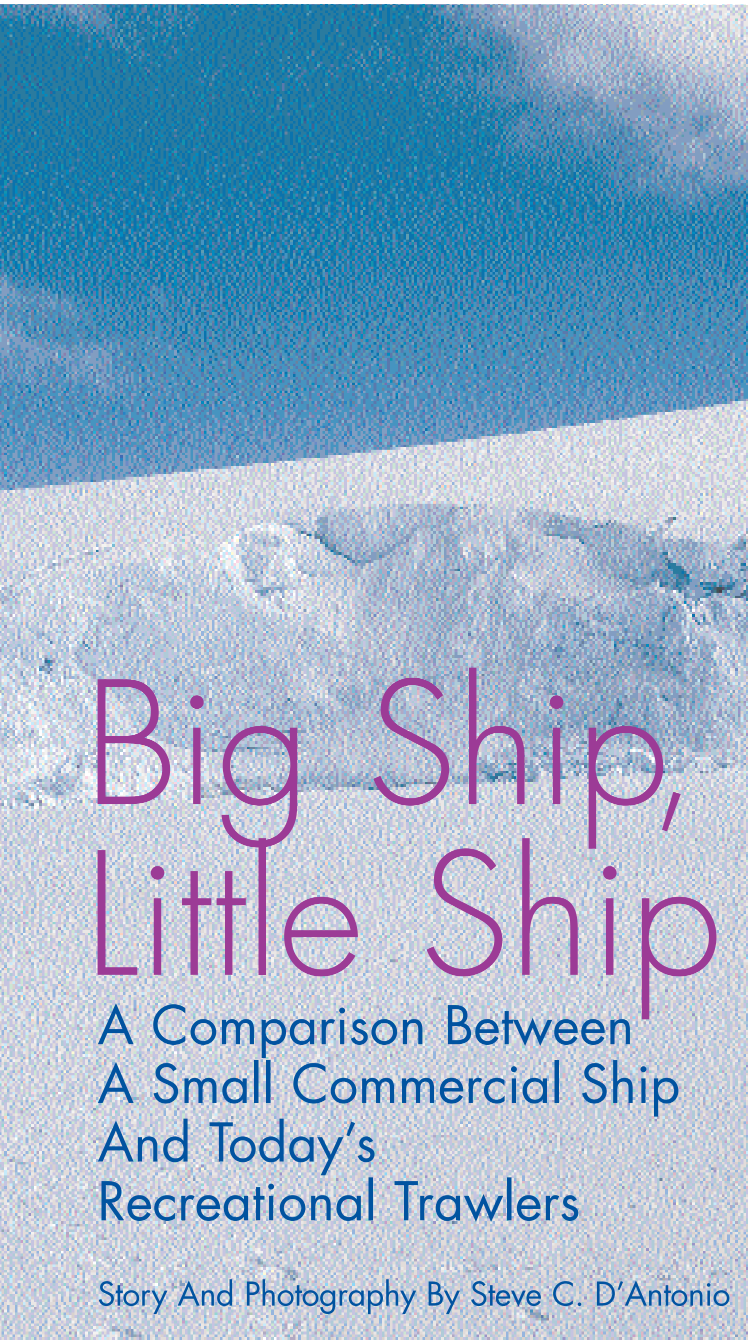
I felt a knee-buckling thud and then heard an echoing scrape as the stem collided with a 50-ton, 30-foot-long chunk of blue-white ice called a "bergy bit." My hand instinctively shot out, reaching for the ice-encrusted rail in order to maintain my balance. *Endeavour* shuddered for a moment as she regained lost headway through the frigid black waters of the Lemaire Channel, on the western side of the Antarctic Peninsula. This region, sometimes known as "the bottom of the world," has a long and storied reputation for devouring ships and men. (See "Mother of All Passages" *PMM* June '03 for the story of Sir Ernest Shackleton and his ill-fated Trans-Antarctic Expedition.)

Fortunately, this is a near-everyday event for a ship such as *Endeavour*, a 295-foot steel, ice-capable expedition trawler. Of course, this isn't something you'd want to try with your trawler unless it was specifically designed for ice work. As I was to discover in the nearly three weeks I spent aboard her, there were many valuable lessons to be learned from *Endeavour* and her crew, lessons that may be



Big Ship, Little Ship

A Comparison Between A Small Commercial Ship And Today's Recreational Trawlers

Story And Photography By Steve C. D'Antonio

Left: The author stands beneath *Endeavor*'s bow as she is "garaged" in fast ice at Port Lockroy on the Antarctic Peninsula. Don't try this at home, folks.

applied to more modestly sized recreational trawlers used in less extreme conditions.

How do the big guys do it? This is a question I've asked and heard asked many times in my career in the boatbuilding and service industry. What do commercial and passenger vessels use for propulsion, electronics, refrigeration, fire extinguishers, washing machines, etc.? Surely, if a Global Positioning System or diesel engine is used under commercial conditions, such as navigating in the Antarctic and pushing bergy bits out of the way, then it must be good enough for most trawler work, right? The answer to this question, in the majority of situations, is a resounding "yes." Simply put, tough gear designed for commercial use will usually serve well under less demanding circumstances. However, there's more to this story than simply buying good gear.

In November 2002, I sailed aboard *MS Endeavour* ("MS" stands for motor ship, which refers to the ship's internal combustion diesel engines, as opposed to "SS," which means steam ship), an expedition passagemaker that began life as a fishing trawler. To call her a cruise ship borders on blasphemy. Other than a dining area, bar and passenger cabins, *Endeavour* shares little in common with the ubiquitous horizontal apartment building, seagoing pleasure palaces. *Endeavour* is–because of her commercial trawler pedigree–all business, and she looks it.

Named after one of the ships used by Capt. James Cook, the famed 18th-century British explorer, *MS Endeavour* is unique among passenger vessels. She is one of only a handful of ships capable of making such a journey into the demanding conditions presented by Antarctic weather and ice conditions. However, the divergence in technology and materials between *MS Endeavour* and today's recreational trawlers presents a much narrower gap than that between her and the ship sailed by Cook, Her Majesty's Bark *Endeavour*. Shortly after boarding *Endeavour* at Port Stanley in the Falkland Islands, I began to take notice of the similarities between her systems and those on today's modern recreational vessels. Before delving into these, however, let's get to know *Endeavour* a little better.

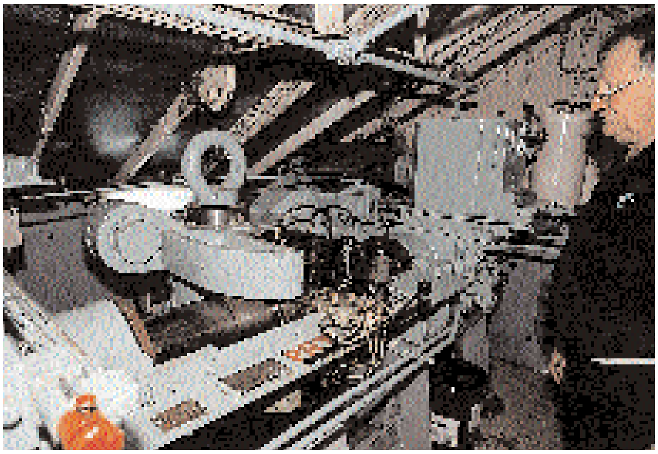
MS Endeavour, History 101

Endeavour, originally named *Marburg*, was built in 1966 by A.G. Wesser of Bremerhaven, Germany, for the Greenland and Newfoundland fishing grounds. In other words, she was designed to spend a great deal of time in places where gales, high seas and ice abound, trawling these tumultuous waters for salmon, whitefish, cod and shrimp. At the time of her construction, she was the largest, most efficient fishing trawler and factory ship in the world.

Because *Endeavour* was designed to not only

This region, sometimes known as "the bottom of the world," has a long and storied reputation for devouring ships and men.

catch but also process fish, she had to be stable and seaworthy. The crew working in the bowels of the ship sorting, cleaning and packaging the catch couldn't be debilitated by seasickness or instability

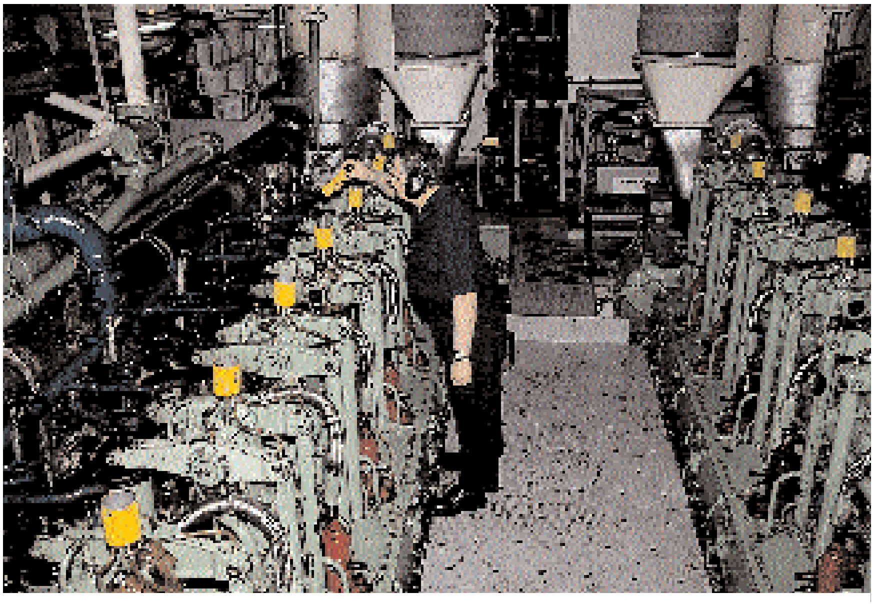


Firth watches over the hydraulic steering ram and rudder quadrant. The system uses electrical signals to actuate two hydraulic pumps, either one of which is capable of steering the ship. On commercial vessels, particularly those operating far from assistance, redundancy is a prerequisite.

(although I'm certain it takes a special type of individual to gut large fish in a gyrating, windowless compartment for days and weeks at a time). Still, *Endeavour* was designed to work in the worst of weather conditions without pause. Her ability to do this, however, ultimately led to her demise. *Endeavour* and her four sister ships operated with such efficiency that they eventually began to deplete the fish stocks in the areas they worked. As catch volumes fell, so, too, fell the profits. These ships, built to the highest levels of durability and sophistication, were very expensive. Returning to port with anything less than a full hold was simply not an option, and thus she and her sisters were mothballed after a comparatively brief 10 years at sea.

In 1983, *Marburg* received a second lease on life, undergoing a major conversion and refit in a Swedish shipyard and getting a new name, *Lindmar*. No longer would her holds and factory devour thousands of pounds of salmon and cod while pitching through frozen seas. Instead, she would haul a more valuable commodity: paying passengers.

After another refit in Canada in 1987, *Lindmar* was renamed yet again, first *Northstar*, then *Caledonian Star* and finally *Endeavour*.



Chief Engineer Robert Firth checks rocker arm lubrication on one of *Endeavour*'s MAK diesels. Although 35 years old, these engines are still running strong, thanks to regular maintenance and service.

A Real Hunk Of A Ship

Built to Class 1A1–Ice C specifications according to the Norwegian Ship Classification Foundation (also known as Det Norsk Veritas, or DnV) as well as the Convention for the Safety of Life at Sea standards (SOLAS, a guideline for merchant vessel safety first adopted after the sinking of *Titanic*), *Endeavour* is one tough little ship.

Endeavour is designed to work and thrive where other ships fear to go. To operate under the harshest conditions, her construction must provide the ultimate in robustness

Endeavour pushes aside 100-ton ice floes with apparent ease as she traverses the Scotia Sea, between the Falkland Islands and the Antarctic peninsula. Her steel hull was designed for this type of work, albeit in Arctic, rather than Antarctic, waters.

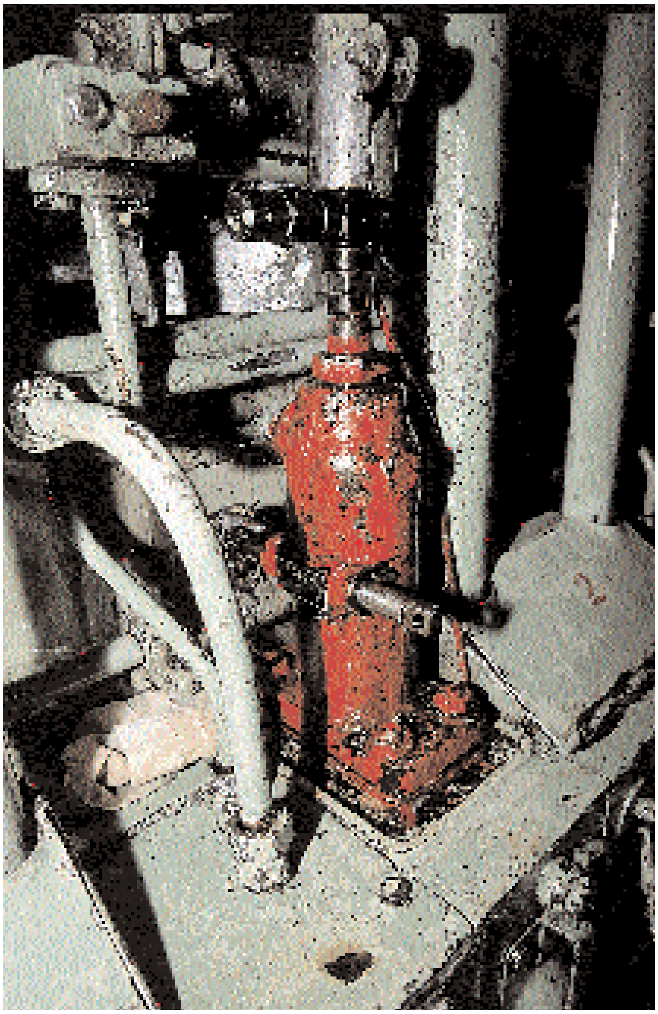
and seaworthiness. Her commercial high latitude fishing lineage ensures that her hull and deck structures are up to the task. Weighing in at 3,132 gross tons (compared to the average 40-foot trawler, which might tip the scales between 10 and 15 tons) and measuring 293 feet in length, with a 46-foot beam and 20-foot draft, *Endeavour* has what I like to call "the right stuff" in a seagoing vessel, be it a ship or a small recreational trawler. She's able to operate in close quarters, amongst ice and in narrow channels, while enduring the notoriously foul weather conditions of the Southern Ocean.

I asked *Endeavour*'s skipper, Leif Skog (a native of Sweden and merchant mariner for 36 years who comes from a long line of farmers, not, as he points out, unlike Cook) what makes her so strong. In a word, his answer was steel, and lots of it. *Endeavour*'s bow plating is high tensile steel, 1-1/4 inches thick, with the remainder of the hull measuring 5/8 inch. The thickness of the average steel recreational trawler's hull measures between 1/8 and 3/16 inch. Clearly, *Endeavour*'s hull is designed to contend with not only ice but also groundings.

Endeavour's thick skin is backed, not surprisingly, by oversized stringers and frames. The stringers, which run fore and aft, are composed of three 1-foot-tall-by-2-foot-wide, 1/2-inch thick "I" beams that run from the bow aft to the engine beds. Coincidentally, many well-built recreational trawlers do exactly the same thing on a reduced scale, albeit in fiberglass and foam or wood.

Just how tough is *Endeavour*, I wondered. Skog related a story to me about his encounter with what he called a "three sisters" wave pattern: three successive waves, each one taller than its predecessor. *Endeavour* was steaming in the Scotia Sea, between the Falkland Islands and Argentina, when she encountered the series of behemoths. The final wave was about 75 feet high. Surely, I thought, this must be an exaggeration, as many mariners are apt to inflate these numbers, particularly with the

Säterskog discusses *Endeavour*'s position and route with a passenger. *Endeavour*'s open bridge policy provides access for all passengers at any time of the day or night.



One of *Endeavor's* 16 main engine fuel injectors. Ths unit is over a foot tall.

passage of time. However, in this case, as Skog explained, the proof was ample. One of *Endeavour*'s inch-thick bridge windows, located 60 feet above the waterline, was blown out by sister No. 3. Hundreds of tons of green seawater succeeded in carrying away the port bridge wing steering station and the radar scanner while inflicting serious damage to the foredeck mast. Many other ships–particularly those whose bridges are located farther forward in order to create additional accommodation spaces–could not have survived this encounter as well as *Endeavour* did. *Endeavour*'s fishing trawler design played a large role, no doubt, in surviving the three sisters.

As mentioned previously, *Endeavour* is anything but an average cruise ship. Her graceful sheerline evidences a strong fishing trawler heritage. This feature is not only more attractive to the eye (and more expensive to build), but an enhancement to seaworthiness as well. Like all true single-screw trawlers, *Endeavour*'s design incorporates a full keel, not only providing rigidity and stability to the hull but also allowing for the occasional grounding. It wasn't unusual, during my passage aboard *Endeavour*, for the skipper to intentionally beach her on a steeply sloped sandy or shingle beach. Setting the anchor and then running her forward over the chain could easily hold her position, with the aid of the autopilot and a little forward thrust. Although this maneuver is somewhat unconventional, it is well established and practiced regularly by *Endeavour*'s crew. A ballast adjustment prior to beaching ensured that the bow attained maximum draft, thus protecting the remainder of the hull–although it wasn't entirely necessary, thanks to *Endeavour*'s full keel.

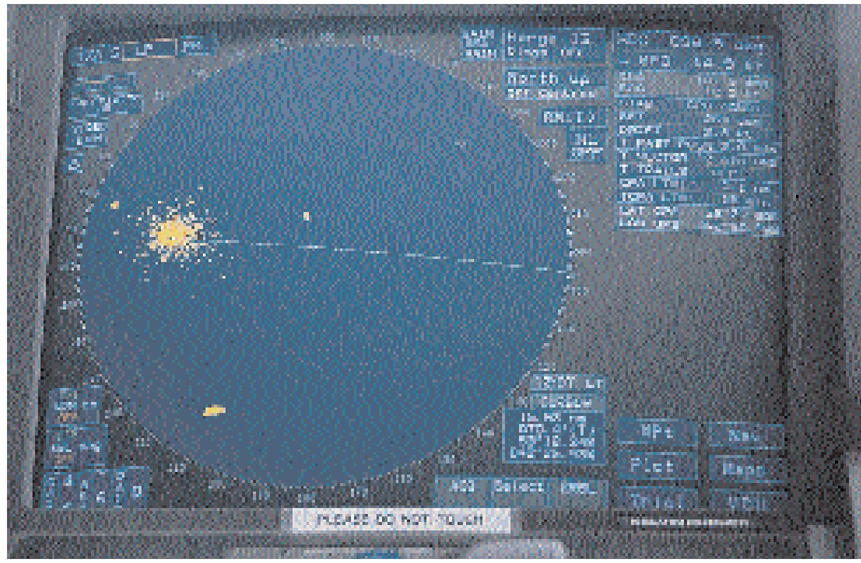
Next to a full-fledged icebreaker, *Endeavour*'s hull is about as tough as they come. Any skepticism among the passengers regarding this fact was quickly dispelled when the skipper decided to pilot the ship, in a procedure called "garaging," into 1- to 2-foot-thick fast ice. Driving *Endeavour* for her full length into a frozen harbor adjacent to the British Antarctic Survey station at Port Lockroy negated the need for setting an anchor and allowed the passengers the privilege of saying that they had walked ashore in Antarctica. Prior to entering the ice, in order to further protect *Endeavour*'s deep single screw, water ballast was shifted aft to increase draft at the propeller and keep errant chunks of ice from being drawn into the screw's vortex. *Endeavour*'s fully retractable, gyro-controlled fin stabilizers were also drawn into the ship's hull, as they are whenever they are not in use, before this maneuver to prevent ice damage and reduce drag.

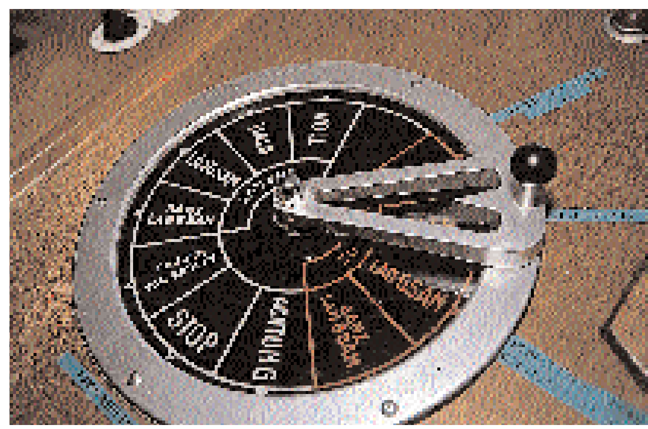
Engineering, Scott Here

Shortly after my arrival aboard *Endeavour* I sought out the chief engineer, a gregarious Aussie named Robert Firth. Firth, a merchant mariner for 42 years (28 of those as chief engineer), has shipped out on everything from oil tankers and freighters to cruise ships and eco-expedition trawlers like *Endeavour*. Firth knows *Endeavour* and her systems, from the bilge keel to her full-figured twin exhaust stacks, as well as the Bremerhaven shipwrights who built her. For a gearhead like me, *Endeavour*'s engineering spaces were the Louvre, the Taj Mahal and the Coliseum wrapped into one.

The heart of *Endeavour*, or hearts in this case, is her two tried and proven German-made MAK turbo-diesels. This same firm manufactured most of the power plants that propelled the dreaded Nazi U–boats of World War II. (If you want to see and hear these marvels in action, rent the movie *Das Boot*–or the English version, *The Boat*–one evening.) Producing 1,600 horsepower each, at just 300 revolutions per minute, the life span of these engines is measured in decades and tens of thousands of hours. Each of the eight pistons measures 15 inches in diameter and travels approximately 2 feet with every stroke. The average recreational trawler's diesels may be, by comparison, 300 or 400hp, with 4.5-inch diameter pistons that travel a mere 5 inches with every stroke.

Endeavour's venerable power plants have amassed a respectable 200,000 hours (that's 22.8 years, or roughly 60 percent of the ship's life) since they first propelled *Marburg* away from the docks at Bremerhaven 37 years ago. It is the MAKs'–and other large marine diesel engines'–infinite ability to be rebuilt that accounts for this long service life. The piston rings and bearings, as well as the occasional piston liner or cylinder, have all been replaced many times since these engines were first assembled. The pistons themselves are also replicable, although this is becoming increasingly more difficult as these engines age. New pistons must be custom made at great expense, and thus existing pistons are often rebuilt. During one of my many visits to *Endeavour*'s engine room, one of her engines' pistons rested in a passageway, awaiting shipment to a specialized machine facility where it would be refurbished. Rocker arm bearings are also becoming rare and expensive; *Endeavour*'s engineering crew improvises by making their own in the ship's machine shop. While I was there, a Filipino engineer stood at a lathe, ankle deep in bronze shavings as he made scores of new bearings.





Top: Icebergs to starboard and icebergs to port, *Endeavour*'s radar indicates where they are with accuracy, giving the bridge crew ample time to alter course and speed to avoid unwanted collisions.
Above: Vestiges of *Endeavour*'s fishing trawler past–here the engine order telegraph is labeled in German.

There are 10 watertight hatches located throughout the ship. These can be controlled locally or from the bridge, either hydraulically or manually.

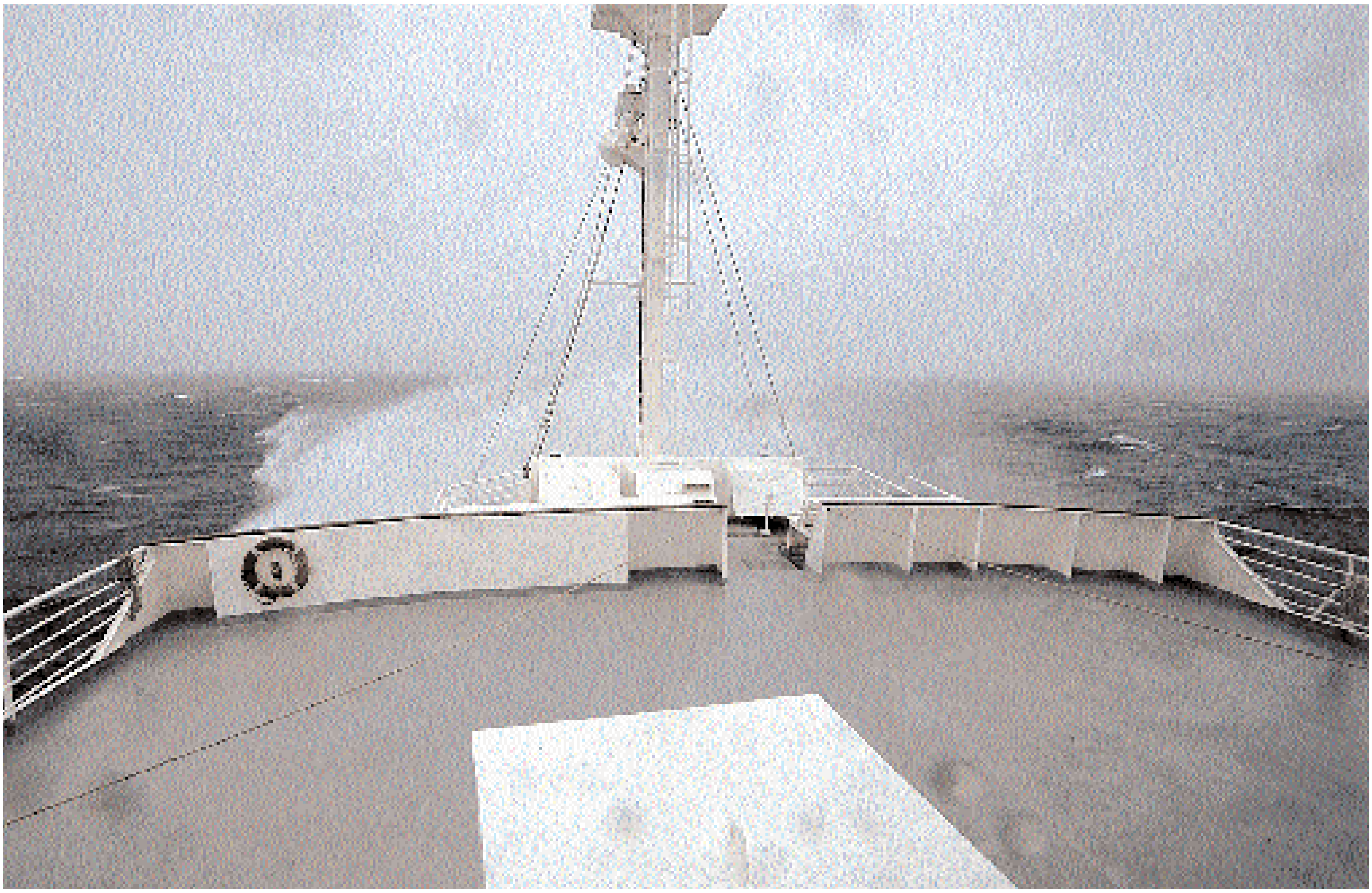
Small recreational trawler diesels, if they are of the lined cylinder variety, share much in common with *Endeavour*'s MAKs. All of the aforementioned components, bearings, rings, liners and pistons may be replaced when worn or damaged. It is unlikely, however, that those engines will require piston rebuilding unless they reach the maturity of *Endeavour*'s power plants.

The fuel injection system on the MAK diesels is also quite similar to that found on smaller engines, with one exception: its immensity. The injection pump is the size of a 200hp diesel engine. Each injector is as large as, and resembles, a full-size automobile's spare tire bottle jack.

The fuel supply for *Endeavour*'s diesels is filtered using a strainer-equipped centrifuge. Because of the quantity of fuel pumped–the fuel consumption for all ship's machinery, engines, gensets and boiler is between 2,800 and 3,400 gallons per day (higher in rough weather because of the need for additional propulsion, as well as increased stabilizer action)–conventional paper elements would quickly be overwhelmed. Instead, an electric motor pumps the fuel through a specially constructed and highly complex piece of machinery that spins the contaminants (including water) out of the solution. Strainer screens then trap them. Periodic cleaning of the screens is all that is required for reliable service. The lube oil is purified in a similar fashion, with one interesting addition: Steam heats the oil to drive out water and other impurities. Main engine lube oil (lube oil consumption is approximately 10 gallons a day per engine) is sent to a lab for analysis, along with dozens of other shipboard lubricants, every three months and replaced annually.

Keeping track of all maintenance items aboard a ship such as *Endeavour* is a monumental task. Chief Engineer Firth's job is made infinitely easier, however, thanks to a computer program that reminds him when each piece of gear is ready for its scheduled overhaul, cleaning, service or replacement. The same computer also tracks fuel and lube oil consumption, as well as remaining onboard supplies. *Endeavour*'s total fuel capacity of 76,000 gallons gives her a range, with a conservative reserve, of approximately 5,600 nautical miles at her cruising speed of 12.5 knots. In calm seas, she attains a respectable, trawler-like speed of 14.5 knots.

As noted earlier, *Endeavour* is equipped with two main propulsion engines but only one propeller. Power is transmitted from these engines through a unique Y–configured gearbox to the single shaft. Shaft speed is a constant 200 rpm, with speed and direction changes being accomplished through the controllable pitch four-blade, 11-foot-diameter Escher Wyss bronze propeller. Either or both engines may be placed online for propulsion. An interesting twist to this setup is the addition of a shaft generator fitted to the output shaft of each engine. (See "Marine Gears 101" *PMM* Feb. '03 for more on marine transmissions.) Generator windings arranged around the output couplings of both engines are able to supply all of the electrical needs of the entire ship (640 kilowatts at 400 volts each, which could provide for the electrical requirements of approximately 500 50-foot recreational trawlers). Thus, while the engines are running for propulsion, they may also be used to produce electricity, or one engine may be used for propulsion and the other for



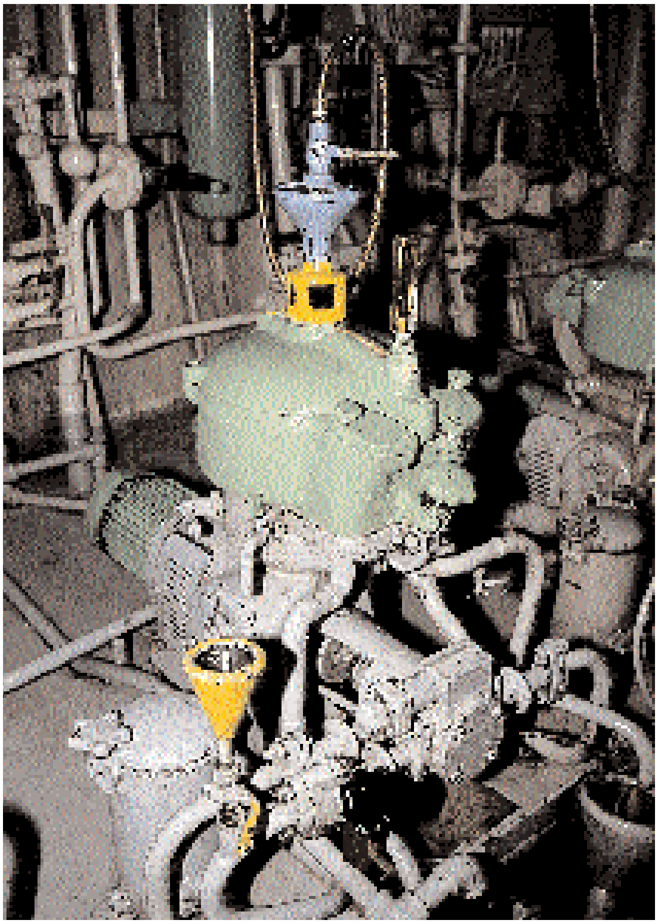
Rough weather in the Scotia Sea just north of Elephant Island. *Endeavour* was originally constructed to operate in the worst of sea conditions for extended voyages while fishing the coasts of Greenland and Newfoundland.

electrical production–not unlike a conventional diesel powered submarine (or U–boat) while it's operating on the surface. Remember, *Endeavour* was built in Germany only 20 years after the end of WWII.

When *Endeavour* was first commissioned as *Marburg* back in 1966, the shaft generators provided for all onboard electrical needs. Since her initial refit, however, a trio of 475hp, 315kW, 380-volt Cummins gensets has been added. Now, any two of these are capable of supplying *Endeavour*'s power needs, with a third in reserve for maintenance rotation. Finally, a single Volvo 127hp, 75kW genset is available for emergency use, should both shaft generators and two or more of the main gensets fail. By comparison, most 40- to 50-foot trawlers have all of their alternating current electrical demands supplied by a single (or dual on larger vessels) 5 or 10kW genset. *Endeavour*'s generators are pampered, having their 27 quarts of oil changed every 200 to 250 hours, or every two weeks.

Once I was able to drag myself away from *Endeavour*'s propulsion and electrical generation plants, I discovered a plethora of other fascinating machinery within the engineering spaces. Of particular interest is *Endeavour*'s ability to produce her own fresh water through an onboard reverse osmosis (RO) desalination plant. These units (there are two main plants, both manufactured by Offshore Marine Laboratories) are, with the exception of their capacity, virtually identical to those installed on smaller recreational craft. In this case, they amply supply the needs of approximately 180 passengers and crew, indefinitely. *Endeavour* requires approximately 7,000 gallons a day for all purposes; however, the chief engineer told me, using a selection of salty expressions, that laundry is the greatest single consumer, using approximately 2,500 gallons a day.

The RO process forces sea water through a semi-permeable membrane at very high pressures (look for a future *PMM* article on watermakers), thereby producing fresh water. One peculiarity of this process is its inability to cope with cold, and thus

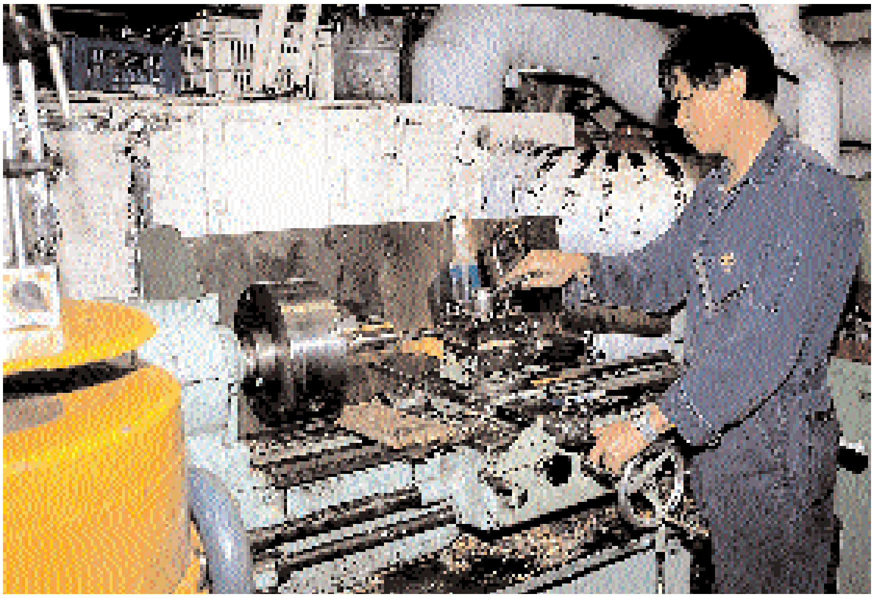


One of several centrifugal fuel and lube oil purifiers found in *Endeavour's* engine room. Ordinary paper element filters would be inadequate because of the quantity of fuel and oil that is pumped through these large propulsion engines.

very dense, sea water. As the sea water temperature falls, so does the efficiency of the system, until it eventually ceases to operate. Because the waters in which *Endeavour* cruises often hover around the freezing mark, it is necessary to preheat the incoming feed water for the RO plants. Raising the temperature of the sea water using the ship's donkey boiler (that's engineer-speak for a small, diesel-fired water heating unit) allows the RO units to operate at maximum capacity. In addition to *Endeavour*'s two main RO plants, any one of which can easily supply the entire needs of the ship, a smaller backup unit is also available for emergency use.

Into The Light Of Day

A friendly rivalry exists on all ships between engine room and deck crews, and it's easy to see why. They both perform tasks that are vital to the safe and efficient operation of the ship and thus are understandably proud of the work they do. I found *Endeavour* to be no exception. While Firth hovers over his engines, generators and other systems deep in the bowels of the ship, Skog exercises complete mastery of *Endeavour*'s bridge. With assistance from his chief, second and third officers, the captain ensures that *Endeavour* is safely and accurately navigated to each destination on the passage itinerary. In the Antarctic, where buoys, marks, lighthouses and correct weather forecasts are often nonexistent, this makes for extremely challenging ship handling, and thus *Endeavour* is equipped with the latest and most sophisticated electronic equipment.



One of *Endeavour's* assistant engineers makes rocker arm bearings in the ship's machine shop. Imagine—an onboard machine shop.

Perhaps the most important piece of navigation gear is the radar, particularly when operating in ice-clogged waters. Although GPS is useful and accurate in this region, it does have its limitations. Many of the charts are inaccurate or out of date, rendering the usefulness of GPS latitude and longitude coordinates questionable. Additionally, a GPS receiver will tell you, on a dark and tumultuous sea, if you are accurately following your course track; however, it will not tell you if there are million-ton icebergs in your path. *Endeavour*'s radars, when properly tuned, identified all but the smallest "growlers" and "brash ice" (small

Nadia Eckhardt, *Endeavour*'s cruise director (in orange jacket), acts as beach master during a landing at Stromness. *Endeavour*, in the background, has been intentionally beached in order to hold her position.

icebergs, less than 20 feet and 6 feet in length, respectively, that lie almost entirely beneath the sea's surface) while she traversed the ice-laden waters between the Falkland Islands, South Georgia and the Antarctic Peninsula.

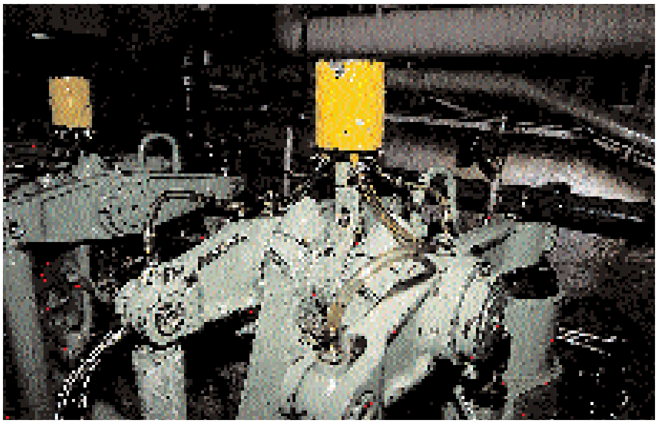
Endeavour is equipped with three radars: a Kelvin Hughes (KH) and two Furunos. All of these units are capable of extreme range up to 96 miles; however, each time I set foot on the bridge, they were all set on 12 miles or less. The KH and one of the Furunos are color, and their extremely large, open arrays provided superb resolution and distinction between even closely spaced targets. At least two units are kept running at all times, and the crew often use the different features of each simultaneously.

Endeavour is also equipped with two Furuno GP–1850D GPS units, one located within view of the captain's bridge chair and another at the chart table. I couldn't resist the temptation to ask if a sextant was aboard. Because it took some time to locate, I began to wonder if anyone knew how to use it. That concern was quickly dispelled, however, when Skog used it to determine, with seemingly little effort or doubt, that a distant tabular iceberg was 110 feet in height. In a nod to tradition and reliability, all charting and plotting work is done on conventional paper charts. *Endeavour* is not equipped with an electronic chart plotter of any sort.

VHF transceivers, the most common shipboard radio medium, are abundant aboard *Endeavour*. The bridge is equipped with three units, all DSC capable and manufactured by the Danish electronics firm Sailor, while the radio room, a small alcove located just off the main bridge, has one of its own. Between the bridge and radio room, there is no shortage of communications equipment aboard *Endeavour*. The inventory includes a Furuno DFAX 210 weatherfax; two TELEX transceivers; Satcom B and C transceivers (covering voice, fax and email); two Global Marine Distress and Safety System alarm receivers; several SSB transceivers, which included emergency units equipped with their own power supplies; an ICOM A22E VHF/UHF aviation transceiver for communication with aircraft; and a

2,182-kilohertz distress watch keeping receiver. Dozens of handheld VHFs are also used regularly by the crew and expedition guides for communication within the ship and during shore excursions. *Endeavour*'s single radio operator watches over all of this equipment, ensuring that it is properly tuned and functional at all times.

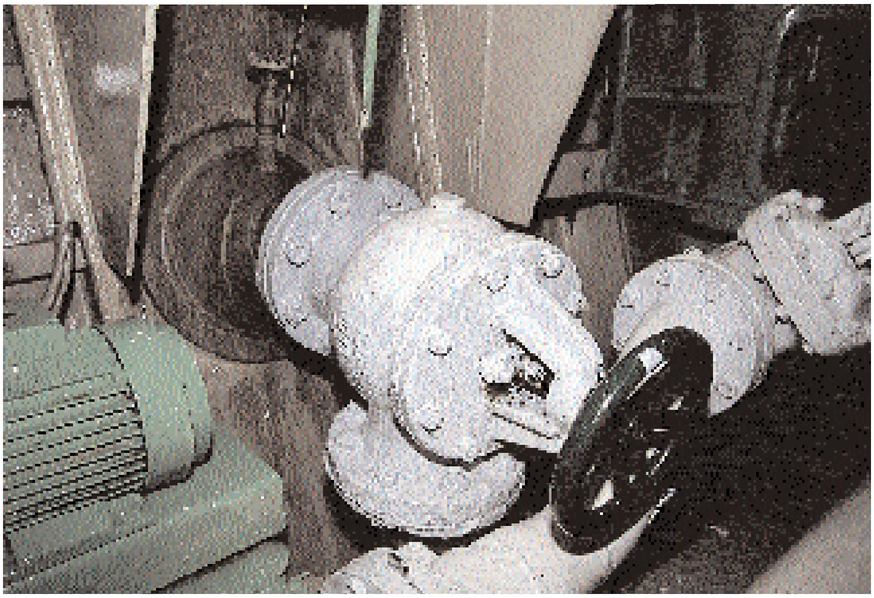
Other electronic gear located on the bridge includes an Anschutz autopilot, which is not interfaced to either GPS; courses are always hand steered by a helmsman or by autopilot and gyro-compass heading. A Robertson "off-course alarm" unit supplements and checks this arrangement when necessary. One of the most heavily used pieces of bridge mounted electronic gear is the Wesmar forward-looking retractable sonar. This unit, when properly tuned, is capable of looking for rocks, shoals and shallows, all of which abound in the Antarctic. It was used extensively on our voyage, particularly when entering shallow bays and harbors. Charts in this region often include warnings such as, "INADEQUATE SURVEYS, USE WITH CAUTION," and thus *Endeavour* and her crew are often forced to conduct their own surveys. Because both *Endeavour* and Capt. Skog have visited the region many times before, a considerable database of customized and proprietary charts has been created, thanks in large part to the forward-looking sonar. Several times during my passage, *Endeavour* was piloted close to shore, and the area ahead was then surveyed by sonar and a path-finding, fathometer-equipped Zodiac. Once the survey was completed, the sonar was safely retracted into its bow compartment, the anchor dropped and, as previously mentioned, *Endeavour* moved forward, over her anchor and chain.



Gravity feed oil cups require regular filling in order to keep the main engine rocker arm bearings lubricated. The engineer on duty does this several time during each watch

Although this sounds unseamanlike, it's worth repeating that this obviously practiced maneuver works well for this particular ship. Once the sonar's been retracted, no appendages protrude on the forward third of *Endeavour*'s hull, so there's little risk of the chain fouling any gear.

Design, operation and maintenance of steering gear aboard any single-screw, single-rudder vessel (recreational or expedition trawler) is critical. The diminutive (thanks to electronic and hydraulic assistance, large ship's wheels offering increased leverage are part of a bygone era) bridge wheel actuates electrical relays and contacts that send signals to hydraulic pumps located in the steering compartment. This compartment, located far aft and directly above the rudder, houses large, powerful hydraulic rams that move the rudder to port and starboard, following relayed electrical signals from the aforementioned bridge wheel. The system is equipped with dual pumps, either of which is capable of operating the system indefinitely.



Seacocks aboard *Endeavour* are lubricated and exercised regularly and disassembled for inspection and service during each drydocking.

If a failure occurs between the bridge wheel and the steering locker, the system can be manually actuated directly from this locker with radio-

Operating in poorly charted, ice-choked waters requires vigilance on the part of *Endeavour*'s bridge crew.

relayed instructions from the bridge. I asked Chief Engineer Firth what would happen if the rudder shaft parted or both hydraulic pumps failed. His colorful, expletive-laced response is not printable; however, he did note that it was unlikely and that it's his job to make sure it doesn't happen as a result of poor or irregular maintenance.

Because of the harsh weather conditions in which *Endeavour* operates, particularly in frigid Arctic and Antarctic regions, all of the bridge windows are heated. This is accomplished by laminating extremely fine heating elements into the thick glass panes. This system is remarkably effective in keeping the windows free of ice, snow and condensation without the incessant running of wipers or blowers. For ordinary rain and sea spray, conventional pantograph wipers and washers do the job adequately.

The bridge is also equipped with vital enunciator panels that indicate the state of fire alarms, fire doors (these doors, located throughout the ship, can be closed from the bridge in order to stop or slow the spread of fire) and watertight doors. Watertight doors, a total of 10 in all, can be operated from the bridge or locally using controls located at each bulkhead penetration.

In addition to the main bridge steering station, *Endeavour* may, not unlike larger recreational trawlers, be conned from bridge wing stations, which afford the helmsman a better view of the vessel's side. These are particularly useful when coming alongside a dock or another vessel. Maneuverability is enhanced thanks to a 500hp electric KeMeWa bow thruster. *Endeavour* departed and returned to the quay at Port Stanley, Falkland Islands, on a blustery day–it was blowing a sustained 25 knots, with gusts to 40–without the benefit of tugs. Capt. Skog and Chief Officer Joachim Säterskog, using the bridge wing steering stations, made these evolutions look effortless.

More Similar Than Dissimilar

Endeavour's scale dwarfs even the largest ocean-going trawlers; however, the similarities between the two types of vessels are nearly endless. Propulsion, electrical generation, refrigeration, freshwater production and waste treatment, to name a few, are all systems that I found to operate on the same principles, although on a grander scale, as the systems smaller recreational trawlers use. I would, however, draw two primary distinctions between the gear and systems used aboard *Endeavour* and the average recreational vessel.

The first, and by far the most important, is maintenance. *Endeavour*'s engineering department includes five engineers and seven crew members. These 12 individuals are focused on keeping *Endeavour* in top operating condition. *Endeavour* goes into drydock once a year, where, among many other tasks, all machinery below the waterline, the complex controllable pitch propeller, shaft, rudder, thruster, seacocks and stabilizers, are serviced and repaired. Regular and thorough maintenance is Firth's constant and everlasting companion. He does not wait for equipment to fail or break. Regular, computer-generated maintenance schedules ensure that down time is kept to a minimum. Cleanliness is also critical in shipboard maintenance. I was hard pressed to find dirt, grease or spilled oil in any of *Endeavour*'s engineering spaces. All machinery appeared to be kept in proper working order and was freshly painted or lubricated.

Second, as Skog emphasized to me early on in the passage, everything used on a commercial vessel such as *Endeavour* must be capable of not only commercial duty operation but also commercial duty operation at sea. For instance, the bearings in an ordinary commercial clothes dryer (such as that which might be found in a hotel) are not capable of enduring the loads and G forces placed on seagoing models. Thanks to the recognition of this fact by equipment manufacturers, the recreational trawler market has benefited from trickle-down technology. The GPS and radar units, EPIRBS, vacuum toilets and watermakers used by the "big guys" are often identical in every way except scale to the equipment found on today's high quality recreational trawlers.

While few recreational trawler skippers can afford to keep a full-time engineering crew, the benefits of regular and thorough maintenance, along with Firth's "don't wait until it breaks" service regimen, are clear. Service and maintenance routine will pay dividends in the form of reliability and longevity for your trawler's gear, just as it does for *Endeavour*'s. This gearhead learned a thing or two from one of the "big guys," and you can, too.