TASK SHEET

Repacking Conventional Stuffing Boxes

Text and photographs by Steve D'Antonio

TOOLS:

- common hand tools
- large adjustable wrenches or Channellock pliers
- pick set
- packing "corkscrew" extractor kit

MATERIALS:

- Packing can include conventional waxed flax, a synthetic variety, or a combination of the two. American Boat & Yacht Council (ABYC) Standards specifically prohibit packing material that contains graphite because of its potential for inducing galvanic corrosion.
- Water-resistant grease, such as Lubrimatic Marine Wheel Bearing Grease

ABYC REFERENCE:

- ABYC P-6 Propeller Shafting Systems

Replace old flax packing material when it loses flexibility and the ability to compress around the spinning propeller shaft in a near-watertight seal.

INTRODUCTION:

This Task Sheet will assist in properly evaluating and repacking a conventional stuffing box—steps essential to the reliability of vessels with conventional fixed-shaft drives. For boats in your care, replace packing material and the hose clamps connecting a stuffing box to the shaft log every four or five years or 1,000 hours running time, whichever comes first. (For a detailed discussion of stuffing boxes and alternative shaft seal options, see "A Guide to Stuffing Boxes and Shaft Seals," *Professional BoatBuilder* No. 206, page 46.)

There are two categories of conventional stuffing boxes: the carrier-nut variety, and the twin-tie-rod type. Both compress soft lubricated packing material into the space between the propeller shaft and the stuffing-box body to limit water intrusion around the spinning shaft.

Choosing the correct packing material is the vital first step. Traditional waxed-flax packing is available in a variety of diameters. In most cases, these are matched to the shaft diameter and specified by the manufacturer. In standard stuffing boxes a 2″ (51mm) shaft, for instance, utilizes ⅜″ (10mm) packing, while a 1.5″ (38mm) shaft uses ¼″ (6mm) packing. If you know the shaft diameter, obtaining the correct packing size is straightforward, but there are exceptions. Some stuffing boxes, particularly those used on vessels built in the Far East, may deviate from this protocol. In those cases, and in the absence of reliable information from the vessel or stuffing-box manufacturer, look for packing that slips into and completely fills the gap between the shaft and the inside diameter of the stuffing box or packing nut. A good service yard should have packing on hand in a range of sizes.

Modern variations on the traditional waxed-flax packing include Teflon and Gore-Tex, as well as graphite-based packing. While these variants tend to be more slippery and longer lasting than flax, they can in some cases work too well, not allowing enough water to pass; especially if improperly adjusted, they lead the stuffing box to overheat, causing excessive shaft wear and hour-glassing. For packing impregnated with graphite, there is an additional electrochemical caveat: because graphite is slippery and a highly noble material, when it is in contact with almost any metal—a stainless-steel-alloy shaft for instance—and the two are immersed in an electrolyte such as seawater, the shaft will be anodic (prone to corrosion). So use high-tech packing materials with caution, and monitor them closely after the initial installation. In some cases, a hybrid arrangement of

conventional and high-tech packing materials may provide the best results. As noted above, ABYC guidelines prohibit using graphite-based packing materials.

Ideally, repacking the stuffing box should be done preemptively rather than after a failure. This strategy means the task can be carried out while the vessel is hauled for seasonal storage or bottom painting; although, if necessary, it can be accomplished while afloat.

Repacking frequency can vary. If, because of chronic leakage, the stuffing box requires repacking every 300–400 hours or less, there's likely an issue with the shaft surface: pitting, water flow may be impeded, or the packing installation or adjustment technique may be faulty. Any flaw should be corrected before repacking the stuffing box.

However, if the packing has served well for 1,000 hours and is simply worn out, follow the repacking steps below.

PROCEDURE:

1 Inspect the stuffing-box installation, particularly the hose clamps, which are prone to corrosion where they are least visible—the lower section between the 5 and 7 o'clock positions. This may require a mirror or phone/camera. Clamps used for stuffing boxes should be all 316 stainless steel, and the T-bolt variety should be of the interlocking, rather than the spot-welded band, type.

Inspect the stuffing box and associated hardware, including the hose clamps that seal the connection to the shaft log.

2 When replacing clamps, the tightening hardware should be positioned on top of the arc between 3 to 9 o'clock to keep this corrosion-prone portion (particularly T-bolt clamps) as dry as possible. Before installation, apply a corrosion inhibitor that will not easily wash or rub off, especially the sections of the bands that overlap. (For more on hose clamps, see "Putting the Squeeze On," PBB No. 186, page 34.)

3 With few exceptions, stuffing boxes are the floating variety, which means they are attached to the vessel via a section of hose. Inspect the hose closely for any signs of deterioration, cracking, and defects. The hose may be either a proprietary 5-ply stuffing-box hose, or a section of SAE J2006 Wet Exhaust Hose (it should not be wire reinforced). As a matter of policy, whenever you remove a prop shaft you should take advantage of the opportunity and replace the stuffing box hose at the same time.

Hose must be quality multi-ply construction with no wire reinforcement.

4 Loosen the stuffing box locking nut(s), and back off the packing carrier nut or tie rod ram. Remove all the old packing with a pick or a proprietary packing-removal tool, which looks like a small corkscrew on a flexible shaft. It's important that all old packing and debris be removed completely. If you have access to compressed air, blow this area out (wear safety glasses).

Use a screw-ended extractor tool to pull the tightly packed, hardened flax from the stuffing box.

REPACKING CONVENTIONAL STUFFING BOXES

5 If the threads are green and crusty, clean them on the stuffing box body with a nonmetallic bristle brush or nylon scouring pad and penetrating oil. Then lightly coat the clean threads with a liquid lubricant—not grease and never anti-seize compound. While a green crust or verdigris is normal for bronze stuffing boxes, if any pitting or pink areas (indicating dezincification) are visible, the stuffing box should be replaced. If the box relies on stainless steel tie rods for compression, check them for discoloration and clean them in the same manner, or replace them if they're corroded.

Corrosion of threads and shaft indicates a failure that may require adjusting or replacing components.

6 If the vessel is afloat when all the old packing is removed, confirm that water flows through the now-empty stuffing box. The clearance between the shaft and inside bore of the stuffing box is usually surprisingly small, so the flow should be more of a lazy garden hose, rather than a fire hose. If water flow is weak or nonexistent, investigate the Cutless bearing and shaft log to ensure that the pathway is not clogged with debris, paint, or old packing material. Even a small blockage can reduce or completely cut off flow.

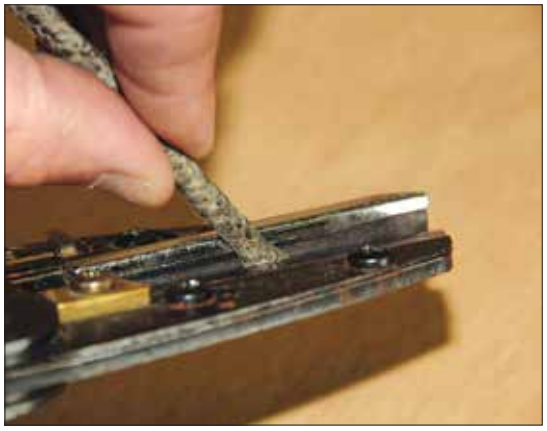
7 Unless specified otherwise by the stuffing box manufacturer, three and only three new rings of packing material should be cut. Match the inside diameter of each ring exactly to the outside diameter of the shaft, and cut the ends of each piece of packing on a roughly 45° angle so they mate in a tapered overlap.

8 Apply a coat of high-viscosity grease to the packing sections. This acts not only as a lubricant, but it also helps keep the sections in place as they are inserted into the stuffing box recess or nut carrier. The overlapping joints should be staggered approximately 120° apart at the 12, 4, and 8 o'clock positions.

Two wrenches are necessary to properly tighten and lock central, or multiple, tie-rod packing-adjustment nuts.

9 The packing nut or ram should be made snug, initially not much more than hand tight. At this stage it is better for the packing to be too loose than too tight. It will be adjusted after sea trials. If the vessel will not be immediately tested, make certain the nuts are properly locked to prevent flooding if the vessel is launched or inadvertently run by someone unaware of the stuffing box service. Never leave a boat with a partially assembled stuffing box. For conventional central-nut or twin-tie-rod stuffing boxes, locking nut(s) must be tightened against the packing adjustment nut(s) with two wrenches to create sufficient tension between the two nuts. Tightening one and then the other with just one wrench is inadequate and may lead to loosening and eventual flooding.

10 At launching and while under way, check for leakage (a small amount is normal). The boat should be slowly run up to cruising speed (roughly ¾ of wide-open



Cut the flax packing at 45° angles and long enough so the ends overlap and seal when wrapped around the shaft.

throttle) and operated there for 15 minutes while you monitor stuffing-box temperature and water flow/leakage. If all is well, run up to full throttle for approximately five minutes, again while monitoring stuffing-box temperature using an infrared pyrometer. It's important to shoot the stuffing box and not the shaft, because highly reflective surfaces such as shafts and hose clamps often give erroneous readings.

11 Ultimately the arbiter of correct stuffing box adjustment is temperature rather than drips per minute. With the ready availability of good pyrometers, drip rates are far less important than they once were. When properly adjusted, the stuffing box should leak little, and no part of it should exceed 30°F–40°F (16.7°C–22.2°C) above ambient seawater temperature, regardless of drip rate, while running at any speed. If it is overtightened, it may overheat, and the wax in the packing will melt, run out of the stuffing box as a liquid, and may accumulate in the bilge in a telltale greenish pyramid under the fitting, after which the installation will leak copiously. That scenario necessitates a complete repacking rather than a simple adjustment.

If necessary, this entire repacking procedure can be carried out while the vessel is afloat. In that case, after the packing nut is removed, secure several wraps of a rag around the stuffing box to temporarily stem the flow of water where the shaft exits. Water will leak during reassembly, but if you work quickly, it will be inconsequential.

Editor's Note: This guideline is not a substitute for following all applicable manufacturer and ABYC guidelines, as well as recognized marine industry best practices. PBB

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