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Emergency Steering Solutions

by

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Based on statistics we have been gathering in the decade we've been out cruising, roughly one-half to one percent (5-10 out of a 1000) of the boats crossing oceans each year suffer a rudder failure. In 2005, half a dozen boats broke their rudders while crossing the Atlantic. Experienced offshore voyagers consider successfully steering a boat without a rudder one of the most demanding feats of seamanship. Faced with the challenge, in the last few years many crews have simply given up and abandoned their boats. However, with the proper preparation and mental attitude almost any boat can be steered to within sight of a safe harbor. We have met more than a half dozen crews who have sailed hundreds and, in one case, over a thousand miles without rudders.

CAUSES OF RUDDER FAILURES

Rudders fail in one of four ways:

(a) The shaft breaks. If the shaft fails, the rudder blade will be lost, leaving only the stub of the shaft in the boat. A severe impact can break the shaft, more often on unprotected spade rudders than on skeg-hung rudders. Corrosion of a stainless shaft can result in failure on both spade and skeg-hung rudders. Finally, improper lamination can result in shaft failure on fiberglass/carbon shafts.

(b) The blade detaches from the shaft. This can happen in one of two ways. First, where the rudder consists of a stainless steel shaft with flat bar webs welded to it and foam and glass shaped over the webbing, the welds can fail at the webs if salt water enters the rudder. In this case, the positive flotation of the rudder blade usually holds it on the shaft, but when the helm is turned the blade does not respond. Alternatively, an impact can destroy the blade entirely leaving only the shaft. This happened when some acquaintances of ours hit a whale off Nova Scotia.

(c) On skeg-hung rudders, an impact at the bottom of the skeg can break or detach the bottom rudder bearing. This causes the rudder to drop down until the quadrant/tiller arm inside the boat jams against something. With only one bearing, the rudder will tilt and bind side to side. This happened to some

acquaintances of ours off the Oregon coast, where they probably hit a large sunken log.

(d) The rudder binds up. By far the easiest rudder problem to deal with, the culprit usually turns out to be fishing nets or monofilament line. Sometimes even after as much of the line as can be seen or reached has been cut away, the rudder will still be very difficult to turn. This usually occurs on skeg-hung rudders when some debris remains tightly wrapped in the bottom bearing

There are two basic messages in this litany of potential problems. First, both skeg-hung and spade rudders are vulnerable to failure. Second, many of the vulnerabilities can be identified and subsequent failures avoided with careful pre-passage inspection.

AVOIDING RUDDER FAILURES

As with so many emergencies aboard boats, the best way to deal with rudder failure is to avoid the situation entirely. We are occasionally asked by sailors getting ready to embark upon the cruising life what our single most important piece of equipment has been. I think they expect to hear us say something like refrigeration or a watermaker, neither of which we carry. Instead, I tell them we consider the steering system/rudder our single most important piece of equipment. The sails/rig come second and the anchor/windlass third. The GPS/good charts are fourth. Most of those getting ready to head off spend a good deal of time and do a more than adequate job preparing the second, third and fourth items. But many take the rudder/steering system for granted and have given it almost no attention.

The most proactive way to avoid rudder failure at sea is to spend some refit dollars on a new rudder and bearings even if it means giving up some creature comforts. It is possible to build a virtually failure-proof rudder, one of close to unbreakable design, for less than the cost of many watermakers. This is what we did on *Hawk*. We were very glad we had done so after we spent an hour bouncing the rudder off some rocks in a remote anchorage in Iceland. In the next harbor a diver checked the rudder for us, and he commented that we might have broken some rocks but the rudder looked fine. We later built a new rudder with slightly more sophisticated shape and took the opportunity to make it even stronger.

At a minimum we would suggest two actions before setting sail. First, a rudder that has a stainless shaft, use a moisture meter or drill a small hole in the bottom of the rudder to see if it is wet inside (the hole can be plugged with epoxy afterwards). A surprisingly high percentage of rudders on used boats will have moisture inside. If the rudder is wet, the stainless shaft/webbing will corrode and break at some point. To decide how and when to address this problem, talk to your boat builder and a good surveyor.

Second, drop the rudder down about 6 inches and inspect the shaft where it goes through the hull. This can be easily done with most spade rudders but will be a bit more difficult with a skeg-hung rudder. Any sign of corrosion, cracks, pitting, or poor lamination in this high load area signal a potential problem. The best solution may well be to have a new rudder built.

AFTER RUDDER FAILURE: STEERING SOLUTIONS

Being very diligent about making sure the rudder is strong and in good condition greatly reduces the odds of a rudder failure but cannot eliminate it. Massive impacts with deadhead logs or containers can damage even extremely strong rudders, and many corrosion and lamination problems cannot be detected until they reach the breaking point.

Your mental attitude will be the key factor in determining whether you are successful in sailing the boat to port without a rudder. First, even with the best emergency rudder solution, you will need to radically adjust your expectations as to how fast you will be able to sail and how good a course you will be able to steer. You should expect to do somewhere between one-third and one-half the boat's normal speed with the bow swinging through 60 degrees of either side of the desired course. Sailors who have experience with wind vanes will adapt to this more quickly as they know that with proper adjustment you average track can be quite straight. However, those who have only sailed with autopilots will have difficulty accepting this oscillation around the desired course.

In addition you must be persistent. Those we have talked to and the detailed accounts we have read about jury-rudder solutions describe three or four attempts on average before coming to a strong enough solution that gives them enough control to make decent progress. As the wind direction and strength shifts, the boat's balance will change and both the sail plan and the rudder solution will need to be adjusted. Even in relatively consistent winds and seas, the sail plan and jury-rudder will take constant attention to maintain the best course possible.

To successfully steer the boat without a rudder, therefore, demands both patience and persistence. Bear in mind that the slower speed and extra distance sailed may increase the passage time by a factor of four or more. Depending on the distance from land and the amount of stores aboard, the crew should consider rationing food and fresh water.

There are four basic approaches to emergency steering solutions. A workable steering solution will combine elements from several of the approaches.

Sail balance. Without a rudder, the boat's normal balance will likely change dramatically, and you will have to adapt your sail plan and trim to the new

balance. On an upwind course it is possible with some boat designs to steer without a rudder simply by properly balancing the sails. This will likely entail most of the drive coming from the jib, with a heavily reefed mainsail used as a trim tab – sheet in to steer higher and out to steer lower.

On a downwind course it is important to get the sails as far forward as possible and as balanced on both sides as possible. The traditional double headsail approach, with similar size jibs poled out both port and starboard, offers one workable solution. This approach was widely used and refined back in the days before good self-steering solutions (wind vanes and autopilots) were available. It is self-correcting, as when the boat yaws too much one way, a jib will back and push the bow back down. An alternative downwind approach, for stronger conditions, is to sheet a jib or staysail flat on the centerline. This is also a self-correcting sail plan as the jib will constantly be pushing the bow back downwind.

A reach will be by far the most difficult course to steer. An eased jib will be the best sail plan on most boats. But the course will change dramatically with small increases or decreases in wind speed.

Drogues. The loss of a rudder means the boat looses wetted surface area aft. This often unbalances the boat. Deploying a drogue adds surface area and can correct the balance. In addition by deploying the drogue on a bridle (one line to each stern quarter) and then adjusting the tension between the two bridle lines you can steer the boat. The vast majority of the people we know who have successfully sailed without rudders have deployed a drogue as a part of their steering solution.

Jury-rigged rudders. The most commonly successful jury-rudder solution consists of a large board (for steering surface area) and chain (to sink the steering surface underwater) attached to the end of a spinnaker pole to create a sweep. The pole is attached to the stern or the backstay in a way that creates a pivot, and the boat is steered using two lines led from the end of the pole through snatch blocks at the aft quarters to the primary winches.

The loads on this sort of rudder are quite high and both the board attachment to the pole and the pole attachment to the backstay/stern have to be extremely well executed. The most successful approach for attaching the board to the pole is to drill two rows of holes down the center of the board, with the two rows being slightly less than the pole diameter apart. Then you thread either large hose clamps or strong lashings thru each pair of holes and run the pole down thru the hose clamps or lashings. Hose clamps work much better but most boats do not carry big enough ones. If you use lashings, they will need to be twisted extremely tightly with ‘Spanish windlasses’. 20lbs-30lbs of chain (or diving weights) also needs to be tied to the pole end to sink it and keep the board from bouncing along the water’s surface.

The best approach for fixing the pole to the boat is to carry a spare spinnaker pole mast fitting that can be quickly bolted to the transom – it will need a large and strong backing plate to handle the loads.

Everyone we know who has tried to use an ad-hoc rudder has found it much more difficult to build strong and to provide much less steering control than they expected.

Emergency rudders. By far the best solution is to have a constructed emergency rudder stowed on board and ready to deploy. Experience suggests that an emergency rudder needs to be at the very least half the depth of the original rudder to provide steering control, with deeper being better. The shaft needs to extend above the transom for the tiller attachment.

The "cassette" rudder is widely considered the best design and is a common solution on round-the-world race boats. This design has four components: (1) Two gudgeons permanently (and strongly) fixed to the transom. (2) The "cassette," which has two bolts on its forward edge that slide into the gudgeons and aft from those two very strong rigid sides with a slot between. (3) The rudder blade, which slides down into the slot in the cassette. (4) A tiller designed to attach securely to either the cassette or the rudder blade.

This design has several advantages over the alternatives. First, it is relatively easy to install at sea, as the cassette can first be fixed on the gudgeons and then the rudder can be slid into place. One piece rudders are much more difficult to install because the waves will throw the rudder blade around making it all but impossible to line up the gudgeon bolts. Second, it breaks down into several components which make it easier to build and to stow. Third, cassette rudders can more easily be made strong enough to withstand the rudder loads than standard one-piece designs. Finally, if you make it yourself the cassette rudder is not that expensive a solution.

However, very few cruising boats carry any sort of pre-made emergency rudder, due to the extra expense and stowage challenge. Many cruising boats do carry wind vanes, and picking a wind vane design which steers its own dedicated auxiliary rudder rather than the boat's main rudder (such as the Hydrovane or WindPilot Pacific Plus) is an alternative. If they are large enough, these rudders can act as full-fledged emergency rudders and require little or no effort to set up.

In 13 running of the Pacific Cup, which runs from San Francisco to Hawaii, they have had a 2-3% rudder failure rate. In response the race has required an emergency rudder system for each boat that has actually be installed and tested. Their website (www.pacificcup.org, in the "inspections" and "race tips" tabs)

has a good collection of links with emergency rudder discussion, calculations and designs.

PUTTING IT ALL TOGETHER: GETTING HOME ON YOUR OWN

As with most potential emergencies, a multi-layered defense will be most likely to get crew and boat back to port safely. To deal with the possibility of rudder failure, crews should prepare a three stage response.

(1) Install a very strong main rudder.

(2) Carry a cassette rudder or a wind vane with an auxiliary rudder for use in the event the main rudder fails.

(3) In case the cassette or auxiliary rudder solution cannot be fit or as back up in case that too fails, be prepared to implement upwind and downwind sail plans to facilitate steering and carry a drogue and the supplies necessary to implement the pole sweep.

Even with this level of preparation, steering without a main rudder will be a challenge. But these steps should keep you from having to abandon the vessel. With patience and persistence you, like other crews before you, should be able to get the boat within sight of a port and within range of help.