



Standard Operating Procedures for:

## **Beaching and Anchoring**

## I. Safety

- a. Never get between the houseboat and the dock or other larger object.
- b. Never try to push or pull the houseboat with lines or by hand. The houseboat weighs 22.5-tons and if it is moving in one direction, you are not going to be able to stop it; so the best idea is to get out of the way.
- c. Never step in the bight of a line, you can't be sure when it might come under tension suddenly and pull tight.
- d. When line handling, always keep at least 10-inches of line between your hand and line made off to a cleat. If a heavy load is placed on the line, it can be pulled through the cleat and your hand can go with it, resulting in serious injuries.
- e. Gloves can help prevent burns and injuries, but care must be taken to avoid getting them caught in the line.
- II. General
  - a. Overview

Safely anchoring the houseboat is extremely important for your safety, the safety of the boat, and your piece of mind during a particularly bad storm. Winds on Lake Powell can exceed 50-mph and you should be prepared to deal with these conditions, which often arise in the middle of the night. By selecting the best available beach, properly preparing your anchors, and being ready to react to high wind conditions, you will be able to ride out the storm.

- b. Basic Terminology
  - i. **Anchor Lines.** Anchor Lines (not rope) are used to tightly anchor the houseboat to shore utilizing either Danforth Anchors, Drive Anchors, or by tying off on prominent features (boulders or rock outcroppings). The Serenity is equipped with 4 anchor lines:
    - Two x 100-ft 1-in diameter double braided Nylon lines with a working load of 36,000-lbs. Nylon double braided line is a good all-around line with high strength and good shock absorption (high stretch).
    - Two x 130-ft ¾-in diameter double braided Nylon lines with a working load of 18,800-lbs. Nylon double braided line is a good all-around line with high strength and good shock absorption (high stretch).
    - 3. One 100-ft 3/8-in 12-stand braided Vectran line with a working load of 17,500lbs. Vectran 12 strand is a high strength, very low stretch braided line. It is

susceptible to Ultraviolet damage and should not be stored in direct sunlight when not in use.

- One 100-ft ½-in 12-strand braided Spectra line with a working load of 22,500lbs. Spectra 12 strand provides very high strength, very low stretch, with excellent abrasion resistance, and floats. It is susceptible to Ultraviolet damage and should not be stored in direct sunlight when not in use.
- ii. Danforth Anchor. A Danforth Anchor, also referred to as a Hinged Fluke Anchor, is a very effective digging anchor. The stock of the anchor is designed to lie on the seafloor while the hinged flukes will dig into the seafloor and provide your holding power; the harder you pull on the shank the deeper the anchor will dig and the stronger the hold will be. This theory holds true on beach applications when the flukes have been appropriately buried and the depth of sand is sufficient (greater than 2-ft). The Serenity has four (4) 25-lb. galvanized Danforth Anchors that will hold at least 10,000-lbs each.



- iii. Drive Anchors. Drive Anchors refers to large stakes that are driven into the ground with a sledgehammer. These anchors should be set in multiples and the anchor line attached as near to the ground as possible. They are not as solid an anchor as properly set Danforth Anchors, but can be useful in certain conditions, for supplementing the 4 Danforth Anchors, or in anchoring small craft. Additionally, it is useful to sink a drive anchor in order to test the depth of sand is adequate for a Danforth Anchor.
- iv. Bowline. The most useful knot you can learn is the Bowline. Any knot will be a weak point in the line, but a bowline comparatively reduces the strength far less than other knots (60% of breaking strength of the line). Additionally, a bowline is structured such that it should always be able to be broken and untied.



v. Figure-8 Knot on a Bight. In anchoring you will often need to tie a loop in the line in order to provide mechanical advantage in tightening the anchor lines (a truckers or movers hitch). DO NOT use a slip knot for the loop; instead, use a Figure-8 Knot on a Bight. The Figure-8 Knot on a Bight is a comparatively strong knot (70% of breaking strength of the line) and should be able to be broken, even after heavy loads. On the down side, it can be difficult to untie after impact loads and it is a directional knot that will collapse on itself if load is placed on it in the wrong direction. For an even better knot, consider the Figure-9 Loop Knot, which is similar, but takes an additional wrap around the standing lines before going through the loop (see http://www.animatedknots.com/fig9loop).



- vi. Making a line off to a cleat.
  - 1. First take a round turn on the base of the cleat.
  - 2. Then take several (3 or more) figure-8 turns over the ears of the cleat.
  - 3. Finally, you may use a locking hitch/half hitch to secure the line in place, but this is not necessary. Under no circumstances should you use a locking hitch prior to taking at least 3 figure-8 turns; if you do and the line comes under heavy tension it can seize such that you will need to cut it off the cleat.



c. **Wind Forces.** The flat side of the houseboat acts much like a sail and wind force on the houseboat can be enormous. Heavy winds can dislodge even well set anchors and you must be vigilant in keeping the boat secure and being ready to respond to high winds. The wind force

exerted on the houseboat can be calculated with the equation below. The Drag Coefficient for a flat plate is 1.17, the approximate area of the side of the houseboat is 1,000-ft<sup>2</sup>, and the density of dry air is approximately 0.074887-lbs(mass)/ft<sup>3</sup>. To complete the calculation, you must divide the result by 32.174 (gravitational acceleration) to convert pounds mass into pounds of force. The table below is provided as a quick reference.

$$D_1 = \frac{C_D A_P \rho V^2}{2}$$

 $D_1 = Drag \ Force \ (lbs)$   $C_D = Coefficient \ of \ Drag = 1.17$   $A_p = Frontal \ Area \ (ft^2) = 1000$   $\rho = Air \ Density \ (lbs/ft^3) = 0.074887$   $V = Wind \ Velocity \ (ft/s)$ 

Wind Speed (mph)	Resulting Maximum Force (Approximate)
10	300
20	1,200
30	2,600
40	4,700
50	7,300
60	10,500
70	14,400

- d. Good Practices
  - i. Site Selection. Selecting the location of beaching the houseboat is critical and is one of the largest factors in how secure the boat will be during your week. Ideally, you should select a site with the following characteristics, but likely you will have to make some trade-offs.
    - Steep Slope. A beach with a steep slope offers several advantages. It allows you to keep the stern in deep water to protect the outdrives from grounding and allow for swimming off the back of the boat. Additionally, this steep slope prevents the houseboat from riding up the beach as much when it is pushed by waves or wind and as the water level of the lake changes, you will find that you do not need to reposition the houseboat as often.
    - Deep Sand. A sandy beach with few rocks is best for bringing the houseboat and other small boats onto; this will minimize hull damage and will also provide you with the best beach experience. Sand should be at least 2-ft deep for the Danforth Anchors to hold properly.
    - 3. **Protected.** Finding a beach that is protected from the predominant wind direction and from waves is important. A beach that is exposed to the main channel will see lots of wake and wave action. Additionally, the larger the fetch (the distance over the water that the wind can blow in a single direction) the larger the waves will be. Try to find a cove or canyon that has good wind breaks and does not expose you to large open areas of water.
    - 4. **Features.** A beach with prominent features, such as large boulders or rock outcroppings, provides you with the opportunity to tie the boat off to these

features instead of digging in the anchors. Just be sure that the features are substantial enough to provide good holding power for your anchor lines.

- ii. Water Level Changes. Depending on the time of year the lake level will either be rising or falling and you must keep track of the stage of the lake level to ensure the houseboat doesn't become permanently grounded or float free.
  - 1. Check with the marina prior to getting underway to see what the lake level has been doing; they should be able to give you a pretty good idea of whether the lake is rising or falling and how fast.
  - 2. In May and June the lake can be rising by as much as 1-foot per day.
  - If the lake level is rising, you will need to drive the houseboat onto the beach and tighten up your anchor lines. If the anchors are buried near the water level, which is good practice, you may have to move them up the beach as well.
  - 4. If the lake level is falling, you will need to back the houseboat off the beach and let out your anchor lines.
  - 5. Failure to back the boat off with a falling lake level could result in sinking the stern of the houseboat if the boat is beached on a sufficiently steep slope, which is good practice. As the lake level drops, the buoyant force of the hull will no longer be supporting the boat, but it will instead be resting on the seafloor. If the angle of the beach is steep enough, such that the boat lying on the bottom would have the stern submerged, then the stern will submerge as there is not enough buoyant force to keep it afloat.
  - Check anchor lines every morning and evening to see if they are slack or taught; make the necessary adjustments to keep the houseboat properly beached.
- III. Prior to Anchoring
  - a. Scout Boat(s). Prior to leaving the dock with the houseboat, you should identify one or more areas for your anchor site and then dispatch a scouting boat, or multiple boats if desired, to go recon those areas and locate a suitable anchoring site. It is best if this boat, or boats, are equipped with VHF radios for communications and a handheld GPS to provide a position of the site. Generally, you should send a minimum of 4 people in the scout boat so that they can act as your anchor party and prepare the beach prior to the houseboat's arrival. If VHF communications cannot be established, a group can be left to guard the site and the scout boat should return to the houseboat to relay the location of the anchoring site. The scout boat crew will need to evaluate the beach and plan for the anchoring of the houseboat; to do this the boat should be outfitted with the following equipment:
    - i. VHF Marine Radio for communication with the houseboat
    - ii. Handheld GPS or Plotter to provide coordinates to the identified anchoring site
    - iii. A Drive Anchor and Sledgehammer to check the depth of the sand. Drive the anchor in to ensure that there is at least 2-ft of sand on the beach and it's not just a shallow coating of sand sitting on a rock ledge.
    - iv. Shovel(s) to check soil depth and begin digging holes for the anchors.
    - v. 2, or more, manual laborers to do all the digging and hammering.
    - vi. Plenty of water.
    - vii. Sunscreen, hats, sun covers, towels, etc.
  - b. Beach Preparation. Once the prefect anchor site is identified the work begins. The anchor party should make every effort to have the beach ready by the time the houseboat gets there. They should:

- i. Check the water for obstructions (rocks, submerged trees, debris, etc.) that might damage the houseboat. If possible, you can mark these dangers with small line and a float (empty bottles work well).
- ii. Identify where the houseboat should beach and how it will approach. It's a good idea to mark where the bow of the houseboat will go, maybe with a cooler or other conspicuous object; this way you can radio the houseboat to aim for that marking when making their approach. Additionally, you may set a second mark further up the beach to create a range for the houseboat to line up on that puts it in the correct orientation on the beach.
- iii. Layout the anchoring plan for when the houseboat arrives; based on where the bow of the boat will be, you can step off about 65-ft to either side and that is where the outermost anchors should be placed. If using the Danforth Anchors, dig holes for the flukes of the anchors in these locations and about 10-ft in from those sites for the secondary anchors.
- iv. Set up a beaching and anchoring area for the small craft.
- c. Anchoring Stations. Prior to arriving you should prepare for the anchoring operations to come.
  - i. It is a good idea to get all the equipment staged on the houseboat; layout the anchor lines on the back deck, and place the shovels, anchors, and any other required equipment on the front deck.
  - ii. Identify 1-2 people that will be stationed on the back deck to handle the anchor lines.
  - iii. Identify 1-2 people that will be stationed on the upper deck to run the line ends from the back of the boat to the front and throw them to the anchor party on the beach.
  - iv. Until the vessel is anchored, the main engines will remain on and will be used to thrust the houseboat into the beach; someone must remain at the helm at all times.
- d. Beaching.
  - i. The scout boat crew should have identified any possible obstructions or dangers prior to the houseboats arrival, but you should always post a lookout on the bow of the boat to watch for potential dangers in the water as you approach the anchor site.
  - ii. Houseboat should not be towing any small craft when beaching; send all small craft ahead to the beach and secure them out of the way from anchoring operations.
  - iii. Maneuver into the beach as perpendicularly to the shoreline as possible.
  - iv. Drive into the beach at clutch ahead or slower, by taking the engines in and out of gear to keep a bare steerageway.
  - v. Once the hull of the houseboat glides up onto the beach increase your throttle to drive the hull up onto the beach and hold it there until anchoring is complete.
- IV. Anchoring Operations. With the houseboat now beached and all the preparations completed, anchoring should go smoothly.
  - a. Anchor Arrangement.
    - i. Houseboat should be beached roughly perpendicular to the shoreline slope.
    - ii. A minimum of two anchor points should be used on each side of the houseboat.
    - iii. Regardless of what anchors are used, they should be positioned so that the anchor lines are at approximately 45-deg angle to the boat. The outside anchors can be positioned by stepping off 65-ft along the shoreline from the side of the boat. The inside anchors can be positioned by stepping off 45-ft from the side of the boat.
    - iv. Anchor line length should be minimized; in the case of the nylon lines, the more line you have the more it will stretch. The Vectran and Spectra lines have virtually no stretch and will behave similarly to steel cable.



- b. Danforth Anchors. Danforth anchors will be the primary means for anchoring on sandy beaches. If properly set, the Danforth anchor will provide an exceptionally sturdy anchoring point.
  - i. The anchor should be set in at least 2-ft of sand. If the sand is shallower than 2-ft over rock ledge underneath, as a strain is taken on the anchor the flukes will dig down and hit the rock surface. The rock will prevent the anchor from digging further and, as more load is put on the anchor, it will cause the flukes to flatten out and cause the anchor to lose hold on the beach.



- ii. The anchor should be placed in wet, well packed sand near the water. Wet sand is much more stable and provides considerably more holding power for the anchor than dry loose sand.
- iii. Dig a hole, but there is no need to completely bury the anchor; you can set it using power from the houseboat.
  - 1. Dig a hole that is wider than the stock of the anchor and deep enough to allow the flukes to open all the way with the shank of the anchor level with the beach surface.
  - 2. Attached the anchor to the houseboat with the anchor line.
  - 3. Turn the helm hard towards the anchor(s) you are setting and slowly increase the throttle to swing the stern away from the anchors and provide a pull on the anchor lines.

4. Keep weight on the crown or stocks of the anchor to prevent it from tipping forward and help it dig itself down into the beach.



- iv. NEVER use a sledgehammer to set a Danforth Anchor; you will likely damage the crown of the anchor and may cause an anchor failure.
- v. Fill in the hole over the top of the now buried anchor.
- vi. Once all anchors are firmly set you may tighten up the anchor lines and secure.
- c. Drive Anchors. Drive anchors are essentially large stakes that are driven into the ground using a sledge hammer. They are not as solid an anchor as a properly installed Danforth Anchor, but if used correctly can be an effective anchoring system. They can be useful in situations where the sand is less than 2-ft deep, but at least 1.5-ft deep.
  - i. Drive anchors should always be set in multiples, at least 2-3 in a line with the anchor line.
  - ii. Angle the Drive Anchors at between 20- to 30-deg away from the houseboat.
  - iii. Back tie the first drive anchor to the next, and so on.



- iv. Once all drive anchors have been driven and back tied, you may tighten up the anchor lines and secure.
- d. Natural Anchors. Large boulders or rock outcroppings can be the most effective anchors; just be sure that they feature you are tying off to is substantial enough to hold the houseboat in a strong wind. In this case, you simply loop a nylon lifting strap around the feature and connect it to itself with a shackle, to which you can then connect the anchor line. Once all anchors lines are attached you may tighten up the anchor lines and secure.

- e. Passing the Anchor Lines. It is never good to have lines in the water near the stern with the engines running and the propellers turning. Someone should be designated to ensure that the lines do not get tangled in the propellers. In order to pass the lines from the stern to the anchor party on the beach:
  - i. Pass the end to the top deck using a boat hook.
  - ii. Pay out line slowly as the line handler on the top deck walks the end forward to the front of the houseboat.
  - iii. The line handler on the top deck should toss the line down to a member of the anchor party on the beach.
  - iv. Pay out additional line as the anchor party walks it over and secures it to the anchor.v. Never let loose lines sit in the water near the stern.
- f. Take Up Slack. Tighten up the anchor lines and secure. There are a few approaches that you can take in taking the slack out of your anchor lines.
  - i. You can pull the line tight on the cleats on the back deck and make them off when they are as tight as you can pull them. While this is sufficient for the Vectran and Spectra lines, this will leave a lot of stretch in the Nylon lines.
  - ii. You can tie a loop in the line using the Figure-8 on a Bight or the Figure-9 Loop Knot and then use a movers knot to put tension on the line. Loop the line through the shackle on the anchor and back to the loop you tied and then pull tension on it and tie off using a few half hitches. This technique is effective on Nylon, Vectran, and Spectra lines.



- iii. You can utilize the houseboat to put tension on the lines by:
  - 1. Swing the stern towards the Port set of anchor points by turning the helm to the RIGHT.
  - 2. Allow the stern to swing about one boat width to the Port.
  - 3. Tighten up the Nylon lines (don't tighten up the Vectran or Spectra as these lines don't stretch and don't need to be put under as much tension) on the Port anchors.
  - 4. Swing the stern away from the Port anchors and towards the Starboard anchors by turning the helm to the LEFT.
  - 5. Us the throttle to stretch the lines and power the stern towards the Starboard anchors.
  - 6. Tighten up the Nylon lines (don't tighten up the Vectran or Spectra as these lines don't stretch and don't need to be put under as much tension) on the Starboard anchors.
  - 7. Bring the helm to MIDSHIP and take the engines out of gear; the houseboat should come to rest in position with equal tension on all Nylon lines.
  - 8. You may then manually tighten and secure the Vectran and Spectra lines.
- V. Storm Procedures. Even with well-set anchors, an extreme wind event can still pose a danger to the security of the houseboat and you must be prepared to deal with a worst case scenario; being blown

off the beach. If the wind comes up and you are noticing heavy strain on your anchor lines you should:

- a. Start Main Engines.
  - i. Turn on Blower and leave it on until engines are secured.
  - ii. Start the main engines per normal procedures.
  - iii. If in extremis, you may immediately begin using the engines without waiting for them to warm up.
- b. Turn the helm away from wind in order to push the stern into the wind and take strain off the anchor lines.
- c. Power forward onto beach and increase throttle until tension on the windward anchor lines begins to slack.
- d. Balance the throttles to maintain line tension.
  - i. If the lee side anchor lines begin to go slack, you should apply more power.
  - ii. If the windward side anchor lines begin to go slack, you should reduce power.
  - iii. Continue playing this game until the wind dies down.
- e. Send people to exterior decks to secure all loose gear.

## VI. Getting Underway

- a. Break down camp and load and secure all gear.
- b. Set Anchoring Stations.
  - i. Send an Anchor Party of 4 or more people to the beach to pull the anchors and cast off the anchor lines.
  - ii. Identify 1-2 people that will be stationed on the back deck to handle the anchor lines.
  - iii. Identify 1-2 people that will be stationed on the upper deck with boat hooks to run the line ends from the front of the boat to the back and pass them to the line handlers on the back deck.
  - iv. Once the main engines are online, someone must remain at the helm at all times.
- c. Start Main Engines per SOP.
- d. Take in all anchor lines and anchors.
  - i. Disconnect the anchor lines from the anchors and pass them to the line handlers on the top deck.
  - ii. Line handler on top deck should walk the anchor lines to the back deck and pass them down to the line handlers there.
  - iii. Line handlers on the back deck should take in slack as the anchor lines are recovered.
  - iv. Remove anchors, rinse them off, and load them on the front deck of the houseboat.
  - v. Once anchor lines are recovered, they should be rinsed, coiled loosely, and hung on the top deck racks to dry.
- e. Once all Anchor lines are aboard you may put the engines all BACK and pull the houseboat off the beach.
- f. Do not take any small craft in tow until out in open water.