

## Steering Without Rudder – Equipment Test

by Michael Keyworth

I have been concerned for several years with the frequency of rudder loss and/or failure and the consequences of boats being lost or crew injured or lives lost. The purpose of the tests was to determine the best method and equipment to effectively steer the vessel to a safe port in the event of catastrophic rudder failure.

The goal was to utilize the equipment normally taken on the vessel on offshore passages or races. This guide is the result of multiple tests conducted in the fall of 2013 off of Newport, RI. The test vessel was a modified MK I Swan 44, Chasseur.

The overriding premise was; utilization of an efficient and controllable object to create drag and transmit to directional stability which results in the desired directional stability. It was my view that a drogue might be used to exert the appropriate drag. I further felt that a small drogue might provide the needed drag but not significantly impede the speed of the vessel.

Chasseur has been modified in the following relevant ways; the rudder skeg was removed and replaced with a modern spade rudder which is carbon fiber with a Carbon fiber shaft, the keel has been modified to a modern shape fin with a shoe, the mast is carbon fiber and 6 feet taller than original. For the purposes of the tests, the rudder was removed and the rudder port was blocked off.

I was familiar with and had onboard Chasseur a “Galerider” made by Hathaway, Reiser & Raymond of Stamford, Connecticut. I contacted Wes Oliver at Hathaway and he arranged to make several prototype drogues for the tests. We were equipped with: a 12inch diameter drogue with a 3 part bridle, a 12inch diameter drogue with a 4 part bridle, a 18 inch diameter drogue with a 4 part bridle, a 30 inch drogue with a 4 part bridle and a 36 inch drogue with a 4 part bridle.

The purpose of the test was to establish whether direction could be controlled under the following “underway” conditions using any of the drogues supplied:

- With sail trim alone
- Motoring using a drogue
- Sailing upwind using a drogue
- Sailing downwind using a drogue
- Motorsailing using a drogue
- Being towed using a drogue

Size of drogue proved to be very important. The findings were definitive:

- The two 12- inch drogues provided no directional stability.
- The 18- inch drogue provided marginal control in winds under 10 knots
- The 30- inch drogue was very effective in all conditions that were tested and resulted in approximately 1 knot reduction in boat speed. In wind conditions over 20 knots of windspeed a chain pennant needed to be added to reduce cavitation.
- The 36- inch drogue worked similarly to the 30 inch drogue but affected boat speed by approximately 1½ knots.

## Rigging

Two spinnaker sheets were used. I believe that spinnaker sheets are appropriate as they are generally sized based on length of boat. The sheets were led as two sides of a bridle (port and starboard) from amidships snatch blocks, thru amidships chock or similar and clipped into the swivel at the lead for the drogue. The tails were lead aft to the primaries in the cockpit. It is important to rig this so as to provoke the least amount of chafe as these lines will become your steering cables. We found that the leads need to be led to the axis of the keel as the boat will rotate on the keel. This point is probably somewhere near amidships.

Note: The aftergyuy block may be ideal for the bridle lead.

Some prior guidance suggested that a lead to the quarters of the transom is the best. Our findings are that this restricts the transom from swinging, therefore preventing the desired change in course.

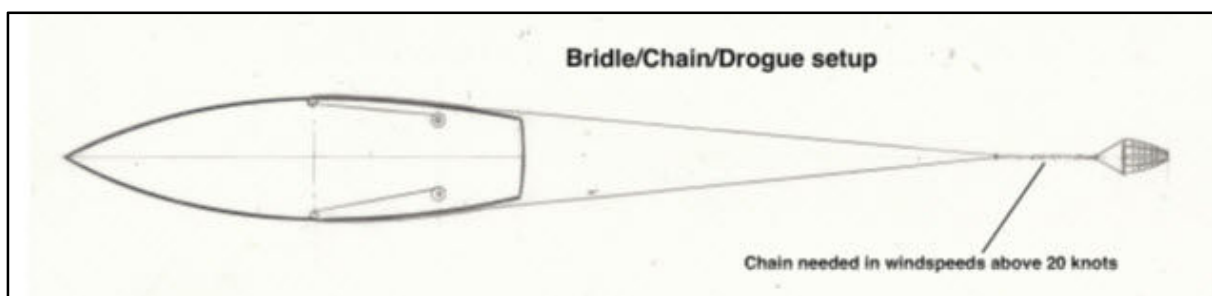


Figure 1

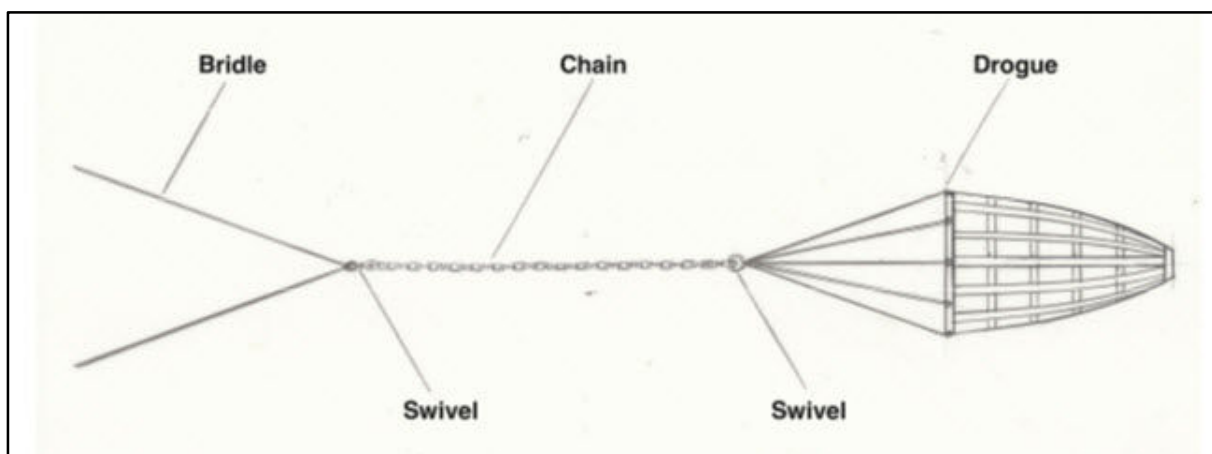


Figure 2

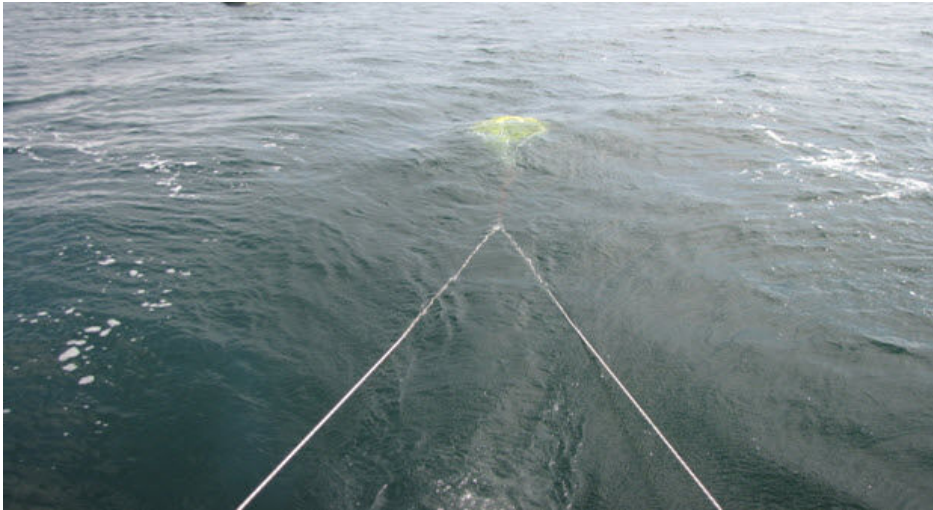
During rough and/or windy conditions it may be necessary to add weight to the drogue to keep it from cavitating. Using the concept of being limited to equipment that is already on board, we were able to use various lengths of chain attached to the swivel at the lead for the drogue. At the other end we effectively used a spare swivel shackle and attached one end to the forward end of chain and the other to the bridle from the boat. It is important to have swivels at both ends as the drogue will tend to rotate as it is pulled along. The bridle may get twisted up but this does not seem to affect the control. During our tests the length of "scope" of the bridle/drogue did not seem important. The nominal distance aft from the transom varied from 50 feet to 120 feet. It may be necessary to add scope in extreme conditions. I found that reference of the drogues position was valuable information. I

whipped colored marks at 10 foot intervals on both spin sheet/bridle which gave a quick reference; this could be done with tape or magic marker.



## Findings

- Controlling direction with sail trim alone: Not Possible!!!
- Control direction while motoring using a drogue: This is the easiest scenario. A wide range of control is available. This can be done with only one person, easily. While testing we were able to execute multiple 360 degree turns with full control. Doing 5.5 knots a full 360 can be executed in 4-4 ½ boat lengths. While motoring, adjustments of 2-3 inches results in 5-10 degree course change.
- Controlling direction while sailing upwind using a drogue: The same principals apply except that there needs to be cooperation between the sail trimmers and the “helmsperson”(bridle trimmer). In this scenario the main must be up, even if reefed, the jib may be overlapping, but more control may be achieved with a non-overlapping jib. Tacking takes coordination but, once you get the hang of it, no problem– traveler up, back the jib and come on to the new tack. We were able to achieve 30-35 degrees apparent sail angle. In large seas wider angles should be expected.
- Controlling direction while sailing downwind using a drogue: When the wind is aft of 90 degrees apparent it is necessary to take the mainsail down and sail under Jib alone. It will be necessary to have an attentive jib trimmer in addition to a helmsperson on the drogue controls. The size of the jib will have to be factored in based on wind and sea conditions. We also found that the deeper the angle the harder it was to have fine control of direction. Jibing is pretty straightforward by easing the jib and rotating the drogue.
- Controlling direction while motorsailing using a drogue: The same principals apply as in sections on upwind and downwind sailing.
- Controlling direction while being towed using a drogue: This test, I felt was important because most successful results of rudder loss has a component of a tow of great and small distances to a safe harbor. In this situation we were towed by a 27' Protector with two 250 HP outboards. A towing bridle was made up on Chasseur and attached to the tow line from the Protector. At 3 Knots the bow was swinging from port to starboard to the end of the tether. At 4 knots it was very difficult to stand on the foredeck. We deployed the 30 inch drogue as rigged for sailing and motoring. The results were immediate. Towing at 7 knots was comfortable and straight, requiring very little input from the helmsperson. This is an important finding as it suggests that a drogue should be carried at all times so that assistance can be rendered safely, even inshore.



### **Additional Findings/ FAQs**

- If you lose your rudder: First confirm that the rudder port is not leaking- if it is you must first deal with the flooding issue. Once the flooding issue is stabilized move on to the next step of getting home or assistance.
- Communicate with Race Officials if you are racing and/or with those onshore who will worry about your situation.
- Communicate with vessels nearby if in need of immediate help away from a lee shore or collision avoidance in shipping lanes.
- Choose your safe harbor destination based on wind direction predictions, ease of access, proximity, repair facilities, etc. Do not feel that you need to end at the original destination port.
- If you lose your rudder, it is likely that you either hit a submerged object or that the conditions were severe. Remember that you have time. Relax, storms don't usually last more than a couple of days. Deploy your drogue or sea anchor and get some rest.
- Each time that we went testing we learned something new. Don't be afraid to try something that you think might help, i.e. longer scope, move lead of bridle forward or aft, larger/smaller jib, reef/no reef, etc.
- An unanswered question is how a drogue will work with different types/styles and underbodies than Chasseur. My personal view is that a drogue will be an effective tool to have on any type of boat and its deployment can be adapted to the type of vessel that uses it.
- Offshore you will have room to maneuver. Take your time and don't stress about steering an accurate course.
- The engine is your friend. You will find that using engine power will provide the greatest degree of control- speed and direction. Use the engine to deploy sails, to get rest, or to retrieve the drogue- retrieval is easiest when the boat is stopped. Be careful to not tangle the bridle in the prop. This was never a problem during our trials. This was probably because; towards the end of trials we used a 5 foot chain pennant to help the drogue from cavitating. The chain component is an important one. I chose the use of chain to weight the drogue because ISAF Offshore Prescriptions require that an anchor with appropriate ground tackle be carried, so it need not be carried as additional gear. Others venturing offshore tend to take ample ground tackle to accommodate the use for other purposes. On a practical matter, I think that it makes sense to have different lengths of chain for required circumstances. It also makes sense that a longer chain can be made shorter using the rig cut away tools as required by the rule. A shorter chain can be made longer using shackles to join shorter lengths.

- How heavy is the Galerider? A standard 30- inch drogue weighs in at 9 pounds and is stored in a bag that is 15 inches in diameter and 5 inches thick. The standard 36- inch drogue weighs 13.2 pounds and stores in a bag that is 18 inches in diameter and 4 inches thick.
- One of the difficulties that you will face to determine where the helmsperson is stationed and has access to heading or a compass. Something that you may want to consider, as you equip for an offshore passage is the purchase of a backup compass which can be remotely mounted. Boats equipped with modern electronic packages may have the option of display of heading for both helmsperson and trimmer/s.
- It would be prudent for any offshore sailor to practice the deployment of a drogue for speed reduction sailing downwind in large seas and to rig and use as a means of steering. This would help to identify the gear necessary to deploy and provide a ready plan to implement if necessary.
- The transition from drogue to drogue steering or vice versa may be easier than you think.
- A trick that we learned is that you can cleat off one of the bridle lines and have control with the other. If you were to cleat off the port bridle line a turn to port would result from easing the starboard bridle and a subsequent change to starboard would result from trimming the starboard bridle. This lazy mans approach gives the helmsperson more flexibility and physical relief.
- What I learned from the extensive testing is that you can achieve a great deal of control using a drogue. I would bet that if any boat is able to sail 100+ miles without a rudder to a safe port, the crew will want to take a victory lap around the harbor to “show off” the newfound skill and seamanship ability.

One last thought. Having sailed over 150,000 miles at sea I have seen many things and have been able to overcome all sorts of adverse conditions, I still have many concerns and reservations. One concern is that of rudder loss and how to deal with that possibility. This test should help all who go to sea with that possibility. The other concern that haunts me each time I go to sea is the amount of floating debris and other objects that may affect the ability of even the most seamanlike sailor to safely passage from place to place. The possibility of being holed or sunk from collisions with floating debris is real. Most of the stories I have heard about boats at sea that have become rudderless have resulted in the abandonment of those vessels. These abandoned vessels represent a threat to those fellow sailors who put to sea and put them unnecessarily at risk.

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