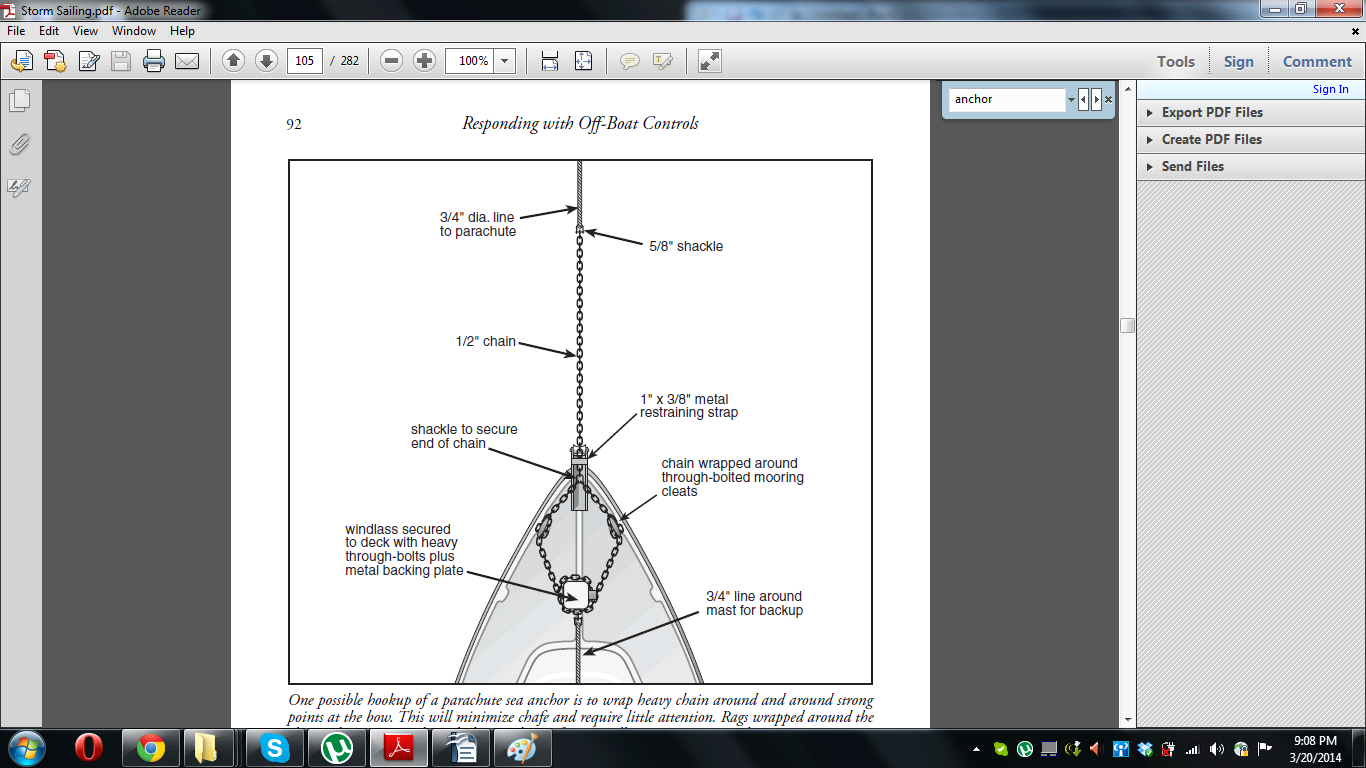
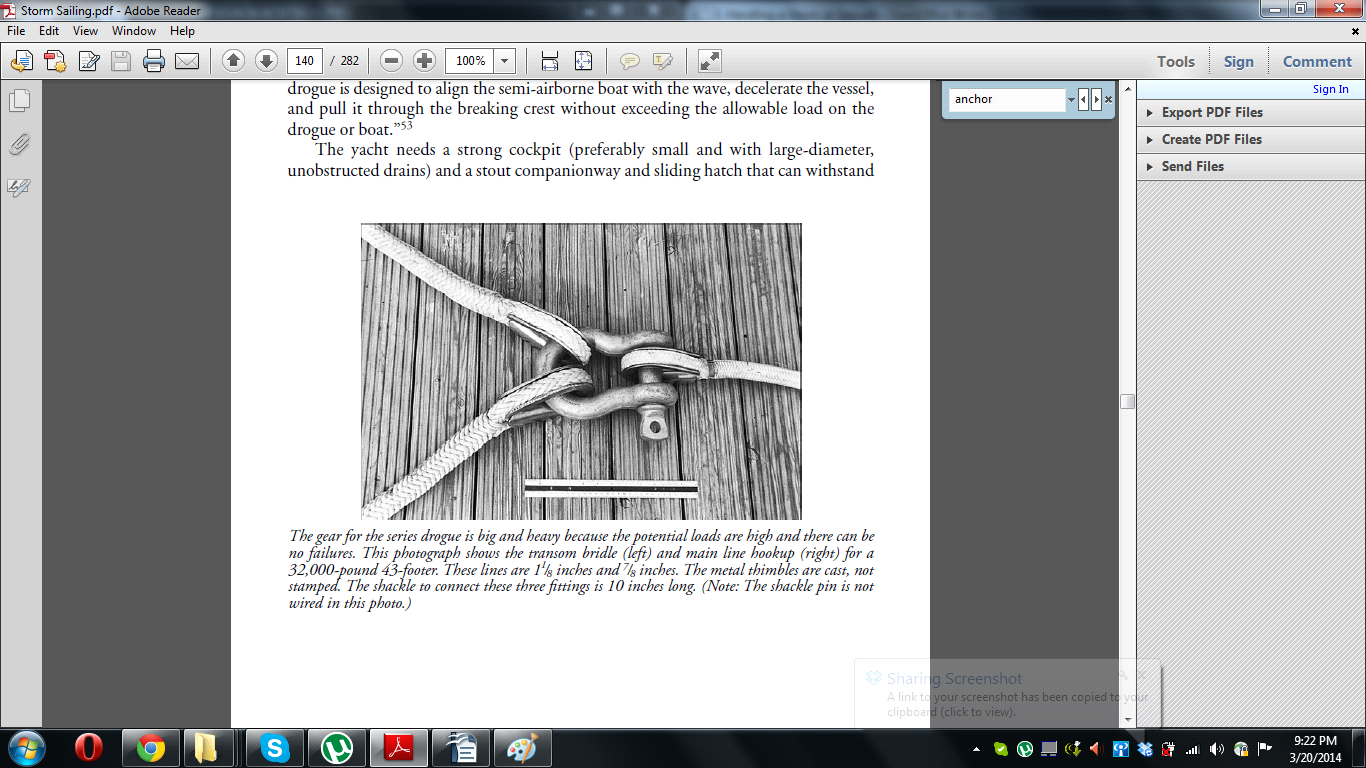
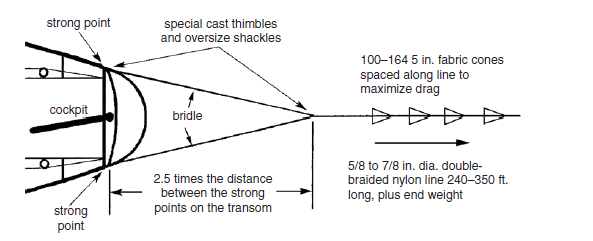
**Handling a Storm at Sea**

**Note**: A study found that boats are nearly impossible to flip if waves are less than 30% the length of the boat. Maintaining communication with someone who can see radar updates can nearly guarantee that this does not happen. If you choose to electrically ground your boat, do so with 8 gauge wire from the mast. If caught in a storm do **NOT** attempt to reach harbors. The breaking of waves in the harbor will destroy the boat. Anything over 25 knots (or 30mph) is considered heavy weather. High waves are intimidating, but not dangerous if handled properly. Breaking waves should be avoided at all costs, and the most dangerous action that the waves can perform is breaking on the side of the boat.

Preparation and Action

* If you have followed reports, but barometer is still dropping and conditions are not improving, immediately take refuge in the nearest cove or behind leeward side of an island and drop anchors. (See Mooring/Docking Procedure) If this is not an option:
* Determine the direction from which the storm is coming, and make note of any possible danger points in the area.
* Try to change course to outrun the storm in the most ideal direction possible. Use engine if it will speed up rate. Make sure to use an anti-jibe device if heading downwind.
* **In winds up to Force 6 (22-27 knots)** Decrease the size of the headsail, reef (lower) the main, clear deck, put on heavy weather gear, life preservers, lock down hatches, and lash down anything possible while confirming location of safety gear including flares. Put on body harness and affix to deck. Close all seacocks and verify bilge is in working order. Disable all electric devices that are not safety critical. Have manual bilge on hand.
* **In winds up to Force 7 (28-33 knots) Heave to:** come about, and maintain the jib on windward (don't touch it) and loosen the main. Lash the rudder to leeward.
* **In winds up to Force 8 (34-40 knots)** **Lie a-hull (Optional/debated):** Pull down and lash all sails. Lash rudder to leeward and float down wind. The boat will most likely fall parallel to the waves.
* **In winds up to Force 9 (41-47 knots) Run off:** Allow the boat to float downwind, only raising sails slightly if you feel daring enough. A whisker pole is strongly suggested for the jib if it to be used on the opposite side. Force 9 typically moves a boat at 5 knots downwind without any sails.
* **In winds up to Force 10 (48-55 knots or more) Resort to off-boat control methods**: Drop a parachute sea anchor (12 ft size for a 30 ft boat) off bow or a drogue off the stern. Remember to use anti-chaffing gear. Steer clear of these lines, they can take off arms or legs if caught under them. Ideally a sea anchor should be in the crest (top) of the second closest approaching wave. Lash the tiller in dead center, and wait in cabin until it passes. If bow steers off from wind, steer it back into it or reduce slack in sea anchor if present.





Other notes taken from academic studies of the designer of the drogue device:

* The number of small boats that go to sea has increased dramatically.

When caught in a storm, most sailors choose to lie a-hull or run off. Few sailors carry drogues.

* A capsize caused by a breaking wave is rare. A sailor can go through a lifetime of ocean sailing without being involved in such a mishap.
* Wind doesn’t cause capsizes. Breaking seas do.
* In tests with breaking waves, all models without a drogue capsized.

When struck abeam, the models capsized violently and rolled 360 degrees. When struck on the quarter, the models sometimes pitch-poled. If the mast is gone, the vessel is much more vulnerable to capsize.

* In a major storm, all single-element drogues will ride on the surface and may be thrown toward the boat by a breaking wave.
* If a drogue is used, it should be deployed from the stern..
* Tests clearly show that a drogue deployed from the stern can hold a boat into a breaking wave crest and prevent capsizing. Use of a drogue improves the motion of a sailboat in a storm and reduces leeward drift.
* The drogue should be on hand and ready so that one person can deploy it quickly and safely—at night or in a storm.
* Boat design changes don’t affect capsizing. Models of typical sailboats from the 1920s, 1930s, and 1980s showed no difference in capsize tests.
* A boat lying a-hull or sideways in nonbreaking seas moves more or less with the surface water and won’t capsize. However, if a breaking wave strikes the boat, it will likely capsize violently.
* Two or more storm waves may combine to form a larger wave that may become a dangerous breaking wave.
* The drogue should be attached to the boat with a V-bridle whose lines are shackled to stout chain plates or other special attachment points at the corners of the transom. All drogue lines should be spliced around high-load cast-metal thimbles (see Appendix 1 for source) and not tied, for example, with bowlines. Running a bridle line through a chock and belaying it to a mooring cleat may not be adequate and can lead to fitting overload, chafe, and failure.
* During a breaking wave strike, a drogue puts significant loads on the hull. According to Jordan, the attachments at each corner of the transom should be built to take 70% of the design load. For a total drogue design load of 15,000 pounds, for example, each bridle leg and attachment should be capable of carrying 10,500 pounds, a number that may be reached only once or twice during the life of the equipment.
* When the boat is aligned to a wave, the load on each leg of the bridle is 50% of the total. But in a wave strike, the vessel is usually a bit to one side or the other, and much of the load is on one bridle leg. The load isn’t applied instantly but builds at a finite rate, and as it increases, the boat yaws to reduce the angle. Computer analysis shows that the load on a single bridle leg can reach 70% of the maximum load before the other leg kicks in and begins to share it.