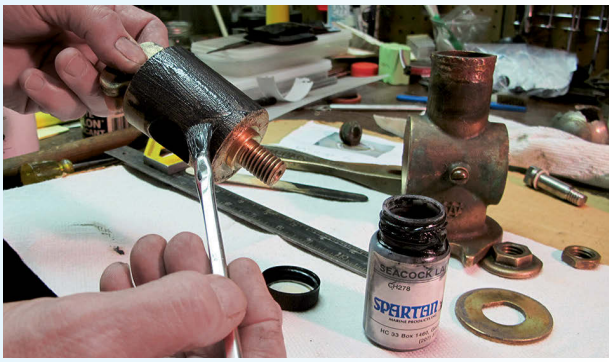
Reassemble the valve and tighten the adjusting nut until it requires a reasonable effort to cycle the handle. Set too loose, it could close due to vibration, disastrous if it is your engine intake!

Check for leaks

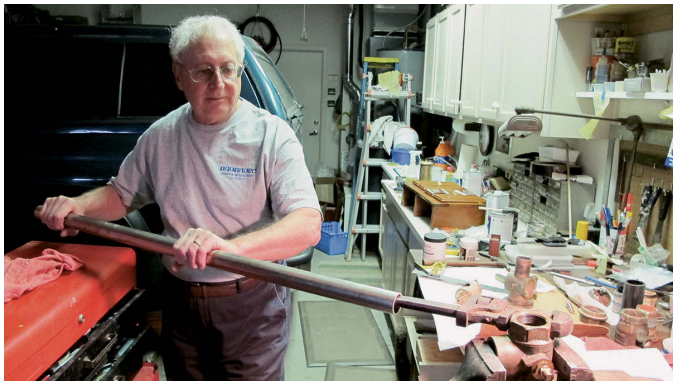
The seacock must be watertight whether open or closed. To test your work, close the seacock completely. (Unlike on ball valves, there might not be a handle stop and the handle could pass the fully closed point, allowing water to pass.) Remove the drain plug(s).

Attach a 3-foot section of clear hose and support it in a vertical position. Fill it with water, and watch what happens. If the hose drains with the valve closed, continue lapping. If the hose remains full and nothing comes out of the drain plugs, you're all set.





From the top . . . Place a straightedge along the cone and, while rotating the cone, look for gaps. Lap the cone until the gaps disappear. Lapping compound, like sandpaper, comes in a variety of grits, from coarse to very fine. When done, coat the cone with grease — thick grease specifically formulated for seacocks is preferable to thinner wheel-bearing grease. Grease seacocks periodically. To make the job easier, temporarily replace the drain plugs with zerk grease fittings. Be very careful to match the threads. Replace the drain plugs when finished.



Never again! During the latest refit of *Entr'acte*, Ed replaced the one ball-valve seacock with the original tapered-cone seacock.

Resources

Spartan, in the US, and Blakes, in the UK, are the only companies that still manufacture a quality tapered seacock.

Blakes Lavac Taylors
www.blakes-lavac-taylors.co.uk

Spartan Marine
- Tapered-cone seacocks and bronze hardware
- Seacock-specific lapping compound and grease

www.robinhoodmarinecenter.com/spartanmarine

Apollo ball valves
www.apollovalves.com

Buck Algonquin
Bronze ball valves and other bronze boat fittings
www.buckalgonquin.com

Groco
Bronze ball-valve seacocks and marine hardware
www.groco.net/products/valves-seacocks

Perko
Ball-valve seacocks
www.perko.com

Midway USA
Lapping compound kit — 220/320/600 grits
www.midwayusa.com/product/486249

Auto-parts stores
Valve-grinding compound

Bronze alloys
Discussion of brass, alloys, and de-zincification
www.proboat.com/2012/07/beware-the-brass

If scraping reveals a bright golden color, the fitting is safe. A rusty red color indicates de-zincification, and the fitting should be replaced at once.

A dark gold color is not necessarily bronze. Brass, especially if it has been on the shelf for years, can look much like bronze.

I will never install an all-stainless-steel seacock on my boat. All its internal components will live in a permanent anoxic environment. I have seen absolute horrors with stainless-steel anchors and chain.

Conclusions

When buying or replacing a seacock, the choice is between the tapered-cone valve and the ball valve. Each type has its proponents and detractors. Whichever you choose, you must know just what you are purchasing. For some assurance of quality, look for the Underwriters Laboratories' logo. This is no place to economize.

If installing a seacock for a new onboard service, make sure you will be able to maintain it. Locate it where it is easily accessible for operation and maintenance, and install it properly (see diagrams on page 43) to avoid problems in the future.

Regularly cycle your seacocks by moving the handle from open to closed and back several times.

While on board, close the seacocks of systems that are not in use. If the boat will be unattended for more than a few hours, close all the seacocks.

During haulouts, or at least every four years, disassemble and inspect each seacock. At the very minimum, remove the hose fittings and look inside with a bright light. If you see any hint of cracks in the ball, replace the ball and any stainless-steel components.

Layups are deadly. More deterioration and corrosion can occur during a six-month layup than after several years at sea. Before launching, grab each seacock and shake it. Tap it lightly with a hammer. Better that something break while the boat is on the hard than after it's launched.

Our tapered seacocks have been easy to maintain and are still serviceable after 37 years. But I have no illusions. Every boat part has a life span and nothing lasts forever. Nothing is maintenance-free. Even the highest-quality seacocks will let you down if neglected.

In our experience, the working life of a ball-valve seacock with a stainless-steel ball (the only type available to us at the time we needed it) is limited. Our average has been six years, despite vigilance and regular cycling and cleaning. In all three cases, they worked until they didn't, and they all failed without any warning.

After our third failure, I dug into my treasure trove of bits and pieces accumulated over the years, found our original tapered-cone seacock of yesteryear, cleaned, lapped, and tested it, and reinstalled it. I feel confident that we will never have to worry about "losing our head" again.

Ed Zacko is a Good Old Boat *contributing editor. Ed, the drummer, and Ellen, the violinist, met while playing in the orchestra of a Broadway musical. They built their Nor'Sea 27,* Entr'acte, *from a bare hull, and since 1980 have made four transatlantic crossings and one transpacific crossing. After spending a couple of summers in southern Spain, Ellen and Ed recently shipped themselves and* Entr'acte *to Phoenix, Arizona, where they are refitting* Entr'acte *while maintaining a busy concert schedule throughout the Southwest US. Follow them on www.enezacko.com.*

Refurbishing an aging furler

A little stiffness could have become a big problem

BY ED ZACKO

We had been tied to a dock for several weeks enjoying the city of Seville, Spain. It was a day just like any other day: I climbed aboard, swung my leg over the bow rail, and, in what has become almost a ballet for me, grabbed the furled headsail to swing myself around onto the foredeck. I don't really know why I do this, it's just something that has developed over the last 30 years. But this time I froze! The furled sail did not swing with me as usual. A slight twist of my arm resulted in a soft "snap." All was well, just a fluke. I repeated my ritual the next day and, to my surprise, *Entr'acte* again refused to dance with me! For the rest of the day, the furled sail turned freely, but in the mornings I felt a definite click when I rotated the furled sail.

We installed the ProFurl NC-32 furler on *Entr'acte*, our Nor'Sea 27, a whopping 17 years and thousands of miles ago. It has seen us through the most severe conditions and had never once given the slightest hint of a problem, until that morning in Seville. For a few moments I deluded myself into thinking the problem was simply the result of airborne sand or debris that had come to rest in the perfect spot to cause this slight jam. Then I heard the voice of rationality: "The reason does not matter! Slight as it is, it *still* jams!"

A jammed furling gear on a dark night ain't pleasant! It can lead to serious damage or injury. We were lucky to get this warning. I learned my lesson on the River Seine: If I even suspect a problem, I fix it right then and avoid disaster. (See "Dead in the Water," January 2015.)

Dire warnings

When we purchased our ProFurl, we were warned that repairing it ourselves would be impossible, but we insisted on buying a complete rebuild kit so we might have a fighting chance "out there." Operating on my brother-in-law's theory that anything someone has put together can be taken apart, Ellen and I tucked the parts away and decided to cross that bridge when we came to it.

Throughout our travels, other cruisers repeated the warning:

"You can't fix it yourself."

"You need special tools."

"It's too old. Parts are no longer available. You have to buy a new one."

"I sent it to two dealers and neither would touch it, so I threw it away."

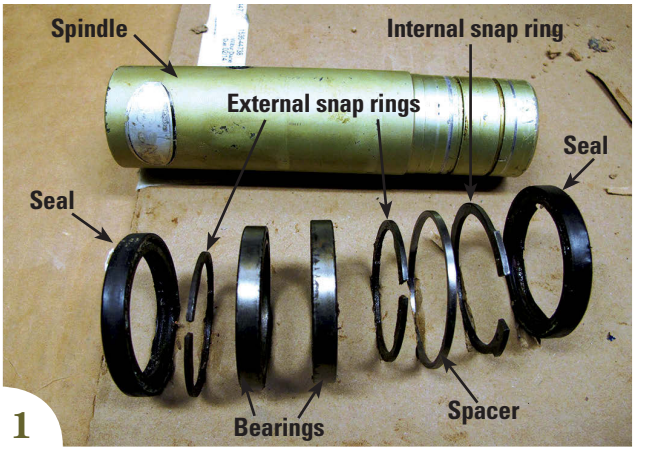
This is a shame, because the repeated warnings are unwarranted. Old ProFurl units are surprisingly easy to repair right on board and everything you need can be purchased from any auto parts store.

I wanted to prove my assertion that this ProFurl unit can be simply and easily rebuilt with widely available parts. I disassembled my unit and, instead of installing my own parts kit, took the original parts to my local NAPA store. In less time than it took me to eat a bag of their free popcorn, the staff put together a duplicate replacement kit (minus the two reuseable spacer rings) for less than $60. Better still, they assured me that the bearings and seals are standard parts, available all over the world.

For perspective, after completing this project, I did find a source selling an authentic rebuild kit for $99 — two of these are needed — along with a quote to perform the rebuild for $500.

Service parts

Looking at the furler from the outside, it is difficult to comprehend how these units are put together. Once taken apart, though, the ProFurl roller furling system has surprisingly few parts: four rubber seals, four bearings, six snap rings (four external, two internal), and two spacer rings (photo 1). That's it!



1

All four seals are the same, as are all four bearings. The parts are divided equally between the upper and lower units. Looking at my parts kit in the bag, it was immediately obvious how things were put together.

The most important thing to understand is that when working on anything that has a seal, you must accept the fact that you cannot remove any seal without destroying it! The secret is to remove the seal without damaging the rest of the unit. The rest of the job is just a matter of paying attention to the sequence of steps and being careful. The challenge I faced was to determine the proper disassembly sequence and not work my way into a corner and ruin the project.

The tools

In the interests of *Good Old Boat* readers, I limited myself to using only tools that any boater would carry on board or have at home. At the top of the list is a digital camera. Otherwise, only a couple of inexpensive specialized tools are needed: a set of loop hooks and picks for pulling seals (photo 2)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and reversible snap-ring pliers. They are available from any auto parts store.

Snap rings (also called circlips) come in two forms that look similar but differ in the way they are installed and removed: external (squeeze the pliers to expand) and internal rings (squeeze the pliers to compress). Both types are standard items and available almost everywhere. With reversible pliers you can remove or install them both. Buy a good pair. For a furler larger than our NC-32, you might need a bit more power (photo 3).

The ProFurl components

The ProFurl system has two swivel units. Their internal workings and their disassembly/assembly sequences are identical. The only difference is that, to disassemble them, you work from the *top* of the upper unit and from the *bottom* of the lower unit.

Before you do anything, carefully mark each unit to show which end is up. On the upper unit, the sail attachment lobe is on the *bottom* of the center spindle (photo 4). Conversely, the sail attachment lobe on the lower unit is on the *top* of the center spindle (photo 5). It is very important that you keep this straight in your mind.

Take photos of each unit from the top and from the bottom. These photos will be of help when you replace the seals. Use calipers to measure the distance from the top and bottom of each unit to the top of each seal (photo 6). Write these measurements down. If you set the new seals too shallow, they will pop out. Setting them too deep will compromise the seal.

Disassembly

For simplicity, disassemble one unit at a time, starting with the upper unit and working from the *top*.

- Remove the sun cover — it lifts right out (photo 7).
- Remove the top seal. Don't try to save the seal. It's dead, that's why you are doing this job.

Slide the loop-hook tool between the spindle and the inner lip. Twist the

hook outward so the hook engages the groove on the underside of the seal. Use a piece of wood as a fulcrum and lever the seal until the old and dry rubber-to-metal bond gives way. You might have to try this at several positions around the seal before it finally lets go. Be careful. Do not scratch the center spindle. Scratches will degrade the watertight integrity of the new seal (photos 8, 9, 10, and 11).


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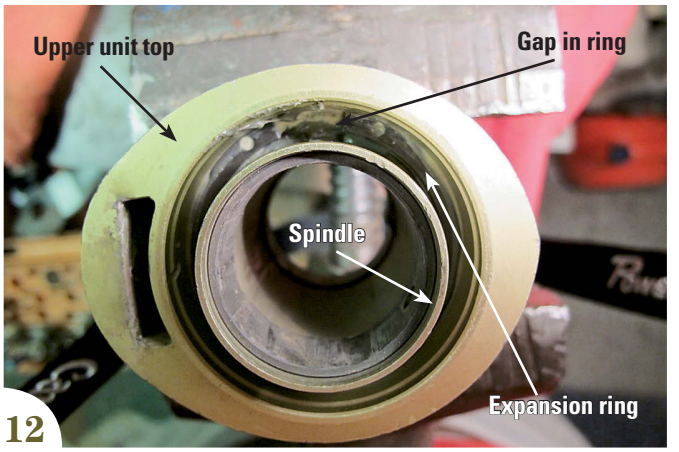

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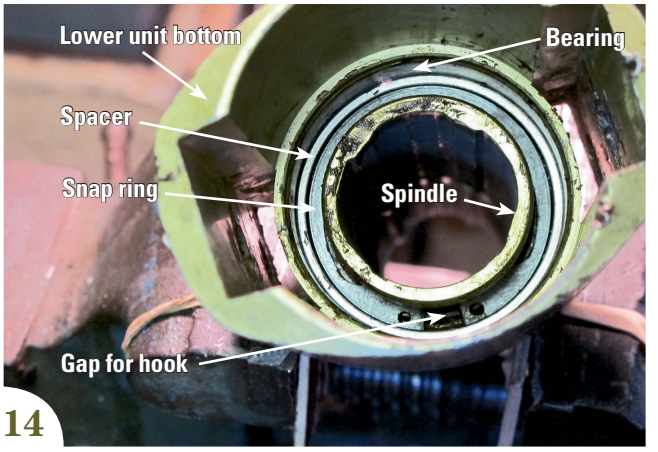

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• Use a Q-tip and brake cleaner to clean out the cavity as thoroughly as possible. You want a clean, unobstructed view of the interior snap ring (photo 12).

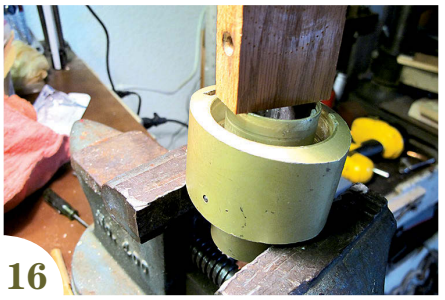
• Set the pliers to "squeeze to compress." Press the points firmly into the holes of the ring and squeeze smoothly until the ring comes free of the internal groove. It should almost, but not quite, touch the center spindle. Carefully withdraw the ring. If the plier points tend to slip out of the holes, there is still too much grease or you need thicker points. Keep the ring perpendicular to the spindle as you withdraw it.

If the ring slips and becomes lodged at an angle, you could have a fight on your hands. This is especially true on the lower unit, due to the longer spindle and the confined space. This is the only scary part of the job (photo 13).

• Clean the cavity again until you can see clearly and study the snap ring and spacer (photo 14).

The snap ring fits perfectly inside and rotates freely within and independently of the spacer. This is important. If the snap ring does not fit perfectly inside and rotate freely on re-assembly, the unit will bind.

• If the area is free of dirt and grease, a simple tap on a table will cause the spacer to drop out. Otherwise, use the 90-degree hook tool to extract it (photo 15).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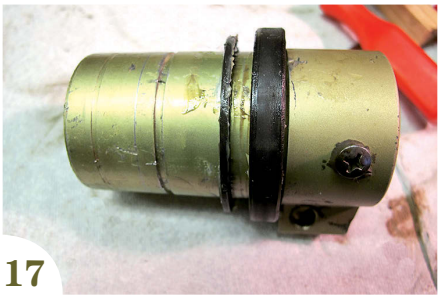
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• Turn the unit upside down and use a small block of wood to gently tap the spindle downward 1/16 inch and *stop* (photo 16). Turn the unit right side up.

• Set the pliers to the "squeeze to expand" position and remove the internal snap ring, once again holding it perpendicular to the spindle.

• Turn the unit bottom side up and break the bottom seal free of the housing, as you did the top seal, but do not try to remove the seal completely.

• Set the unit right side up on a vise with the center spindle free to rotate. Gently tap the spindle completely through the housing. The spindle, second snap ring, and bottom seal will come out as a unit, leaving the bearings behind (photo 17).

• Tap out the bearings. For my upper unit, I used a short length of PVC pipe that was the exact diameter of the bearings. A few gentle taps and it was done. For the lower unit, I used the tried-and-true bearing removal technique: a flat cold chisel and gentle taps around the circumference of the bearing. One light tap at the 12-, 3-, 6-, and 9-o'clock positions and repeat until the bearings drop free. Do not bang. One gentle tap at each point is all it should take. If the bearing becomes lodged at an angle, do not pound but simply turn the unit over and tap the offending side until the bearing is again straight, then continue. If the bearings are rusted in place, you may have to soak the unit for a few hours in WD-40 or PB Blaster (photos 18 and 19.)

• The final step is to remove two tiny balls from each unit. They seal small holes that allow for the venting of air and excess grease on reassembly. These balls must be removed prior to reassembling the units.

Press the balls out from the inside using a simply-made extraction tool. Find a nail or old drill bit that fits exactly into the vent hole from the inside. Cut it to a length of ¾ inch and press or glue this pin into a short length of ½-inch-wide wood or metal. A tight fit without wobble is best (photo 20).

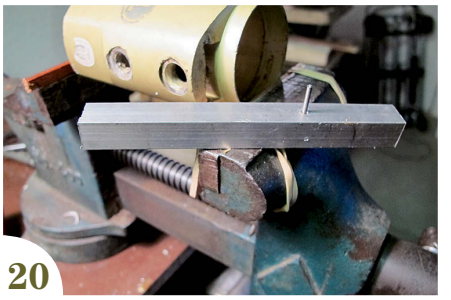
Fit the pin into the vent hole (photo 21) and hold each end of the tool in place with a small C-clamp (photo 22). Use the clamp nearest the vent hole to slowly press out the ball. Watch the ball. There is no eruptive force here but a bit of masking tape over the ball will keep it under control. Resist the temptation to just squeeze the rod with pliers. You do not want to lose these balls! Store them in a cup for safety (photo 23).

Before re-assembly

Clean the unit thoroughly, inside and out, with brake cleaner. Remove every trace of grease, oil, and sludge from every surface and also from your hands, gloves, pliers, and snap rings, especially the pins of the pliers and the holes in the snap rings. Cleanliness is vital!

Inspect the center spindle where it comes into contact with the inner lips of the seal for scrapes, nicks, gouges, and burrs — anything that could compromise the integrity of the seal. If you find anything serious, you can fill it with epoxy and smooth it with 800-grit wet/dry. Do not do this unless you must!

Should you need new spacers, know that, other than their precision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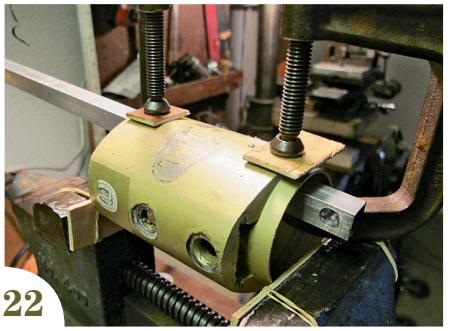
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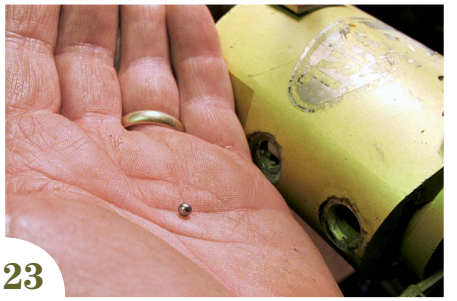
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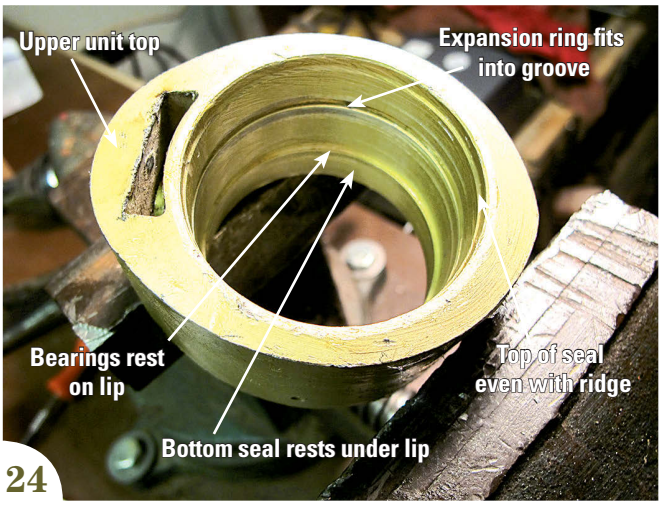

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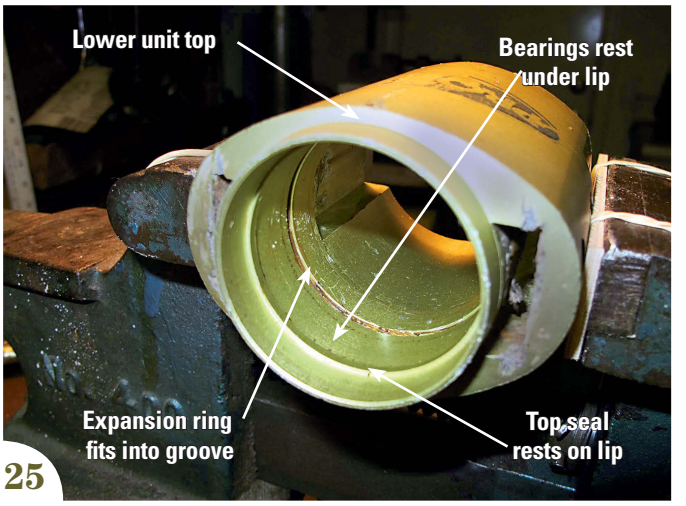

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measurements, there is nothing special about them. Any machine shop can duplicate them if necessary. Despite the muck I found in my lower unit, both the spacers and all the snap rings appeared like new and were reuseable.

Reassembly

The assembly process is exactly the reverse. (Don't you just love that term?) It really is that simple. However, there are some caveats, so take it slowly and carefully.

First, make certain that you know which end is up! Inspect the interior of each unit and note the following:

Upper unit

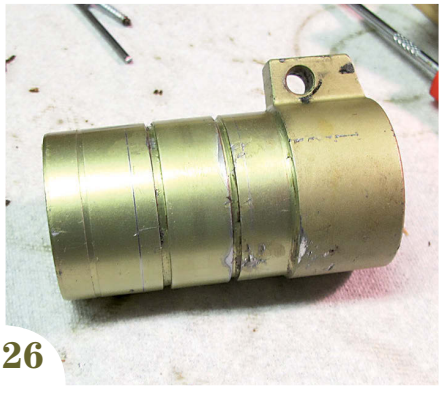
Identify the ridge at the bottom of the unit that serves as the stop for the bearings and also for the bottom seal.

Locate the groove into which the expansion ring must sit. It is critical that the ring sits in this groove all the way around.

Note the ridge at the top of the unit that shows the proper depth for the top seal — the top of the seal must line up with this ridge, otherwise it will eventually pop out due to the slightly larger diameter above the ridge (photo 24).

Lower unit

Note the ridge at the top of the unit that serves as the stop for the bearings and the top seal.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Look for the groove into which the expansion ring must sit. It is critical that the ring sits in this groove all the way around.

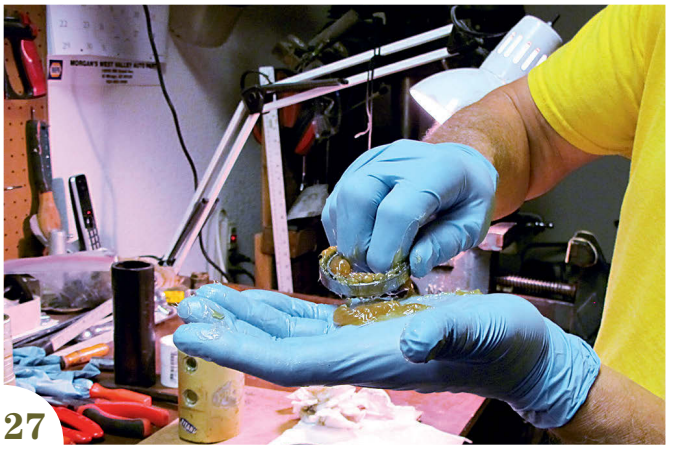
Find the small lines at the top and bottom of the unit. These lines indicate exactly where the tops of the seals should be after assembly. The tops of the seals must press to these lines or they will come adrift (photo 25.)

Center spindle

Note that, on both units, there are two grooves around the center spindle. The snap rings *must* sit perfectly inside these grooves all the way around. If they do not, the unit will bind (photo 26).

Reassembling the upper unit

• Unless your new bearings are pre-packed and permanently sealed, pack the new bearings with grease and gently tap them into the casing one at a time until both bearings come to rest on the lip (photos 27 and 28).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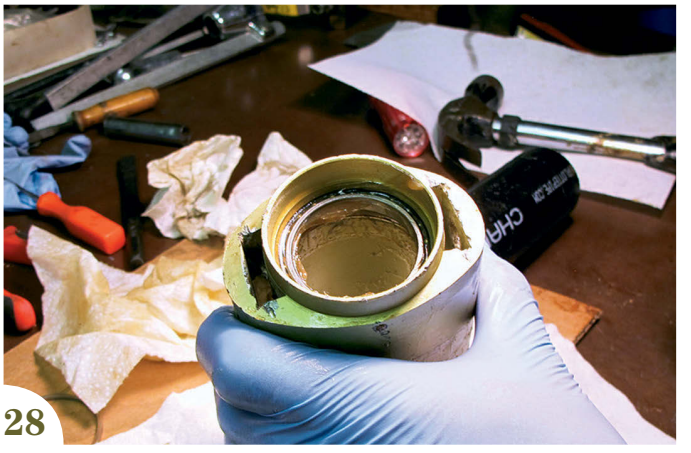
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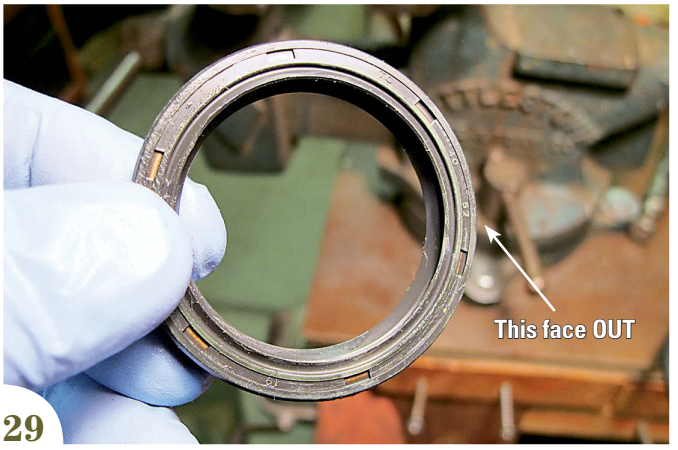

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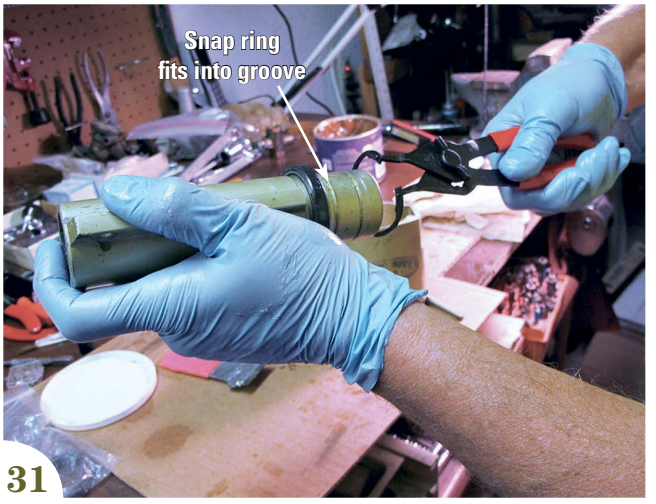
• Put on a new pair of gloves and thoroughly degrease your pliers and snap rings. I cannot overstress how important this is. You do not want the rings to slip off the pliers and become lodged inside the unit.

• Apply a very light film of grease to the spindle. Slide the bottom seal (photos 29 and 30) onto the spindle and install the lower snap ring (photo 31).



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• Turn the upper unit bottom-up. Slide and twist the spindle into the casing. Press in the bottom seal until it is even with the edge of the casing and *stop*! Make certain the seal is even all the way around. If thumb pressure is not enough, tap the seal into place with a flat wooden dowel, working around the circumference.

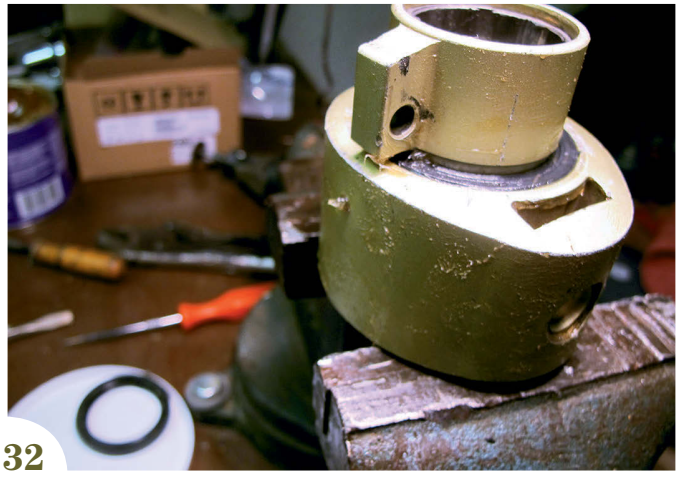
• Gently tap the spindle until the sail-attachment lobe almost touches the edge of the casing and *stop*! This will better expose the groove for the next snap ring (photo 32).

• The bearings will now have moved away from their inner lip stop. Turn the unit over and use the cold chisel to gently tap them back against the stop. Install the upper snap ring into the spindle groove. With the chisel, tap the ring at 1-, 6-, and 11-o'clock to make certain it is in the groove. A gentle "snap" at each point tells the tale.

• Gently tap the bottom of the spindle until the snap ring just makes contact with the bearings. Rotate the spindle. It should feel stiff but smooth.

• Install the spacer ring. It drops right in. Rotate the spindle and make certain that the snap ring sits perfectly inside the spacer. If it does not look exactly like photo 14 (on page 25), the snap ring is not completely in the groove! If you hear or feel any grinding, back up a few steps and try again.

• Install the expansion snap ring, using the pliers in "squeeze to compress" mode to place it in position. Make certain the ring snaps completely into the groove in the casing. Add a layer of grease around the circumference (photo 33).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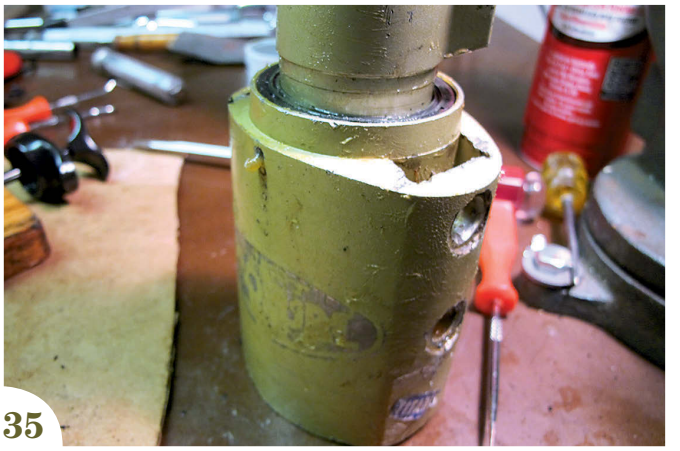
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• Rotate the spindle in both directions. All should be smooth and quiet. Up to this point you can completely disassemble the entire unit with no loss except for your time.

The last step

Be absolutely certain you are ready before you install the last seal. There is no backing up! Once this seal is installed, you cannot remove it without destroying it!

• If all is well, cover the circumference of the snap ring with grease, press the seal into the casing and, using your thumbs and the wooden dowel, gently tap around the circumference until the top of the seal is even with the edge of the casing. Rotate the spindle a few times in both directions and stop! Enjoy a cup of coffee while the grease flows and equalizes.

• Tap all the seals to their proper depth, at one end even with the ridge and at the other when it comes into contact with the inner lip. Refer to the photos and measurements you took before you disassembled anything. Rotate the unit a few times and allow the grease to equalize and flow through the vent holes (photos 34 and 35).

• Using a nail set, gently tap the vent balls into their holes so they are flush with the casing. There is no danger of tapping them through to the inside.

• Lay the sun shield on top of the top seal of the upper unit and install the halyard lifting ring. If for some reason you do not have a sun shield, make one out of any dark plastic you can find. Without a shield, this seal would be exposed to a lot of harmful sunlight.

• Install the drum, basket, and link plates on the lower unit.

Going slowly and carefully, it should take about two hours to rebuild each unit. After that, you can sit back and bask in the glow of a precision job well done and congratulate yourself on having saved somewhere between $500 and $2,500. And you might also have avoided a lot of grief and drama on a windy night!

Ed Zacko is a Good Old Boat *contributing editor. He and Ellen met while playing in the orchestra of a Broadway musical. They built their Nor'Sea 27,* Entr'acte, *from a bare hull and since 1980 have made four trans-Atlantic crossings and one trans-Pacific. They spent the last five seasons based in Seville, Spain, sailing in and around the Mediterranean and playing in the jazz clubs of Spain, France, and Morocco. Last September, they shipped themselves and* Entr'acte *to the U.S. Now in Phoenix, Arizona, they maintain a busy concert schedule throughout the Southwest U.S. Follow them on www.enezacko.com.*

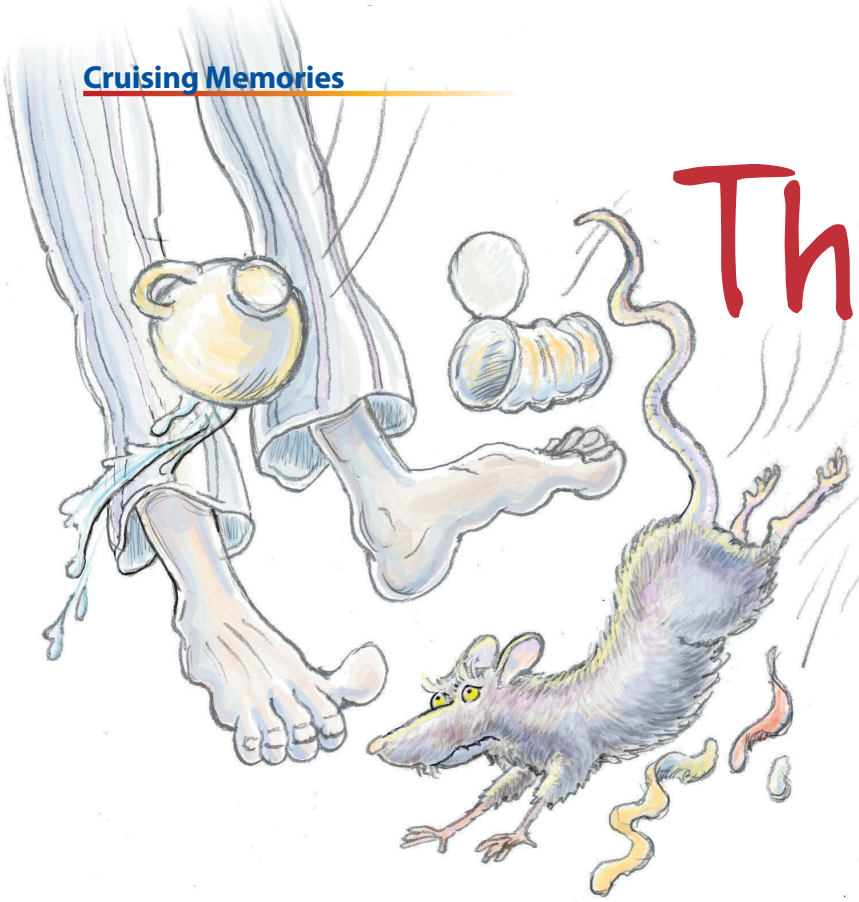
Furler TLC

I was pleasantly surprised at the longevity of our ProFurl unit. Seventeen years of ocean passages is a long time for any device with more than one moving part. How did we get so lucky?

First, we made certain to install the sun cover over the top bearing of the upper unit. The upper seal of this unit is exposed to the sun, and sun is the enemy of all rubber.

The lower unit also lives in a brutal environment. The bearings are constantly subjected to salt water under pressure from wave action, from above and below. Then there is rainwater. Our practice has always been to remove both units and stow them below whenever *Entr'acte* is laid up. This dramatically reduces their exposure to the sun, which degrades the seals, and rain, which can seep past the seals over time.

It takes only a few minutes to remove and stow the ProFurl, and it seems to have paid dividends.



The Rata of Seville

A ravenous rat unites a community while wreaking havoc on board

BY ED ZACKO

At our farewell party at the Club Náutico de Sevilla, Spain, I ate something I shouldn't have, and on returning to *Entr'acte*, I lay down on a main-cabin settee to await the inevitable consequences. When I awoke thirsty and rose from the settee to fetch a drink, I suddenly sensed I was not alone in the dark wee hours. I stood in the silence and waited. Nothing. When I reached for a cup in the galley, I heard a rustling in the trash bin, then I felt a warm furry body and damp little feet touching mine. I crashed into the head door as my visitor scurried out of sight up and under the galley stove. Through the darkness, I saw his broad backside and tail. A long, skinny tail. A rat's tail! There was no denying what I saw, and we could not go to sea with a rat on board. Our planned 0800 departure was the first casualty.

Entr'acte was still in her slip at 1000 when our neighbors Antonio and Tonia from *Habibi* walked by.

"*Que pase,* Eduardo, too much *fiesta* last night? Relax! Tomorrow is another day," Antonio said to me in Spanish, rolling every "r" as the Spanish do: rrrrrr!

"No, Antonio, *tenemos una problema muy grande!* A rat came on board last night."

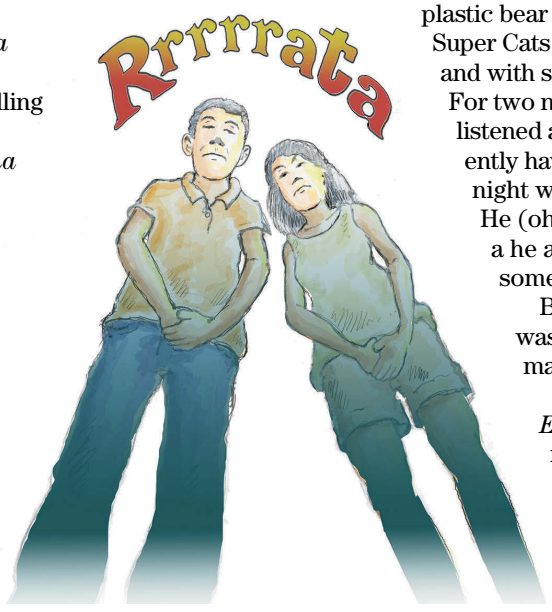
The couple looked quizzically at each other.

"*Una rrrrata?* You mean *un raton*, a mouse, no? Oh, they are harmless, such little things."

"No, Antonio, no raton, *una rata, una rata grande!* A rat!"

"*Rrrata?*" Antonio paused, looking down. "*Rrrrrrrata!*"

Mice seem innocent, they have some redeeming value, but rats . . . Just the word "rat," no matter how it's said, sounds disgusting. The Spanish have a way of saying "rat" that manages to incorporate feelings of awe and disgust. They'll pause, think a moment, then bow their heads as if in shame or prayer. Taking a quick breath and while still looking down — seemingly into hell — they manage to simultaneously inhale and exhale using their diaphragms as if playing a very loud note on a wind instrument and, with a quick shake of the head, a gasping rush of air, out comes that single word: "*Rrrrata!*" Then silence. I have tried to duplicate it and cannot come close.



And so, the battle was joined. For the next three months we engaged in an all-out war.

First came the traps, big traps and small traps. We found one called Super Cat, which looked like a large plastic bear trap with teeth. We baited several Super Cats with cherries, with peanut butter, and with salmon skin. It was all for naught. For two nights, we lay awake at 0200 and listened as our friend leaped about, apparently having a wonderful time. On the third night we heard scratching and gnawing. He (oh merciful King Neptune, let it be a he and not a she) was feasting on something.

By day four, the entire yacht club was involved. Escobar, the restaurant manager, pulled me aside.

"Don Eduardo, *es una rrrata Espanol*," he said. "And a Spanish rat must have Spanish bait. Wait here!"

He returned with a trap that looked like a guillotine and large enough for three rats. Wearing latex gloves to eliminate any

ILLUSTRATIONS BY FRITZ SEEGERS

human smell, Escobar inserted *jamon serrano*, *queso viejo*, and *camarones* — the three most expensive items on the restaurant menu.

"This never fails! *Venga*!"

Not only did this trap fail, la Rrrata wouldn't touch the bait. In fact, he was aboard a boat newly stuffed with provisions for a transatlantic passage to Trinidad and he wouldn't touch any of it! Oh, he nibbled on a single cracker just enough to ruin the package, and on a single strand of pasta to ruin *that* box. And he did make a tiny hole in the plastic jar of honey so the contents ran through the locker, across the galley sole, and into the bilge. But no, la Rrrata's food of choice was *Entr'acte*, or to be precise, her electrical system. He absolutely *loved* electrical cable!

At this point, Club Náutico hired an exterminator at their expense. The professional appeared and, rat-like, crawled about the boat, peering with beady eyes into hidden spaces and squeaking merrily as he scattered hundreds of poison pellets throughout our home.

"To kill a rat, one must think like a rat. *No problema, en dos o tres dias, muerto! Guarantizado!*"

For the next week, la Rrrata chewed on one wire after another. Each morning, one more electronic device fell victim. First was the GPS, then the VHF, then the SSB. At 0500 one day, the bilge pump activated. I opened the engine-room door and wanted to cry. A smorgasbord of wire, insulation, and wire bits floated in water that had gushed from a hole in the sink-drain hose. What stopped my heart was the frayed hose from the engine intake. I closed all the seacocks and returned to bed.

Next came the Rat Glue. "This glue is so sticky nothing gets away from it."

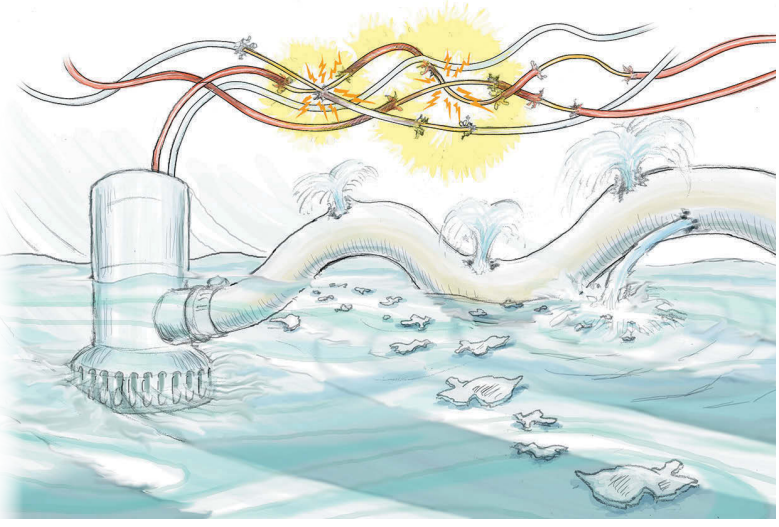
We placed two traps baited with greasy salmon skin on top of pieces of cardboard smeared with Rat Glue, and placed more Rat-Glue-smeared cardboard pieces on the stovetop, on the sink, on the head, in the trash bin, on the settees, and all along the sole. Our cabin was a minefield of Rat Glue.

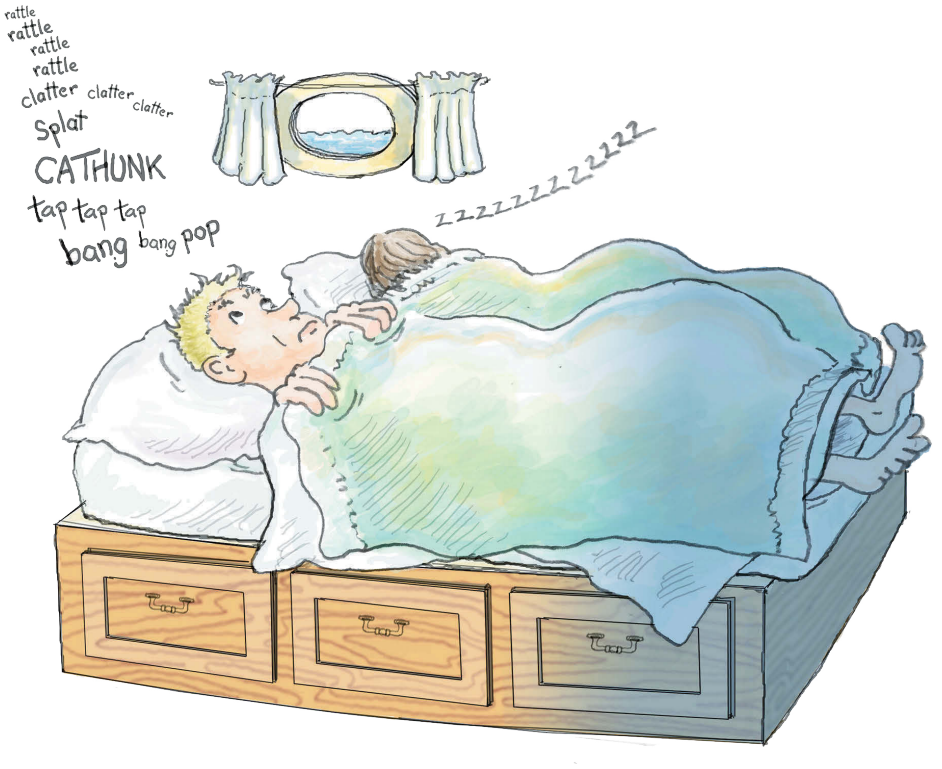
At 0200, a loud *bang!* One of the Super Cats! I carefully approached the overturned trap . . . empty! La Rrrata had escaped with the bait.

I stepped backward . . . onto Rat Glue. #%&*@!!!! I reached down, carefully trying to find, in the dark, a glue-free spot on the cardboard that I could grab to pull my bare foot free. Then my hand stuck fast and I couldn't move. I pulled hard, and stringy tendrils of glue followed. A small wave caused *Entr'acte* to roll just enough for me to lose my balance and I flopped down onto the settee. My foot was stuck, my hand and legs were covered in glue, and now my butt was stuck to another piece of cardboard . . . my butt, because I was stark naked.

"Did we get him?" Ellen called from her bunk. I was too angry to scream.

At 0330, she and I were both in the cockpit, naked and covered with Rat Glue. It spread faster than we could clean it up. The slightest touch left behind a stringy trail that had no end. We quickly learned that neither water, soap, alcohol, nor acetone will remove it. We had no gasoline and the toluene was buried under our clean bunk, which we were smart enough not to touch. Dry rubbing with a towel eventually and painfully brought things under control and Ellen returned to her bunk. I was right behind her, but stopped for a quick visit to the head.





"Ellen! I have a problem!"

There was still some glue on my hand and fingers. I was now in a real pickle, well and truly "stuck on myself." Back in the cockpit, both of us still naked, Ellen, scissors in hand, prepared to perform surgery on the family jewels.

"Lean back, rest your feet on the lifeline, and hold the light."

As she began to cut, we were suddenly bathed in the bright glare of a spotlight. We froze.

"Damn, it's the police!"

"No, it's the security lighting. We have to work fast!"

The only time the security light comes on is when the main gate opens to admit the men and women rowers for their dawn workouts. Any minute, our dock would be crawling with jocks. As Ellen operated, the glue migrated to her, and we became attached to each other in a most embarrassing way. We could hear la Rrrata, to whom Michel, of a neighboring French boat, had given the name Little Rochefort, leaping and cavorting down below.

A few nights later, I awoke to find water covering the cabin sole. Not only had Little Rochefort eaten through the hose to the starboard water tank, but he had taken out the electric bilge pump as well. This was serious.

Someone suggested we plant a rubber snake under the galley stove to scare him away. Klaus of *Woodwind* was horrified.

"No, no, there is no life essence in a rubber snake. You are wasting your time! This is what you must do. Remove the hose from a seacock. In the dead of night, start the engine. With the engine running, open the seacock, allow the boat to fill with water, and set off an alarm. In the dark with all the noise and the sound of water, the rat will think the boat is sinking and abandon ship!"

"What do you mean the rat will *think* the boat is sinking? Klaus, the boat *will* be sinking! And don't forget, we have no electric bilge pump and it's 20 feet to the bottom."

Klaus stood by the manual pump while Ellen and I searched all of Seville for a rubber snake, *una serpiente de goma*. All we could find was a fully articulated wooden snake, complete with tongue. We bought it.

We returned to *Entr'acte* to find a note from the French yacht *Maestro* pinned to our lifeline.

"Sun Tsu in *The Art of War* mention the effect of the element of surprise. What have no taste or smell? Electricity. Your rat like electricity, so we give to him!"

Accompanying the note was a drawing of a 220-volt electric trap.

"It ees simple, non? We take a plate of stainless steel and connect it to electricity. For bait, we use somesing wiv a very high moisture content like ze French Camembert, no? Ze rat he have ze rear legs on ze plate. When ees tongue just touch ze bait, tak! *Il est mort! Voilà! Très simple, non?*"

"Michel, I really like the *Il est mort* part, but what about the risk of fire?"

"Edouard, zat ees ze beauty of my plan. Ze electricite on ze dock has defense, ze breaker, so we know when he die because when ze tongue she touch ze bait, ze defense she pop and ze lights zey go out immediatement before ze fire can begin."

"What lights?"

"*Tout le club! Poof!* Ze plate ees so large e must step on it. *Très simple, non?*"

So here we were, in the restaurant, plotting to electrocute a rat. We began with a multimeter, measuring the electrical conductivity of an assortment of cheeses, fruits, and meats provided by the restaurant. The winner? A peach. Oh baby, do peaches conduct!

We worked all day with gloved hands to keep our human smell from contaminating the trap. I could just imagine Little Rochefort peeking out from his hiding place and laughing at all of us. Somehow, we managed to assemble and install our trap without electrocuting ourselves, which, given *Entr'acte*'s small cabin, was a challenge. We carefully exited the main cabin and closed the doors. Between all the poison, Rat Glue, Super Cats, and electricity, our main cabin was now a truly lethal place.

A Frenchman in pajamas on a dock at 0200 is a sight to behold. All night, Michel paced up and down while we sat on the dock, all of us waiting anxiously for the lights to go out. It was agonizing, as we could hear scratching, the patter of little

feet, and Little Rochefort chewing on everything — everything except that peach.

Another morning dawned after another sleepless night.

"You must gas him! Run a tube from a car's exhaust pipe to the boat."

"No way, that will stink up the whole boat!"

One evening, the club threw a party (in Spain there is always a party). A live band played, accompanied by the obligatory smoke machine. I had an inspiration, and set out the next morning to rent a smoke machine. It was a holiday (in Spain there is always a holiday) and everything was closed.

That afternoon, the *comodoro* told us that the club was going to pay for a second exterminator. This became an argument of honor on both sides.

"Don Eduardo, we cannot have *rrratas* at Club Náutico! It is our *rrrrata* and our responsibility."

"Don Paco, no! I will pay. I am the captain. It is my yacht and therefore my rat and my responsibility."

"No! The club will pay, and that is final!"

Back on *Entr'acte*, Ellen asked me for the ditty bag so she could finish a minor canvas repair. I opened the bookcase and, in broad daylight, there he was! As his rump descended along the engine exhaust hose into the bilge, I noticed two very important things. First, his color. He was brown, not gray. Second, the length of his tail. If it's true that the length of a rat's tail is equal to its body length, he was one big rat. To this day I regret that my reflexes were not fast enough to grab the tail and flip him out through the hatch.

"Oh, so he is brown, not like those gray river rats. My daughter, she has a pet like this. You call it a gobel, no?"

"No, Antonio, Gobel was an American TV star. You mean gerbil, and this one is not harmless!"

The exterminator arrived carrying only a very small paper bag. As he climbed on board, I took the bag and started to reach inside. He slapped my hand, hard.

"No! Poison, *muy toxico. Mira!*"

He put on a pair of rubber gloves and removed from the bag a small plastic packet on which was printed the silhouette of an anatomically correct black bull (in Spain everything eventually arrives at the bull). The bag bore a warning in large letters: *CONTENTES SUFFICIENTE POR UNA TORO 850KG*.

"*No toca! Muy, muy peligroso!*"

He next produced two large tomatoes, cut them into very small pieces, and mixed them with the *entire contents* of the packet.

"Smear this over everything he eats or touches and everywhere he steps. When he licks his feet to clean himself, he will die!"

I diligently coated every wire and hose in the engine room, the engine, fuel tank, lockers, cans . . . everywhere with the Salad of Death.

"*Dos o tres diaz, morto! Me guarantia!*"

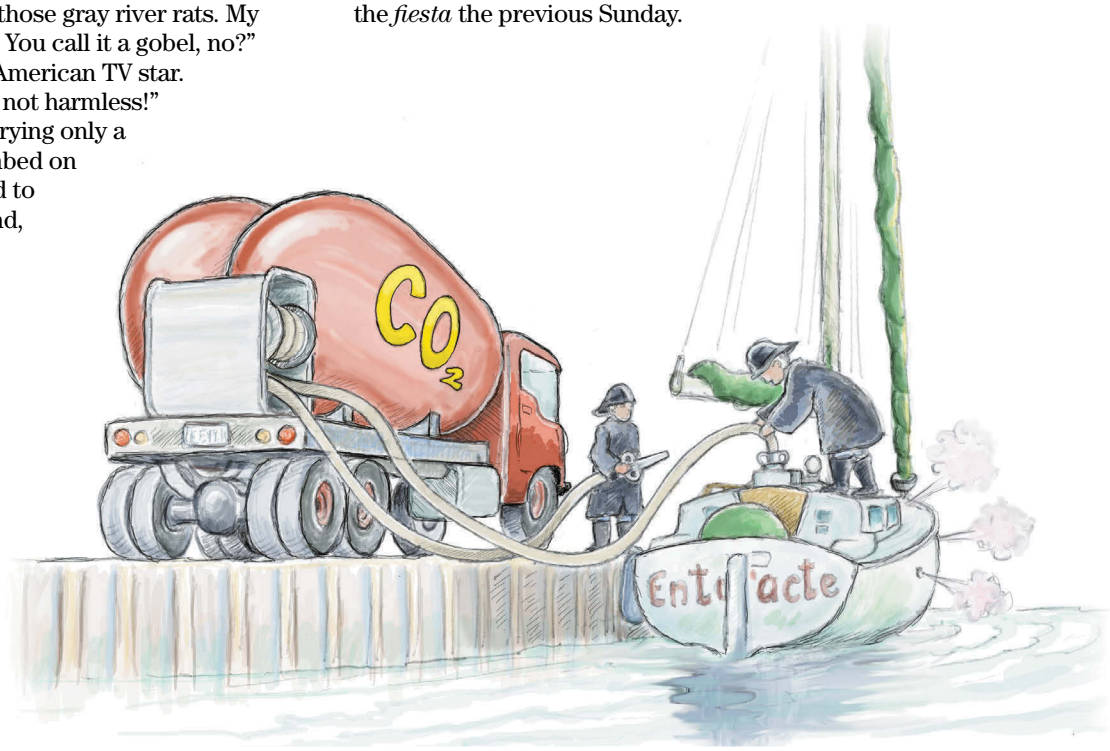
Oh please, let it be so!

All night long, Ellen and I waited. As the scratching and chewing began anew, it was like being inside a submarine during a depth-charge attack. All we could think was, "Die! Die!" He could be fried, crushed, decapitated, and stuck by that damn glue (and I knew firsthand how that one goes). But alas, the lights of the club remained lit as Little Rochefort partied on.

I didn't remember falling asleep, but we woke suddenly to a hellacious racket on the dock. I poked my head out to see, running in our direction at full tilt, four firefighters in full combat gear, including air tanks on their backs, towing a wagon filled with large tanks.

My God! Fire! That damn electric trap must have started a fire! "ABANDON SHIP! Ellen, get up, hurry!"

We both catapulted ourselves out of the aft cabin to land on the dock just as the firefighters came to a stop at . . . *Entr'acte*! The leader removed his oxygen mask and we recognized Alejandro, the husband of a friend we sat with at the *fiesta* the previous Sunday.



ILLUSTRATIONS BY FRITZ SEEGERS

"Don Eduardo, I am sorry we took so long to come but we were in Germany on a training exercise. Carina told me of your emergency and we have a solution that I know will work." Alejandro pointed to the large tanks. "We'll close up your boat and pump in carbon dioxide. This gas will displace the oxygen and *la rrrata* will flee or die. Go to the bar and take a *café*. This will be a good training exercise for my new men."

By now, everyone in the club had gathered around the *bombieros*. "*Ya-tay* Entrrrrract-*ay, ole!*" Our hearts still pounding from the fire scare, we just stood there laughing.

I wish that I could report that our little friend came staggering into the open, coughing and gagging as he jumped ship, but it didn't happen that way. Instead, we worked throughout the summer heat to get *Entr'acte* back in order. We repaired the entire electrical system, systematically unloaded and reloaded all our stores, and thoroughly cleaned and disinfected every nook and cranny, all the while searching for the body. But we never heard or saw the rat, nor did we find or smell the body.

Entr'acte was once again poised to depart for the South Pacific, but at dinner on the eve of departure, Ellen was quiet.

"What's wrong?"

"I don't know how to say this, but I'm just not ready to leave here. These past weeks have been so much fun. We've met so many new friends, and after everything that's happened, it seems so wrong to go running off."

"You call what just happened *fun*? What was fun? The sleepless nights, the mess, the 0200 Rat Glue haircut under the spotlight?"

The sudden silence crumbled into laughter so uncontrollable that we were crying.

Then Antonio and Tonia from *Habibi* appeared with a bottle of champagne and a card containing a crude photo of me dressed as a matador.

"Don Eduardo, we salute you. You fought your bull valiantly. Forevermore, Club Náutico will remember you as El Rrratador, Don Eduardo, el Ratito de la Maestranza de Sevilla. You are now a titled Spanish Don."

Epilogue

Five years later, somewhere in Fiji, *Entr'acte* is making close to 7 knots running before a stiff trade wind, the engine running to charge our batteries, when the oil-pressure alarm sounds madly. We'd blown an oil line. The seas are smooth behind the barrier reef, but we have only about an hour before we hit open water and the ocean swells. We have a spare oil line. If I work fast, I should be able to install it within our window, allowing us the security of the engine when we run the pass into the next atoll.

The engine room is covered with hot black oil. I squeeze, stretch, rotate, and manage to get a wrench on the line. *Entr'acte* rolls to a gust. The wrench slips and clatters into the bilge as something hits me on the face and ends up in my mouth. It's soft. And chewy.

"Hmmm."

It's a piece of dried tomato, a vestige of the *ensalada de muerte*. A drop of hot engine oil hits my glasses. I stop and lie there, remembering, and laughing.

"Oh Little Rochefort, whatever became of you? You changed our lives for the better in ways that can never be explained. I sincerely hope that you are living a long and happy life … somewhere else!"

ILLUSTRATION BY FRITZ SEEGERS

Ed Zacko is a Good Old Boat *contributing editor. Ed, the drummer, and Ellen, the violinist, met in the orchestra pit of a Broadway musical. They built their Nor'Sea 27,* Entr'acte, *from a bare hull, and since 1980 have made four transatlantic and one transpacific crossing. After spending a couple of summers in southern Spain, Ed and Ellen shipped themselves and* Entr'acte *to Phoenix, where they have refitted* Entr'acte *while keeping up a busy concert schedule in the Southwest US. They recently completed their latest project, a children's book,* The Adventures of Mike the Moose: The Boys Find the World.

TORQUOLOGY

Set fasteners to the right tightness with a torque wrench

BY ED ZACKO

"Remember, Eddie, one hand on the socket end of the wrench and your other hand perpendicular to the end of the handle. Now, pull gently until . . ."

Snap went the handle!

"I broke it!"

"No, Eddie, that's the way it's supposed to work. Pull until the wrench clicks and that's it."

I was 16 years old, in an ice-cold Pennsylvania garage pit under a car with Big George. We were replacing the main bearings on a '51 Plymouth and I had just used a torque wrench for the first time. I was doing a real grown-up job with a real grown-up tool and I was being taught by the best. Big George looked like Jimmy Stewart and his delivery was that same Jimmy Stewart drawl.

"Now, let's try the other side. Left hand on the socket. Nice steady pull. When you feel the click, stop."

Click! I was hooked!

Torque is a twisting force that operates in a way to rotate or turn an object. Those of us who get up close and familiar with our good old boats use wrenches frequently to apply torque to a nut or bolt to loosen or tighten it. When tightening, we usually keep going until that "feeling" tells us it's tight enough, but who hasn't at one time or another applied so much torque that the bolt has broken or the head has twisted off?

In many applications, getting the torque right is critical, and engineering organizations have calculated tables of specific torque values for every size of nut and bolt (see the table on page 25). Exceeding these values risks stretching or breaking a bolt, stripping threads, or damaging a part the bolt is being used to secure.

In a set of standard open-end or box wrenches, the length of each wrench is matched to the size of the fastener it is used for — short for smaller-diameter fasteners and longer for larger ones. The purpose is to limit the amount of torque that can be applied. If the wrench is used properly, there should be little danger of over-tightening unless you pull like Hercules. This is fine where the tightness of an assembly is not critical to its function, but when working on machinery, such as that Plymouth's transmission or its engine's cylinder head, torque matters. The car's manufacturer will have developed a specific torque value for every bolt in the assembly. The mechanic must know what those values are (they are in the service manual) because over- or under-tightening can lead to serious problems.

Enter the torque wrench, a special kind of socket wrench with a built-in mechanism that can be adjusted to tighten a nut or bolt to a specific torque.

Two popular types of torque wrench are the beam wrench (black handle) and the click wrench (silver handle), at top of page.

Standard wrenches are made in lengths to roughly relate to the torque they are meant to apply under normal use: short wrenches for light torque, longer wrenches for higher torque, above.

Purist engineers say that the only truly accurate way to measure tightness is by measuring bolt tension through "bolt stretch," that the torque wrench is a poor proxy for measuring bolt tension, and that tightness derived from a torque wrench is prone to many inaccuracies. While this may be true in the strict engineering sense, such measurements are far beyond the resources of us mere mortals, especially at sea. Thus, the lowly torque wrench will have to do. Besides, manufacturers of engines and other complex machinery have done their homework and established torque values for every nut, bolt, and screw in their products. Every car, truck, boat, or aircraft engine assembly I have ever witnessed employed a torque wrench. Plus, if it's good enough for NASA . . .

Measuring torque

In the US, the most common units used to express torque are the foot-pound (ft-lb), for larger fastenings, and the inch-pound (in-lb), for smaller fastenings that need lighter torquing.

A foot-pound of torque is defined as one pound of pull on a lever one foot long, the pull being perpendicular to the lever.

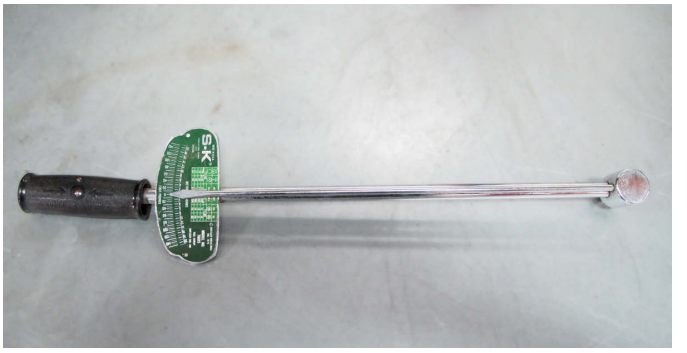
The metric units are the newton meter (N-m) for large fastenings and meter kilogram (M-kg) for small fastenings.

Applying 65 pounds of "pull" to a 1-foot-long wrench creates 65 foot-pounds of torque. The torque wrench is designed to measure this exactly. Torque wrenches are made in lengths to suit the torque values they are intended to measure — shorter for lower values and longer for higher values. Whatever the actual length of a particular torque wrench, it is constructed and calibrated to precisely achieve the desired torque.

Types of torque wrench

The beam wrench is simple and inexpensive. While not terribly accurate, it is better than nothing. The main drawback to this design is that reading the gauge at any angle other than from directly above can result in a serious error. Because the head does not ratchet, I found this wrench very difficult to use in the confines of our engine room aboard *Entr'acte*, where there was insufficient room to swing the wrench and read it correctly.

The click wrench is a vast improvement over the beam wrench. It is built with internal mechanisms that can be preset to the desired torque. To operate it, twist the handle until the indicator reads the desired torque, fit the wrench to the fastener, and pull gently. When the applied torque reaches the set value, the handle flexes with an obvious "click" that can be felt as well as heard. A lock at the bottom of the handle prevents the setting from changing while the wrench is being operated. This design is far more accurate than the beam wrench and not overly expensive. The click wrench is most desirable because its accuracy does not depend on the user being able to see anything. You can be in the most convoluted position putting all of your thought and energy into pulling that handle until you hear that rewarding "click." The click wrench has a ratchet head that makes it easier to work with in a confined space.



The beam wrench is not expensive, nor is it very accurate. Because the user must watch closely for the pointer to reach the desired torque on the scale, errors are possible.

The click wrench is more accurate and reliable than the beam wrench. These two, above, are sized and calibrated for different ranges of torque, the smaller in inch-pounds and the larger in foot-pounds.

The ratchet mechanism, at right, is essential for working in confined spaces.

This wrench is set to 27 foot-pounds or the metric equivalent of 9.5 newton meters. A locking handle is important to prevent changes while tightening.

Torque wrenches come in many sizes. Larger ones are calibrated in foot-pounds (newton meters) and smaller ones are calibrated in inch pounds (meter kilograms). They typically have the US scale printed on one side and the equivalent metric scale on the other.

The range of settings for a standard torque wrench can vary. The most common ranges are 10 to 150 foot-pounds, 20 to 200 foot-pounds, and 30 to 250 foot-pounds. For torque values above 220 foot-pounds, a larger wrench or a "torque multiplier" would be needed, but such high torque values are extremely rare.

Using a torque wrench

When embarking on a project that requires the use of a torque wrench, first determine, from the engine service manual or a table of torque specifications, the torque values needed for each fastener, and write them down. Then check them again.

Make certain that whatever you are torquing cannot move! Applying 60 foot-pounds of torque even to a heavy engine could move the engine unless it is properly secured, and that could lead to injury or damage to the boat.

Clean all friction surfaces thoroughly using either brake cleaner or acetone.

Lubricate all threads and friction surfaces with a quality oil. Engine oil works best. Avoid light oils such as 3-in-1 or WD-40.

Install each fastener in the proper sequence and turn them by hand until they are finger tight.

Set the torque wrench to one-third of the final desired torque (click wrenches). For a final torque of 88 foot-pounds, begin by applying 29 foot-pounds to each fastener in the prescribed sequence.

Using a torque wrench is always a two-handed operation. If you neglect to support the fulcrum with one hand you will at best be inaccurate but will also stand a very good chance of breaking a bolt or your hand.

Position your body and brace yourself so that you can make a nice smooth steady pull. (This can be a real challenge in a confined engine room.)

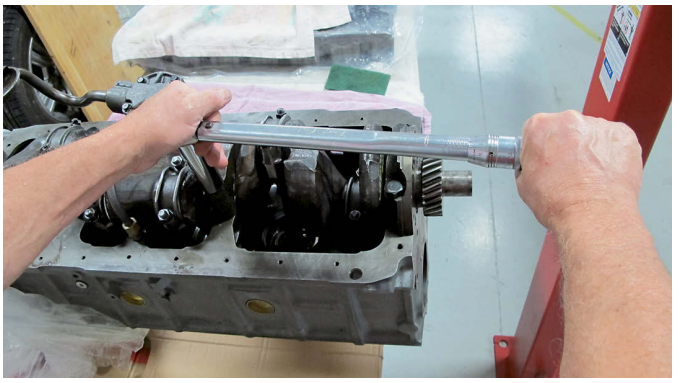
Make certain the ratchet is fully engaged.

Use precisely the right size socket for the fastener.

Never use a socket that is worn or has visible cracks — if the ratchet or socket slips or breaks it can damage the fastener or cause a hand injury.

Fit the socket onto the bolt or nut and place one hand on the socket end of the wrench to support the fulcrum. With your other hand, grasp the handle of the wrench perpendicular to the handle with your fingers facing into the direction of pull. Yes, this matters! Look directly at the needle (beam wrench), and with a gentle motion, pull steadily until the gauge reads 29 and stop. Do not jerk on the wrench and do not push it! With a click wrench, pull steadily until you hear and feel that unmistakable "click" and stop. Do this for each fastener according to the prescribed sequence.

Reset the wrench to 58 foot-pounds (two-thirds) and repeat the sequence.



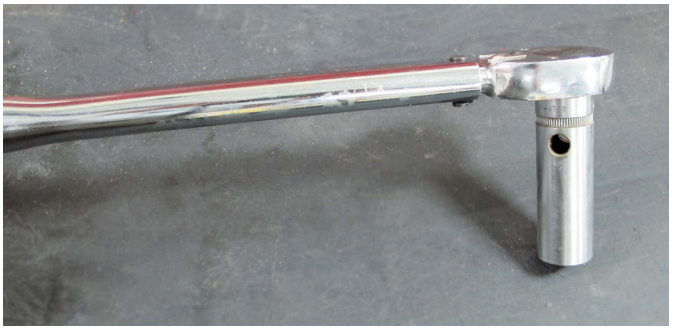
When using a torque wrench, one hand should be steadying the fulcrum while the other pulls steadily at right angles to the handle.

Finally, reset the wrench to the final figure of 88. In confined spaces with limited swinging room, the ratchet head of the click wrench is a definite advantage, but be careful. When using a click wrench it is possible to overtighten a fastening. As soon as the wrench clicks, *stop*! That's it!

Avoid long extensions and crowfoot accessories, as they flex and result in false readings.

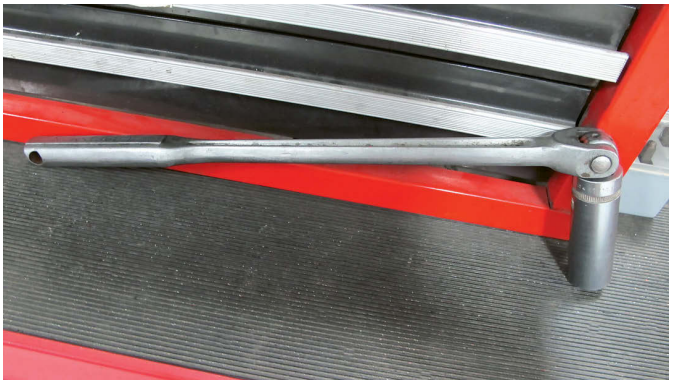
Using a torque wrench is serious business. If visitors drop by, ask that they return when you are done. There is a real danger that any distraction from the task could cause you to misread the manual or make some other dumb mistake.

To loosen and remove bolts, use a breaker bar, not the torque wrench. Working in the reverse sequence to that used



Crowfoots, extensions, and adapters, above upper, should be avoided, as they flex, twist, and slip, seriously reducing torque and compromising accuracy.

Deep sockets, above, are OK to use with a torque wrench as long as they are sound, a perfect fit, and free of cracks.



A proper breaker bar should be used to release fastenings from tension. Using a torque wrench as a breaker bar could damage it.

for installing them, release the tension in stages of approximately one-third at a time. This prevents undue stresses and damage to critical metal castings.

Maintenance

A torque wrench is a fine precision instrument and should be treated as such. Keep it in a sealed plastic box and stow the box where it cannot be splashed on or become immersed in water. Should the wrench get wet, rinse it with fresh water, dry it, and oil it well. Rust will destroy it. Inspect it periodically. After 25 years, our wrench looks and behaves as if new.

Never store a click wrench with the spring under tension, not even a little, but release the tension completely after use. A spring stored under tension will weaken and compromise the wrench's accuracy, which could result in stretched, broken, or stripped bolts, stripped nuts, cracked engine castings, and prematurely blown gaskets.

Who needs a torque wrench?

A torque wrench is not needed for tightening every nut or bolt on board. In most cases a standard open-end or box wrench will do nicely. A torque wrench will more than earn its keep, though, should a cylinder-head or exhaust gasket blow in an area far from the nearest mechanic (see "Dead in the Water," January 2015). Even if you carry the engine manual and spares for these two gaskets on board, and you should, without a torque wrench, your repair will be very short-lived and lead to serious engine damage. Perhaps you don't have the confidence to perform the engine work yourself, but having a torque wrench on board would enable someone with the experience to assist you who, without the proper tool, would be powerless to help.

Aside from complicated internal engine work, the torque wrench is valuable for many seemingly mundane tasks as well. Almost every part of an engine is designed to be installed and tightened to a specified torque. When installing

Sample Torque Values for Stainless Steel and Non-Ferrous Fasteners

Bolt Size	18-8 Stainless Steel		316 Stainless Steel		Silicon Bronze	Monel	Brass	2024-T4 Aluminum
	Dry	Lubricated	Dry	Lubricated				
4-40	5.2 in-lbs	4.4 in-lbs	5.5 in-lbs	4.7 in-lbs	4.8 in-lbs	5.3 in-lbs	4.3 in-lbs	2.9 in-lbs
6-32	9.6	8.2	10.1	8.6	8.9	9.8	7.9	5.3
10-24	22.8	19.4	23.8	20.2	21.2	25.9	18.8	13.8
10-32	31.7	26.9	33.1	28.1	29.3	34.9	25.9	19.2
5/16-18	132	112	138	117	123	149	107	80
7/16-14	376	320	393	334	349	427	317	228
— — //— — — — — — // — — — — — — // — — — — — — — // — — — — — — // — —								
1/2-13	43 ft-lbs	37 ft-lbs	45 ft-lbs	38 ft-lbs	40 ft-lbs	48.7 ft-lbs	35.2 ft-lbs	26 ft-lbs
5/8-11	92	78	96	82	86	111	76	60
1-8	286	243	299	254	265	344	235	184

Every bolt or nut has a suggested torque value relative to its size and the material from which it is made. These values do not refer to the maximum load but to the tightness at which the fastening will perform at optimum level in a given application without causing damage from overtightening. Notice that there are different values for lubricated and non-lubricated threads.

Note also that torque values are different for fasteners of the same diameter but different threads (see 10-24 and 10-32, for example). In this table, the units change from in-lbs to ft-lbs at the ½-inch bolt line. Tables from other sources might use a different breakdown.

Comprehensive tables can be found at engineershandbook.com/Tables/torque.htm.

such items as water pumps, fuel pumps, and thermostats, we usually tighten them by feel, but when is a bolt or nut tight enough that it won't vibrate loose? When is it too tight? Reading the sections about these items in the engine manual will reveal that their torque values are surprisingly light. When you use a torque wrench, there is no doubt when you have the tension right.

Even the lowly hose clamp is assigned a suggested torque value; for a #8 clamp (½-inch hose) it's 24 to 35 in-lbs and for the #20 clamp (1½-inch hose) it's 45 to 60 in-lbs. These are quite low values, far lower than we are tempted to apply by feel, and explains why our attempts at clamping hoses fail, either by cutting the hose or by overstressing the clamp.

I also use the wrench in certain rigging applications, such as chainplate installations or whenever multiple fastenings are involved, to ensure that they are all uniformly tight.

Choosing a torque wrench

When buying a torque wrench, assess your personal needs and select what works for you. I find that a small wrench of 20 to 200 inch-pounds (16 foot-pounds) and a larger one of 10 to150 foot-pounds have covered the entire range of anything I have encountered on board. The only exception is the large trailer-hitch bolts (250 foot-pounds) for our 15,000-pound-capacity trailer.

A quality click wrench can be purchased for as little as $50 and upwards. Don't look for a bargain. Whatever you might pay, remember, if it saves you a single dockside mechanic's bill, it has paid for itself three times over. Yes, using it is an acquired skill, but with a bit of practice you take one giant step closer to being self-sufficient when dealing with your good old boat.

Ed Zacko *is a* Good Old Boat *contributing editor. Ed, the drummer, and Ellen, the violinist, met while playing in the orchestra of a Broadway musical. They built their Nor'Sea 27,* Entr'acte, *from a bare hull, and since 1980 have made four transatlantic and one transpacific crossing. After spending a couple of summers in southern Spain, Ellen and Ed shipped themselves and* Entr'acte *to Phoenix, Arizona, where they refitted her. They have since towed her to the Southwest US and have also been cruising on her in the Bahamas. Follow them on enezacko.com.*

Read, Check, and Check Again —EZ

I learned the hard way how important it is to read the engine manual carefully more than once and to write down the torque values and tightening sequence before working on the cylinder head.

Way back in the "before time," I was retorquing *Entr'acte*'s cylinder head. I had clearly read the number 13 in the manual, and even though a little voice told me that this was a ridiculously light cylinder-head torque, I set the bolts at 13 foot-pounds. The engine started and ran well, and we proceeded to cross the North Atlantic without incident. After we'd arrived in the Azores, we had to change our mooring. The engine started, then immediately shut down with a sudden belch as water ran freely from the air intake, a classic example of a blown cylinder-head gasket.

The head-bolt torque in the manual was indeed 13 — newton meters — and next to it in parentheses was its equivalent: 86.8 foot-pounds. The manual had clearly given figures for both metric and US units, and had I read it more closely, I would have used the 86.8-foot-pounds number in parentheses. This is a very common mistake.

We were perhaps lucky that I made my mistake on the cylinder head, and luckier that the damage was not greater — an improperly tightened cylinder-head gasket will leak and allow cooling water to mix with the lubricating oil, or warp or crack the cylinder head causing an engine failure, perhaps at an inopportune moment. Had I made the same mistake on the exhaust manifold, the result might have been exhaust gases inside the boat, which could have been deadly, as those gases include carbon monoxide.