Damage Control and Jury Rigging

Bill Leary
Safety at Sea Seminar

Key Concepts

- Plan for self-sufficiency and to minimize damage due to a casualty
- Avoid escalation
- Have the proper skills, tools, and materials aboard to deal with casualties at sea
- Repair boat sufficiently that it can reach a safe harbor without assistance
- Excellent planning guide at http://www.honeynav.com

What defines a successful voyage?

- Crew remains safe
- No outside assistance
- Intended landfall reached
- Vessel is in good shape at the end
- No harrowing stories

- What’s not so important?
- Departing on time
- Arriving on time
- Getting there first

Important decision:

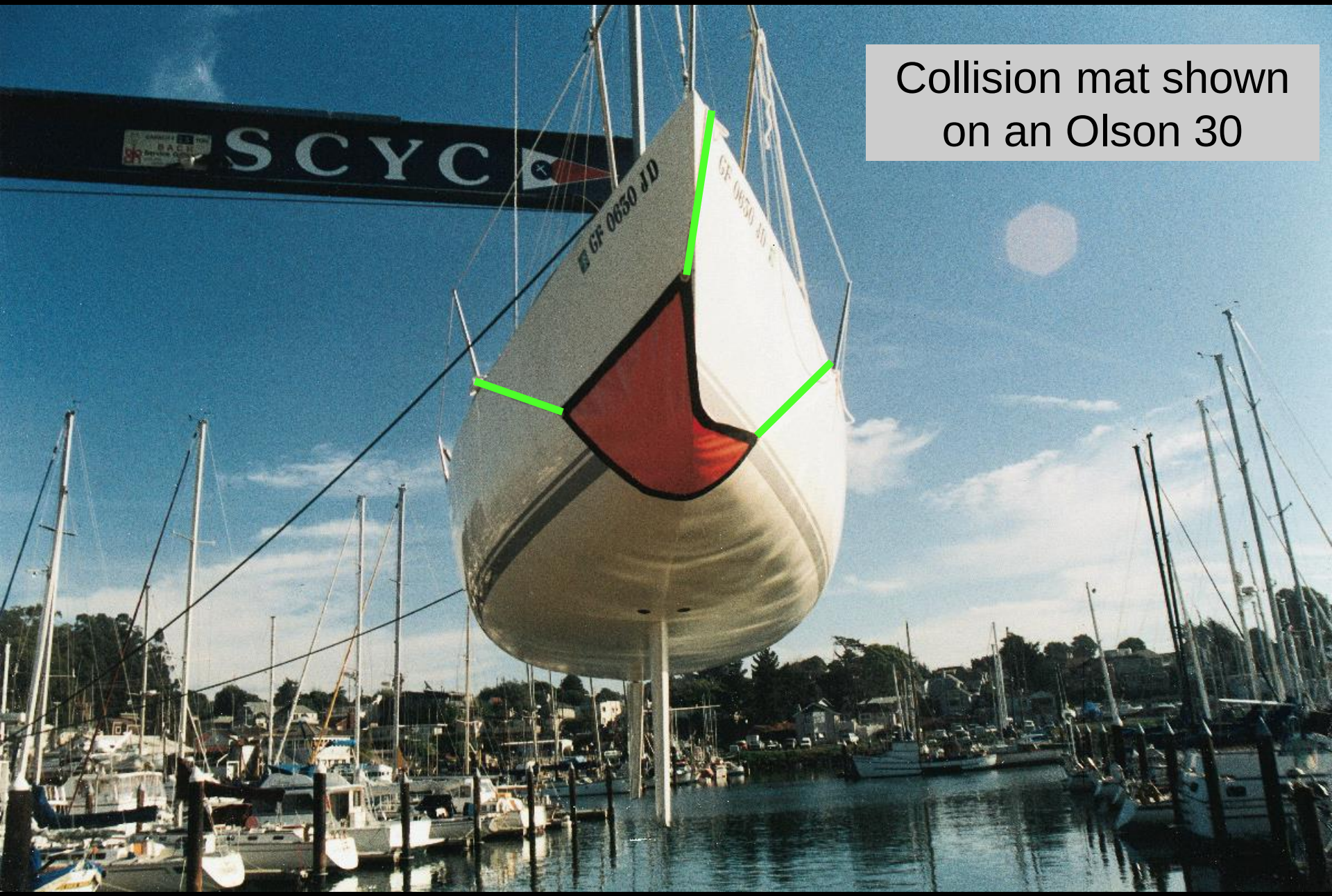
- Decide whether you’re still racing or not
- If you break your (only) replacement rudder, you’ll regret it.

Damage Control Categories

- Hull damage
  - Breach, keel problems
  - Down flooding
  - Loss of steering
  - Structural failures
    - bulkheads, delamination, chainplates
- Stranding (aground)
- Rig damage
  - Mast failure, boom/gooseneck failure
- Systems failures
  - Electrical, fresh water, sanitation, hydraulic

Flooding, hull breach

- Timely identification of source is critical
- Pumps cannot keep up with anything but a trivial leak
- Stemming the flow
  - Collision mats, small sails, cushions, DC plugs
- Support the damaged area from inside
- Patching materials
  - Underwater epoxy, patches (sailcloth and Splashzone)
- Thru-hulls and plumbing
  - Location, plugs



Collision mat shown on an Olson 30


95
GF 0630 JD


Standard Coast Guard Pump
100 gpm
400 lpm
Read the instructions, please!

Keel problems

- Not common?
  - Charley, Drum, Martela OF, Pandemonium, Coyote, America's Cup (several!), Skandia, Everest Horizontal, Schock 40, Open 60s, Volvo 70s, Rambler 100, Cheeki Rafiki, Polina Star III
- 3 presenters at this seminar have been aboard boats at sea when keels failed
- Problem of construction, design, or grounding
- Virtually assures a capsize
  - Can life rafts be reached?
  - Will heavy gear injure crew?
  - Can crew escape?
  - Can crew call for help?


RAMBLER 100

Downflooding

- Brought to attention after Fastnet 1979.

- Special regulations require:
  - No inward hinging hatches
  - Hatchboard(s) must tied to vessel and secured in place
  - Hatch slide must be opened from inside and out
  - Limit cockpit volume and specify size of scuppers
  - Securable cockpit lockers

Companionway on Assa Abloy Volvo 60

Structural failures

- Need to understand what is causing the problem
  - Falling off waves, mast compression, chainplate loading, broaches, grounding
- Eliminate forces: reduce loads
- Patch with available materials
  - Plywood, glass, carbon, Kevlar, resin, mechanical fasteners
- Highly dependent on DC kit contents
  - Tools, materials, fasteners, Band-It tool, drill motor, rivet gun, spectra

The extremely useful Band-It tool

Galvanized Carbon Steel also available.

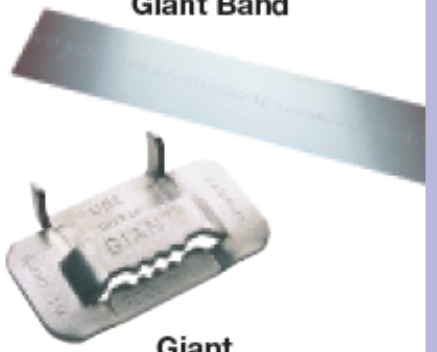
Giant Buckle Ear-Lokt Style

Part No.	Material*	Width In	Width mm	Package Quantity	Package Weight Lbs	Package Weight Kg
G44099	SS	3/4	19.1	25/box	1.8	0.8
G44199	SS	1	25.4	25/box	2.4	1.1
G44299	SS	1 1/4	31.8	25/box	3.2	1.4

Hand Tools for Band and Buckle

Part No.	Description	Package Weight Lbs.	Package Weight Kg
C00169	BAND-IT® Tool - For band widths from 3/16" to 3/4"	4.3	1.8
C00369	BAND-IT® Heavy Duty Tool - For band widths from 3/16" to 3/4"	4.3	1.8
C07569	Bantam Tool Low torque - For band widths from 3/16" to 3/4"	2.6	1.1
C08569	Bantam strapping tool - Low torque for band widths from 3/16" to 3/4"	2.6	1.1
C40099	Ratchet Tool - For band widths from 3/16" to 3/4" Ratchet style alternative to C00169	3.3	1.4
G40269	Giant Tool - For use with only Giant Band from 3/4" to 1 1/4"	10.4	4.5
J02069	Pok-It II Tool with cutter - For band widths from 3/16" to 3/8" wide	0.8	0.3
J07599	Thriftool®, 10 Pack - Applies tension, 3/16" - 3/8" wide band, BAND-FAST™, BAND-IT Jr.® Clamps	5.9	2.7

Giant Band



Giant Ear-Lokt Buckle

G40269 Giant Tool

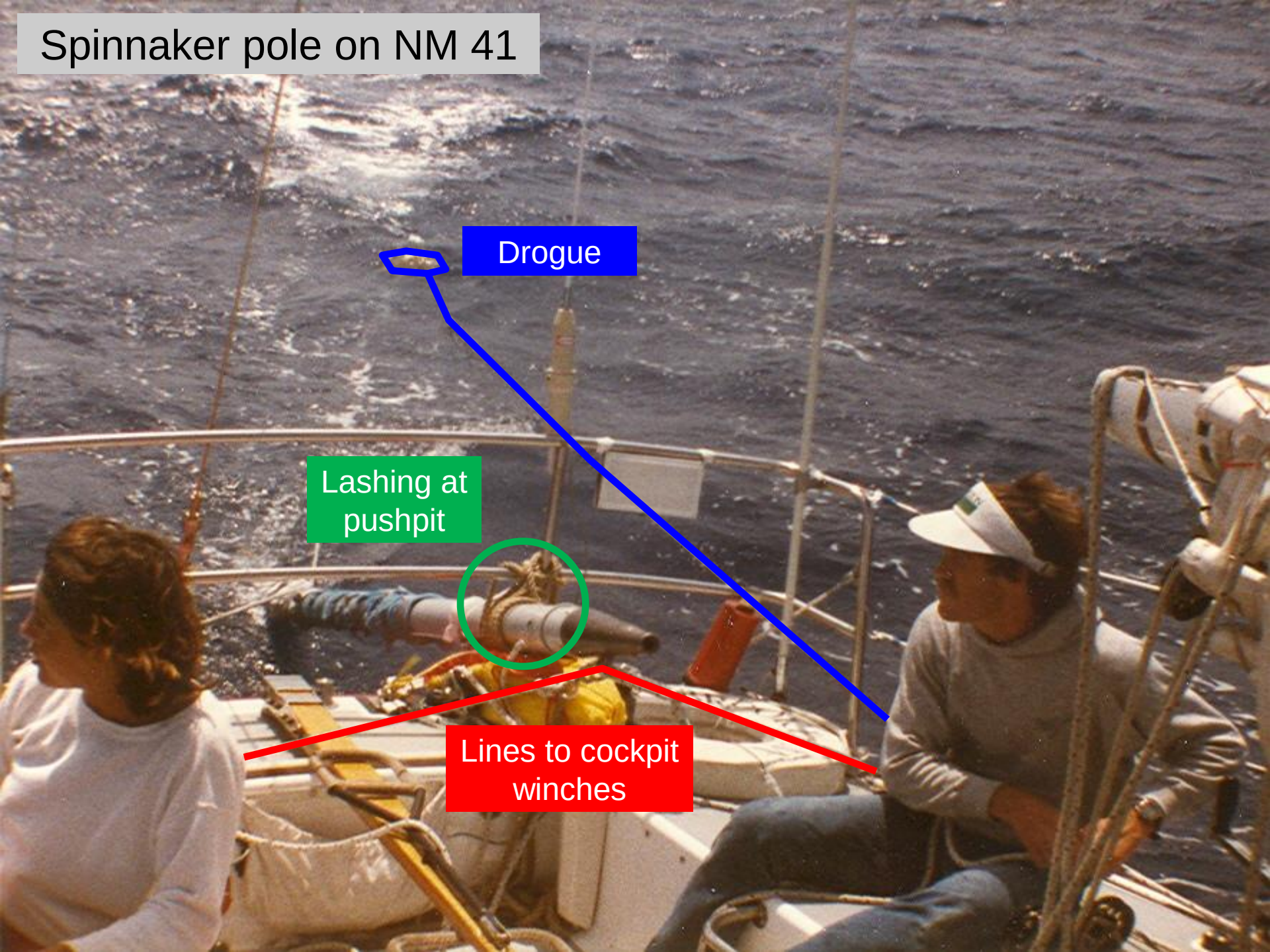
J02069 Pok-It II Tool with Cutter

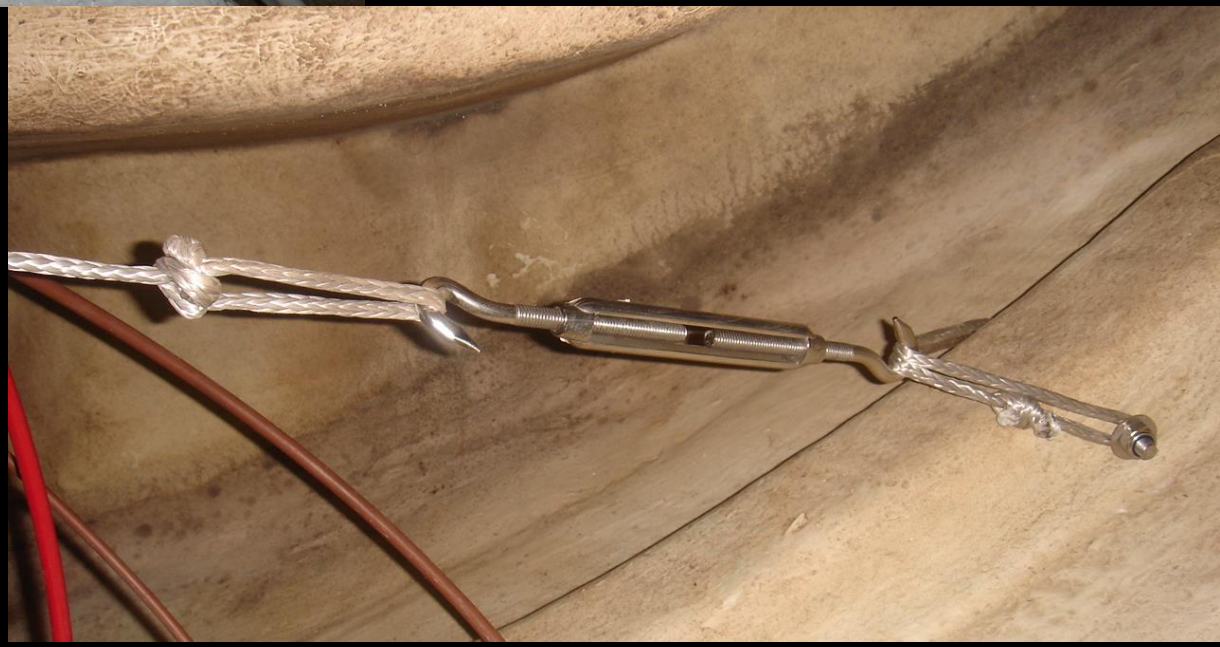

Club Med

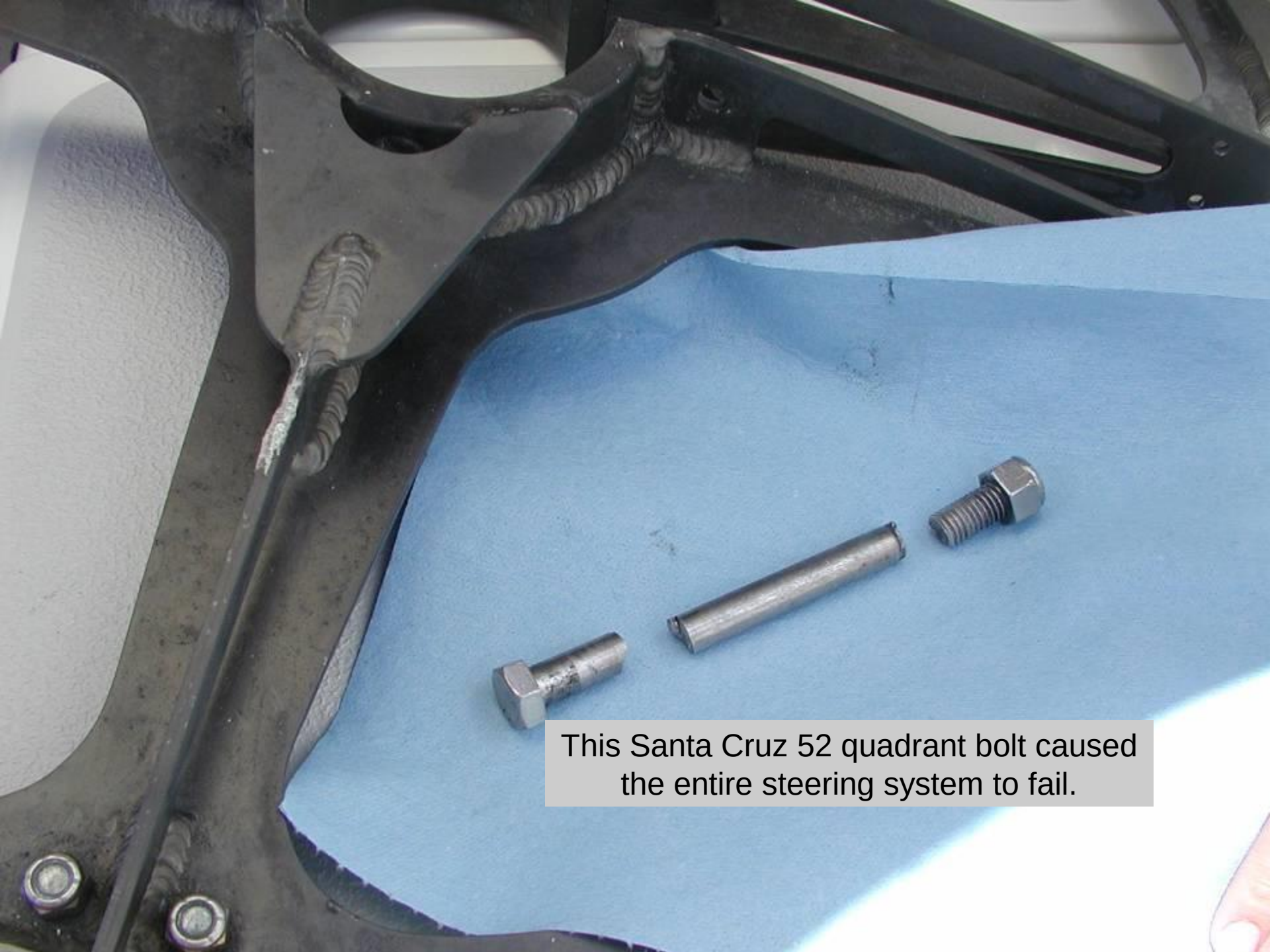
Loss of Steering

- Can be a failure of the steering system or loss of rudder
- Sweeps seldom work
- Emergency rudders design
  - Small surface area
  - Extremely strong
  - Able to be attached to the vessel at sea, and be used
- Emergency tillers should not require major dismantling of cockpit/pedestals
- Must reduce speed and keep boat balanced

Spinnaker pole on NM 41







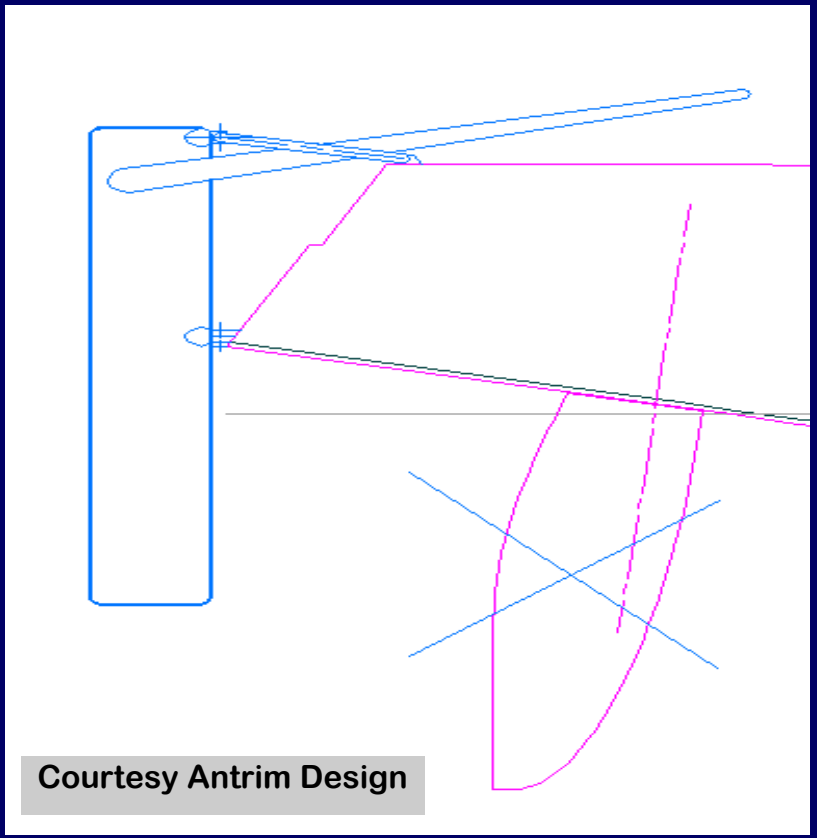
This Santa Cruz 52 quadrant bolt caused the entire steering system to fail.

When you lose your rudder

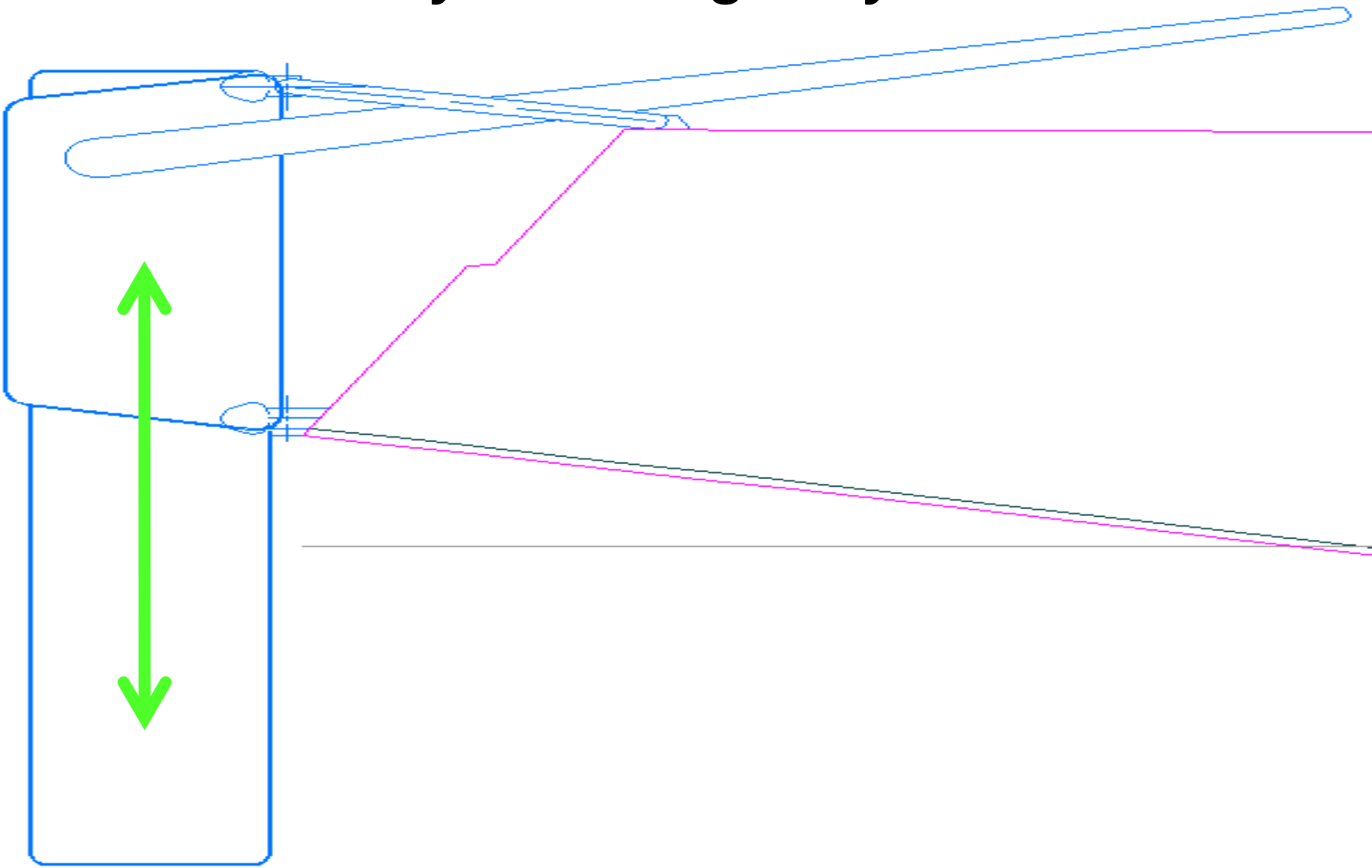
- “Out of Control” takes on a new meaning.
  - Fin keel boat may spin like a top
- Emergency Rudder tests you did at home will not prepare you for this experience!
- Deal with problem calmly, crew harnessed to boat.
- Deployment of emergency rudder will be very difficult with boat swinging
- Drop sails. Raise working jib. Sheet in hard.
- Deploy drogue tied to stern until new rudder is fitted.
- See www.antrimdesign.com

Guidelines for building an Emergency Rudder

- Draft half of original rudder
- Area half of original rudder
- Thick foil to keep it strong
- Rough surface finish OK – may help with fat foil
- Design guidance at https://pacificcup.org/kb/emergency-rudder-design-guidelines

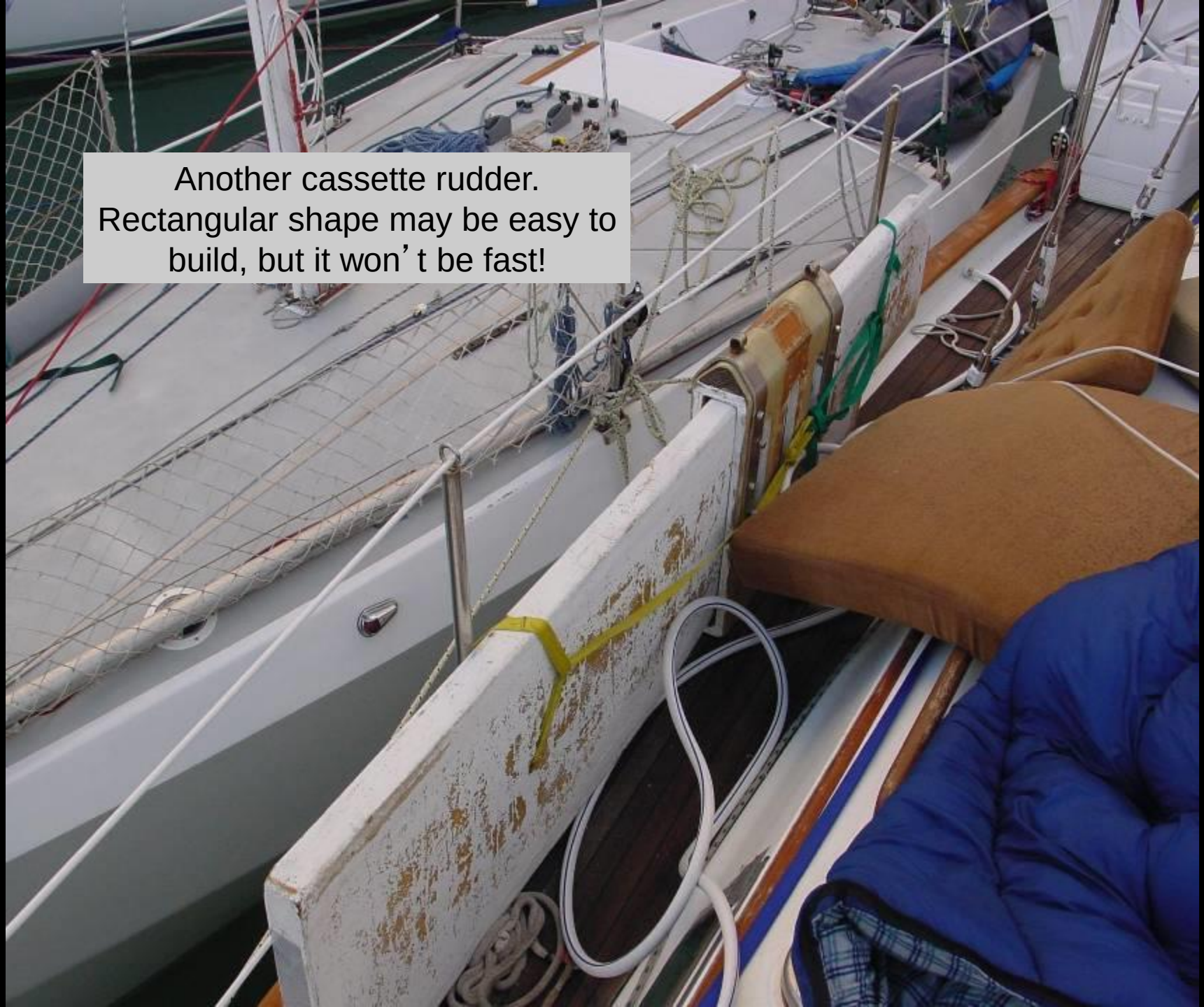


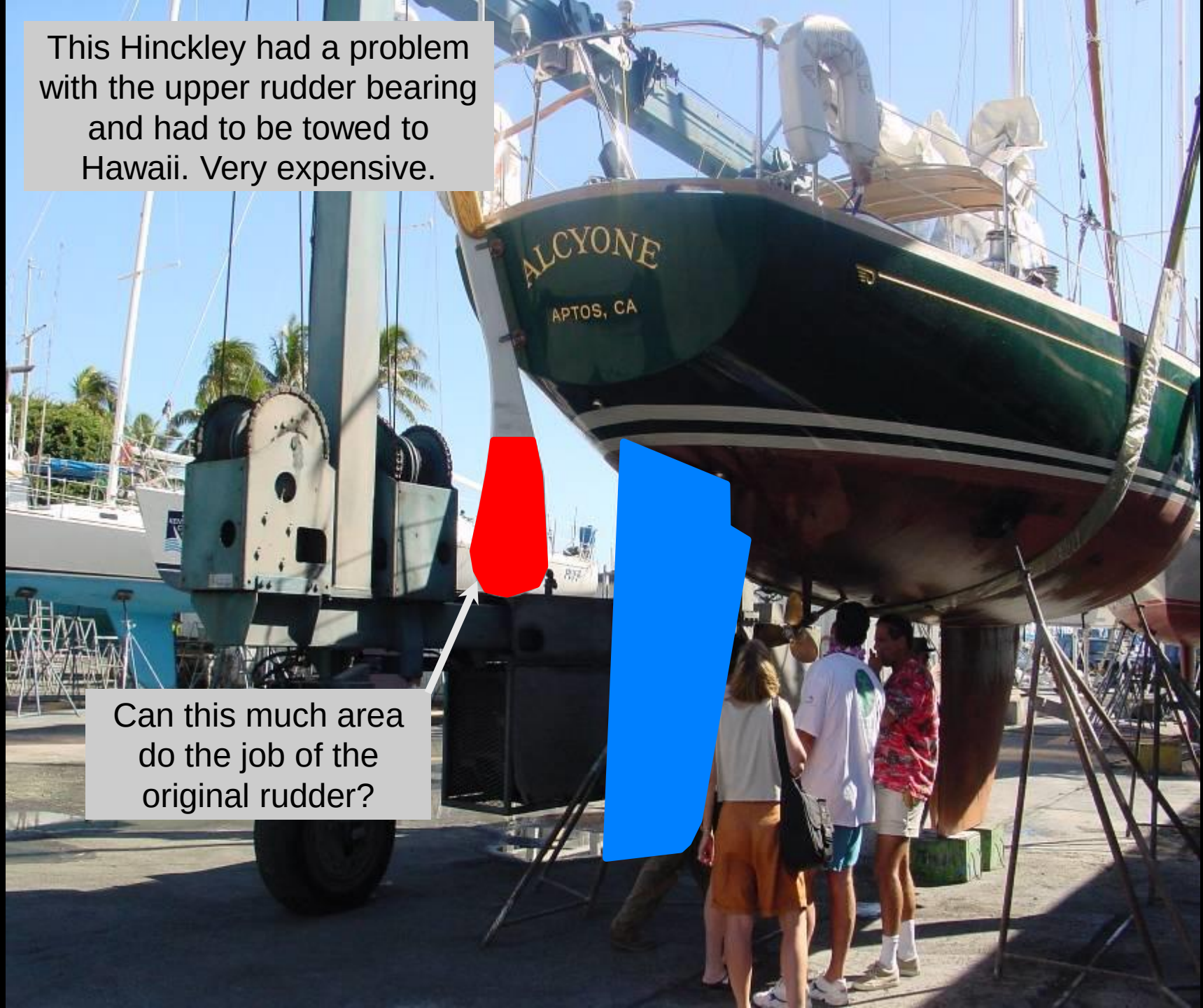
Cassette-style emergency rudder



Courtesy Antrim Design

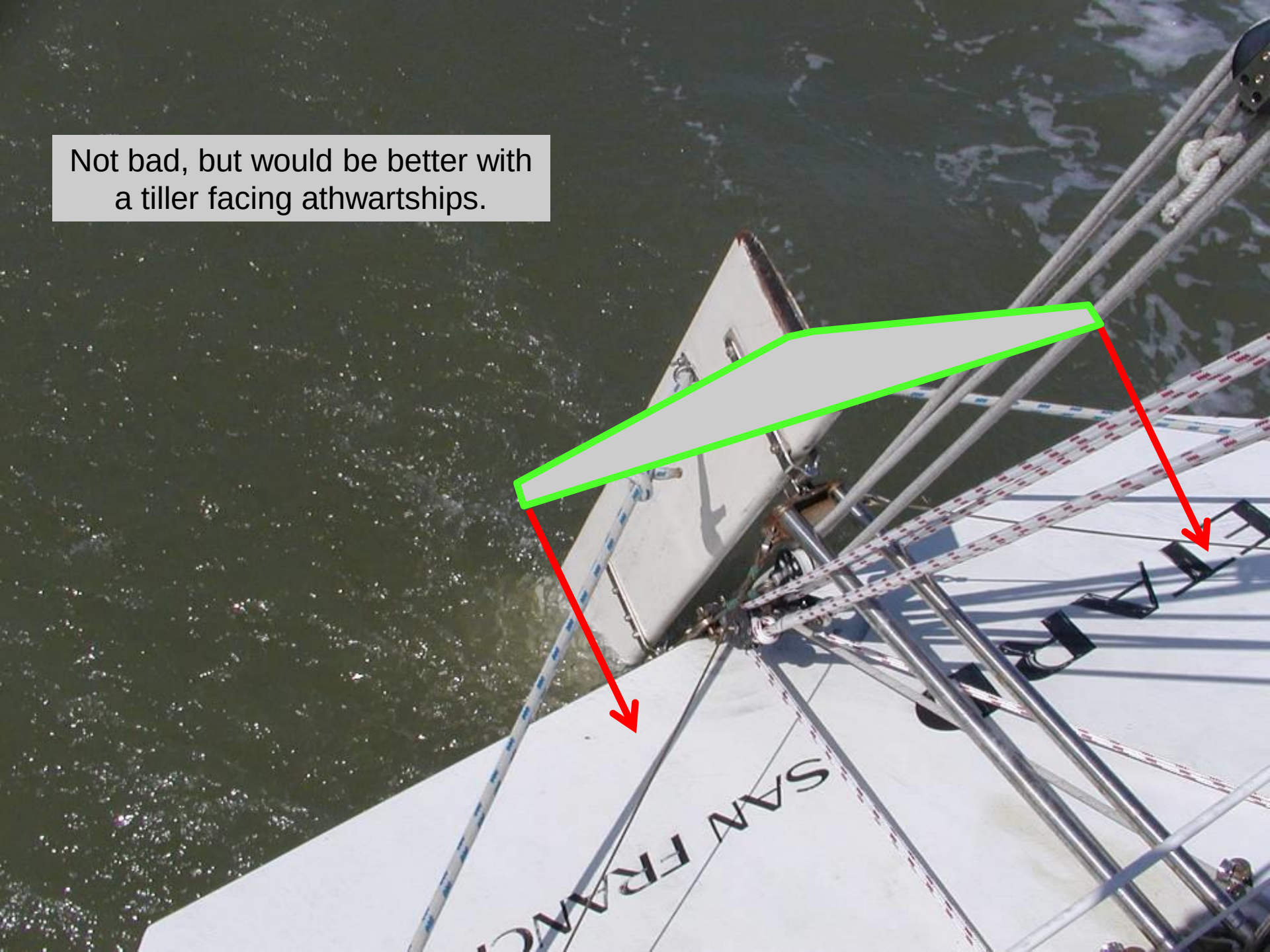
Cassette style rudder
turned 90 degrees


Another cassette rudder.
Rectangular shape may be easy to build, but it won’t be fast!


This Hinckley had a problem with the upper rudder bearing and had to be towed to Hawaii. Very expensive.
ALCYONE
APTOS, CA
Can this much area do the job of the original rudder?


Santa Cruz 52. Pedestal needed to be removed. Emergency tiller had to be lengthened.


This is a nice try, but it absolutely won’t work.


Not bad, but would be better with
a tiller facing athwartships.


Santa Cruz 70 rudder using Schaefer lead blocks for gudgeons.
Note distance between lower Bearing and top of rudder

T Track bolted to transom.

Steering lines leading to tiller.

Volvo 60 with large gudgeons for emergency rudder already installed.

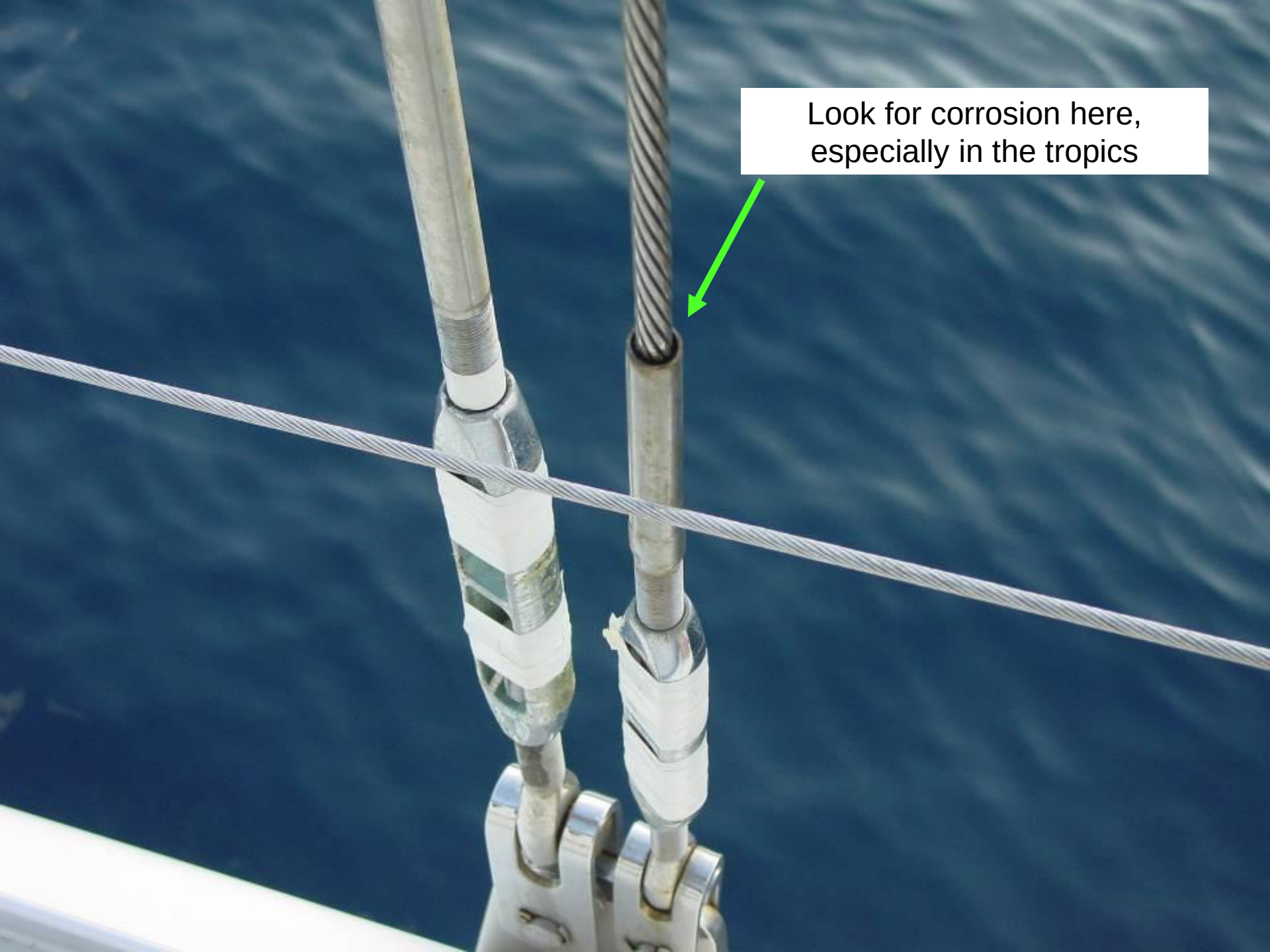
Stranding

- The longer you are on, the less likely you will get off
- Protect the rudder
- Don’t skimp on ground tackle
  - Light weight can still be strong (Viking anchor)
  - Low modulus line is better
  - Anchor chain – the heavier the better
- Consider pulling from masthead to reduce draft
- Keep lines away from prop

Mast Failure

- On-going rig inspections can reduce occurrence
- General causes:
  - Rod failure at terminal or spreader bend
  - Wire failure at lower swage fitting
  - Insufficient support
    - Check stays
    - Inversion
    - (Spinnaker pole in water)


Stress corrosion crack
in stainless steel toggle


Look for corrosion here,
especially in the tropics

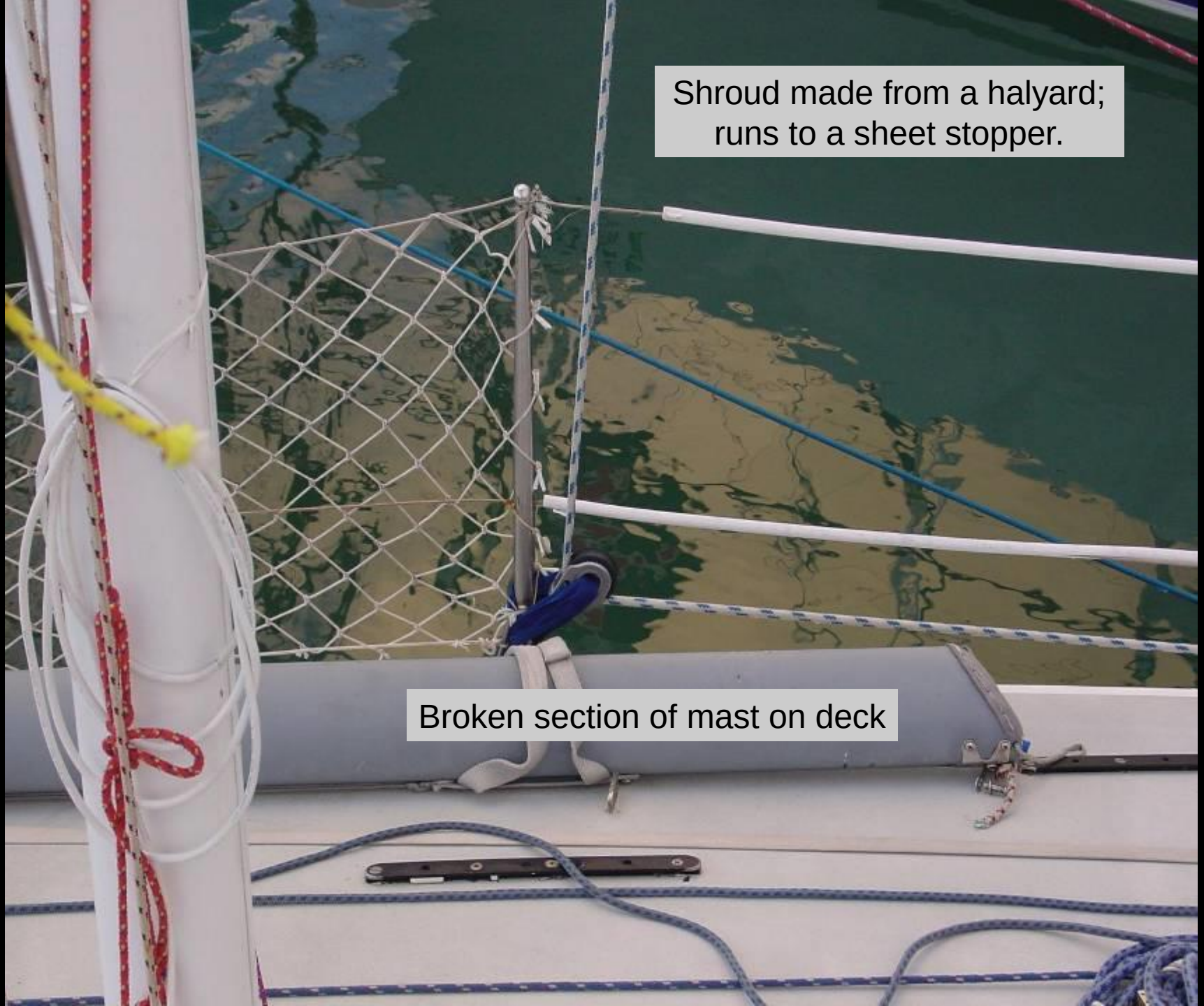

4 broken strands at top of headstay
Eau De Vie
Pacific
Kaneohe Host

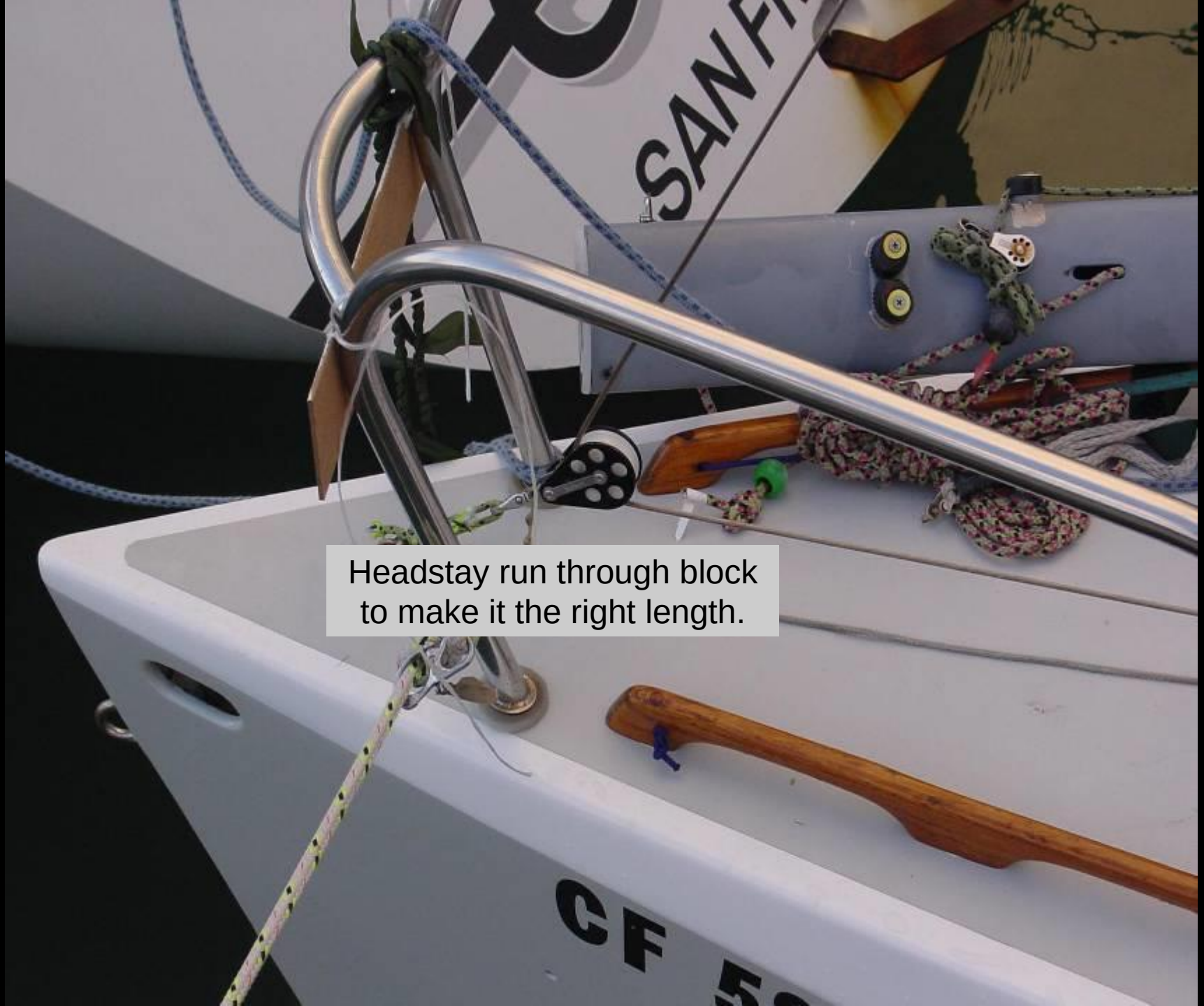
Dismasting

- When mast fails:
  - Keep the crew safe; make sure they are all accounted for
  - Keep rig from sinking the boat
  - Retain what you can to be used in jury rig
  - Bend on whatever sails will fit
  - Rig emergency SSB and VHF antenna

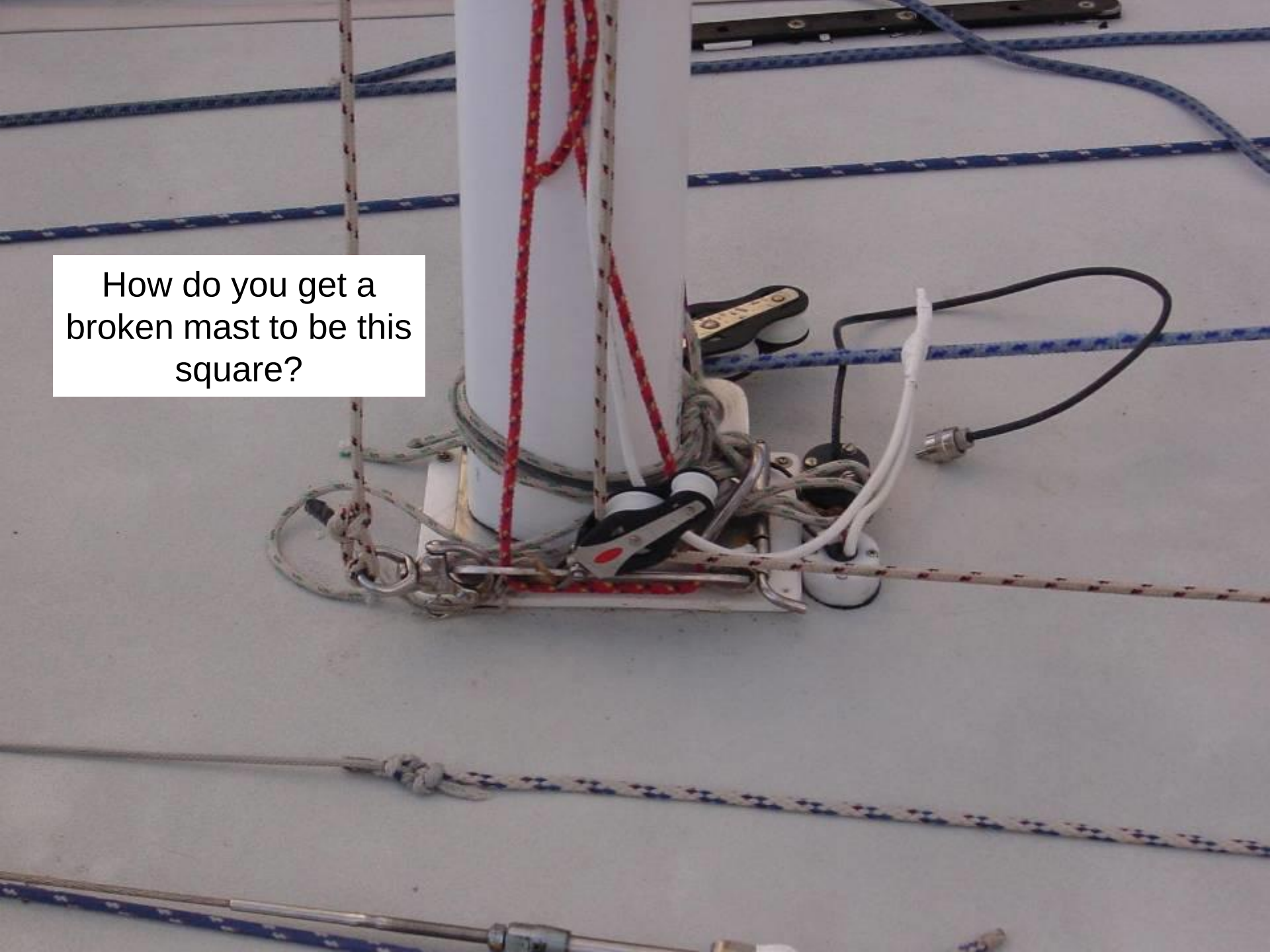
Jury rig of Moonshine

Custom 26' at end of West Marine Pacific Cup in 2000

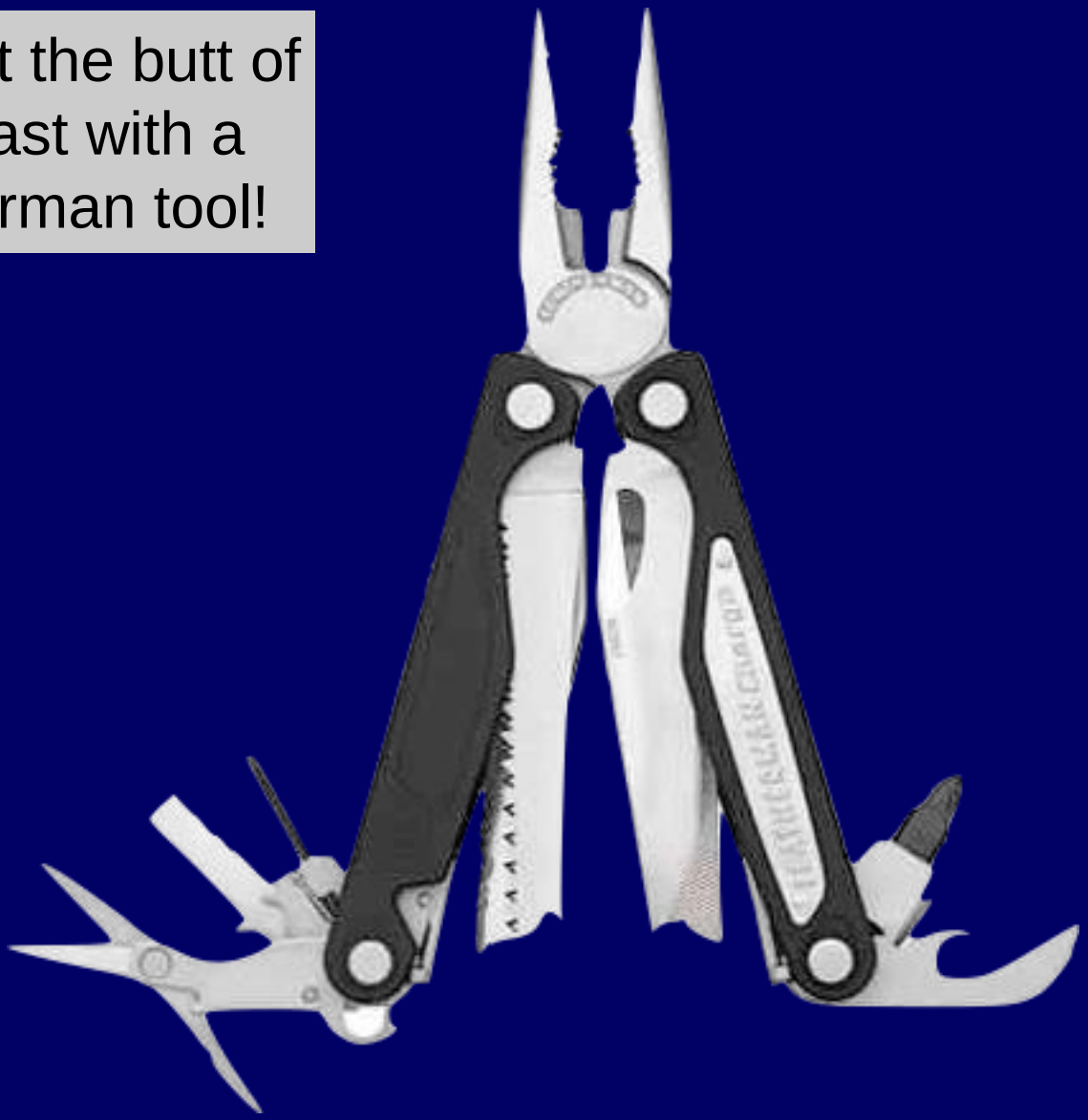

Shroud made from a halyard;
runs to a sheet stopper.
Broken section of mast on deck



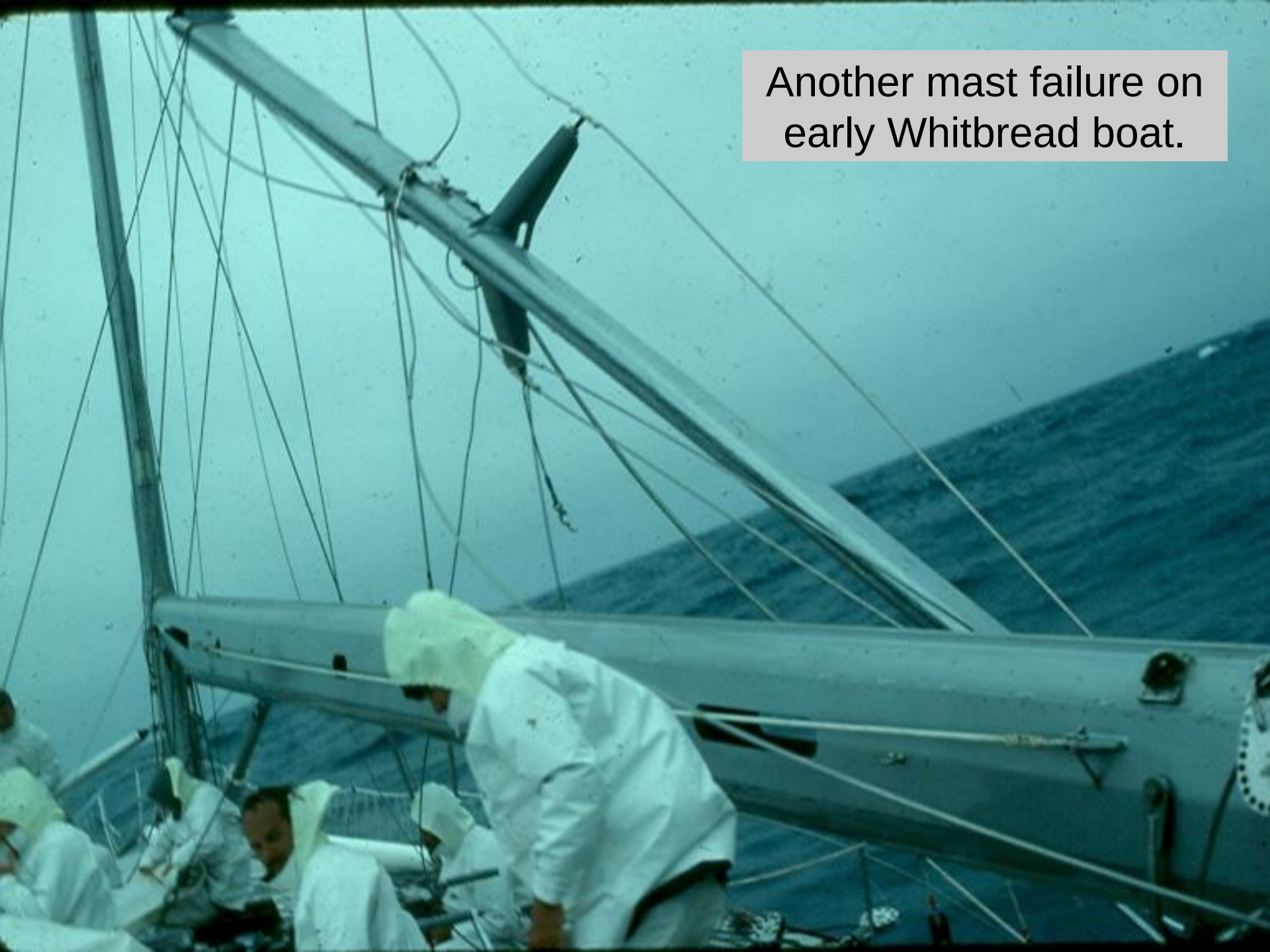
Headstay run through block
to make it the right length.

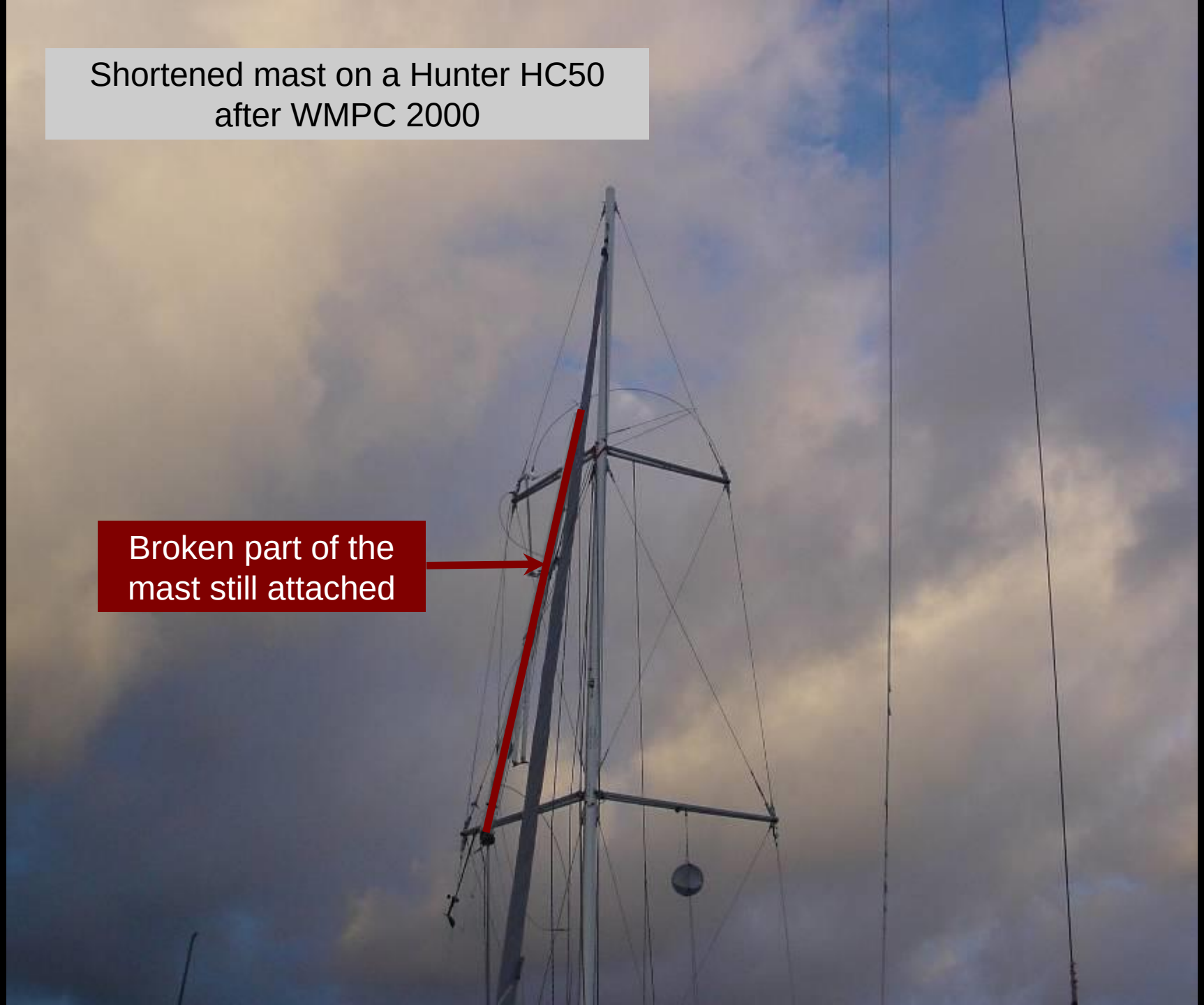

How do you get a broken mast to be this square?

They cut the butt of the mast with a Leatherman tool!



Mast failure on early Whitbread boat.


Another mast failure on
early Whitbread boat.


Shortened mast on a Hunter HC50
after WMPC 2000
Broken part of the
mast still attached

Boom/gooseneck failure

- Dragging boom in water is frequent cause with vang/preventer
- Inspect attachment of gooseneck to boom and mast
  - Band-it tool
- Booms can be spliced with spinnaker poles
  - Band-it tool again
- Vang attachment point is also source of failure


Booms can break from dragging in the water.
Don’t expect your storm trysail to set using the boom.


NZL-8321


Tough stainless pin against
aluminum castings

Systems problems

- Engine/propulsion
- Electrical
- Freshwater plumbing
- Sanitation
- Ballast pumping
- Keel canting
- Winch driving
- Electronics/instrumentation

Electrical

- Battery problems
  - Inability to start engine due to dead batteries
    - Have a completely separate engine battery
    - Manual starting options?
  - One bad battery in bank compromises system
    - Isolate one at a time to find bad battery
- Charging problems
- Distribution system problems
- Equipment problems
- Lightning Strike
  - Put GPS and VHF in the oven

Engine problems

- If you can't start your engine…
  - You can't charge the batteries, keep food cold, motor back to a MOB, power away from shore, make water…
- Engine won't start
  - Battery connections
  - Main battery switch
  - If battery is weak, use compression release
  - Air in the fuel injection system
- Engine won't run
  - Fuel problem
  - Cooling water/exhaust
  - Line in propeller?

Freshwater plumbing

- Three main problems
  - Water becomes undrinkable
  - Water escapes into bilge
  - Water is inaccessible (pump failure)
- Need a planned manual work around for electric pump failure
- Carry emergency water in jugs
- Insure tanks are isolated from one another
- Empty half of the first tank, then switch to second
- If pressure system, put monitor light on electric pump to check for excessive operation

Sanitation

- Inability to empty holding tank; no options
- Clogs
- Impeller problem with electric heads

Bottom Line

- Regular inspection during passages reduces casualties
- Good sailors practice self-sufficiency
- Have the skills, tools, and materials necessary to fix and/or improvise
- The builder/yard manager doesn't go to sea: you do!


GLAD