

This Old Hobie

Drilling Rudders

By Matt Bounds

The pivot bolt hole positions in the rudders are one of the most important adjustments you can make on your boat. Minute hole position changes can have major affects on helm feel, the tiller arm vertical position (both in the locked down and parked positions) and the lock-down mechanism's efficiency, especially on the older, non-rake adjustable castings. What makes hole position a black art is that there's not a single straight edge or reference point on a rudder blank – you can't just measure out the hole position, drill it and have it work 100% of the time. To make matters worse, different rudder types have slightly different shapes – just enough to throw off any measurements. Also, the castings have changed several times over the years, making this a problem with lots of variables.

Before You Start

Use the procedures in the "This Old Hobie - Get the Rudder Slop Out!" (Fall 2010 *HOTLINE*) to eliminate the play in the rudder pin joint. This is critical to obtain accurate rake measurements. Determine what problem you're trying to solve – too much weather helm? Slop in the lockdown mechanism? New rudders with no holes?

Not everyone can afford an industrial drilling jig like the one at the Hobie Cat factory

Fill Before You Drill

If you're re-drilling a rudder, it's very likely that the new holes will overlap the old. While it's tempting to use a quick-setting epoxy to fill the old rudder holes, five-minute epoxy tends to be rubbery and soft after curing – unsuitable for something that will bear the load of a rudder bolt. JB Weld® is a good, hard, all-purpose epoxy as is Marine-Tex®. Both are very viscous, so apply them with a toothpick to ensure you eliminate all the air bubbles in the fill. Tape one side of the rudder, fill the hole to the top, tape that side, then flip the rudder over, pull off the first piece of tape and fill again. Once the epoxy cures, sand flush.

Drill Them Right

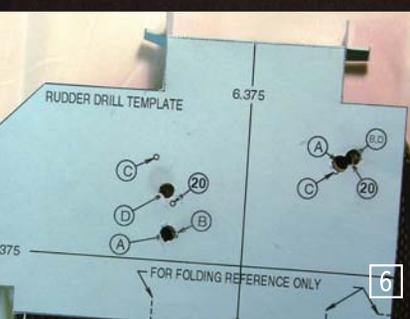
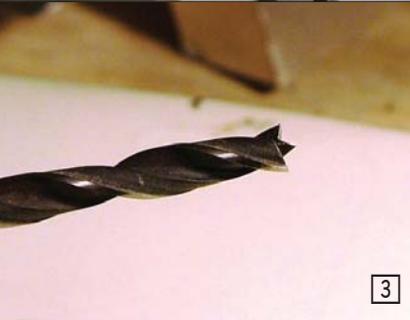
The best way to drill the rudders is with a drill press **1**. Inexpensive (~\$120) presses are available at your favorite home improvement store. Make sure to clamp the rudder down on the press to keep it stationary and perpendicular to the drill bit.

If you must drill the rudder with a hand drill, use the casting as a guide. Drill about halfway from one side, pin the rudder in place with a bolt, then complete the hole from the other side **2**. At the very least, get a new ⁵/₁₆" brad point bit **3**. You won't need to drill a pilot hole to keep the bit from wandering.

To simplify testing and rake measurements, build a rudder rake jig out of scrap plywood and some old gudgeons **4**. This way, you can drill, test, measure and re-drill without running all over the place. We found that if you set up the gudgeons for the 17/18/Wave castings, the 14/16 castings would fit as well, with the upper gudgeon above the casting.



MATT MILLER



Any time you drill rudders, **never drill all the way through at once, unless you are confident the holes are in the right place.** Drill about ¼" deep and then test them on the jig by pinning them in place with a bolt. Measure the rake and see if there's slop in the lock down mechanism. On rake adjustable castings, lock down slop can generally be removed by adjusting the top plate forward. Once you're satisfied with the position, finish drilling the holes all the way through.

Drilling the Easy Way – Using a Template Rudder

The easiest way to drill rudders is to use another rudder as a template. If you're replacing the rudders, and you don't have any existing helm problems, you can use your old rudders or a rudder from another boat. If you're using another boat's rudder, the template rudder **must** come from a boat with well-balanced helm, mast rake set up similarly to yours, with the same vintage castings, and no fore/aft slop caused by the upper casting lock-down pin (non-rake adjustable 14/16 upper casting) not seating firmly into the rudder cam.

Build a wooden jig [5] to hold both rudders in alignment. Notice that there are only three stops – two at the top of the rudder head, angled slightly to capture the blades and a third at the leading edge, above the waterline. The stops must be at least 1–½" tall to hold both rudders accurately.

With the template rudder on top, clamp the rudders in place so they lie flat and parallel with each other. Very carefully, use a hand-held drill to mark the position of the new holes on the bottom rudder, using the top rudder's holes as a guide. Don't drill all the way through – the holes won't be straight, and there's a good chance you'll wallow out the holes on your template. Finish up the holes on the drill press.

Drilling the Hard Way – Starting from Scratch

If there's no suitable rudder from which to copy the hole pattern, all is not lost. How you proceed depends on what type boat you have and, in the case of 14/16s, what generation castings you have. You'll need to download the rudder drilling template from Hobie Cat's support web site (www.hobiecat.com > Support > Sailboats > Rudder Drilling Template and Instructions). Print out the PDF file on card stock at the proper scale (**very important**), cut it out, fold and assemble it per the instructions [6]. If you plan on doing more than a couple of rudders, make it out of sheet aluminum for longevity.

On all the boats, the lower/forward hole generally determines the rudder rake; the upper/aft hole determines the lock down tightness and the vertical position of the tiller arm both in the locked down and parked positions. However, they are not completely independent of each other. The template is a good starting point for positioning the lower hole; the upper hole position is determined after the lower hole is drilled. Hobie has changed the 14/16 hole positions slightly at least twice since the template was developed to accommodate increased rudder rake and the addition of the rubber bumper at the lower contact point. If you've got a newer boat (2007 onward), you're better off having the factory drill the rudders or using a template rudder off a new boat.

Hobie 17 / 18 / Wave / 20

Lay the template on the rudder head, making sure it's flat and the reference edges (the vertical parts) are at a right angle to the rudder head surface. The template is tricky to use and hard to position correctly, so take your time to ensure it's in the right place. Mark the lower hole center only with a punch [7]. Drill about ¼" into the rudder for the lower hole only. Check the rake and adjust the hole position as necessary (sidebar) before committing to drilling all the way through.



Measuring Rudder Rake

Install the rudder on either the boat or the test jig and lock it down. Using a straight edge, project the transom line (or vertical mount of the jig) down the rudder blade . At a point 12" below the casting, mark a horizontal line . The rake measurement is the distance between the vertical reference line to the leading edge of the rudder along the horizontal reference line. (Some tuning guides use a projection of the rudder pin centerline as the vertical reference line. To convert to the transom reference line, subtract $\frac{9}{16}$ " from the tuning guide measurements.)

Basic Rake Measurements

14 – $1\text{-}\frac{3}{16}$ "

16 – $1\text{-}\frac{1}{16}$ " to $1\text{-}\frac{3}{16}$ "

17/18/Wave/20 – 1"

These are only basic settings – your mileage may vary depending on your boat's set up (more or less mast rake) and rudder type. Different rudder sections and thicknesses can make a difference in the helm feel.



Hobie 17 / 18 / Wave / 20 (cont.)

Set the lockdown plate in the upper casting in the middle of the adjustment guide . "Dry fit" the upper casting in the locked down position, and check the mating surfaces of the castings to make sure they are aligned , . Make sure the rudder blade is tight against the forward stop at the bottom of the lower casting and the locking plate is seated firmly into the cam. It really helps to have an extra set of hands to do this . Mark the upper hole position using the upper casting as a guide. Again, drill only about $\frac{1}{4}$ " into the rudder and test the fit again, both in the locked down and parked positions. When you're happy with the hole position, drill all the way through. Re-assemble the rudder and castings and remove any slop in the lock down mechanism with the adjustment plate in the upper casting.

At this point, you might want to do some on-the-water testing. Install the rudder on the boat and go sailing. Sail upwind and check the helm feel when your newly drilled rudder is on the leeward side and the weather rudder is up. There should be a very slight weather helm – just enough to slowly head the boat to wind when you lay the tiller down.

Once you're happy with the helm balance on your new rudder, use it as a template to drill the other rudder.



Hobie 14/16 – Rake Adjustable Castings (1983-present)

Proceed as per the instructions for the 17/18/Wave castings. Use Hobie's template to ballpark the lower hole; check the rake; then fit the upper casting / tiller arm. However, because the castings have curved mating surfaces, you must be vigilant to get the arm height correct. With the rudder locked down, the tiller arm forward end must be just above the rear crossbar. With the rudder parked, the tiller arm should be several inches above the deck [12]. That will prevent the tiller connectors, especially the old style, from scratching the deck.

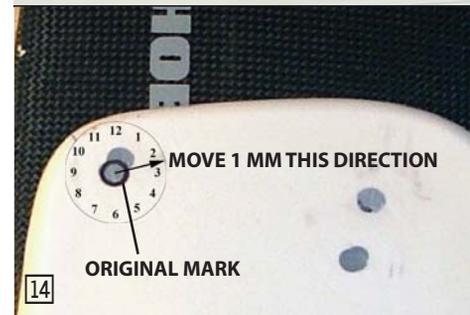
Hobie 14/16 – Non Rake Adjustable Castings (1968-1982)

Proceed as per the instructions for the 14/16 rake adjustable castings. However, since you don't have the luxury of taking the slop out with the adjusting plate, you'll need to tweak the upper hole's position after you initially mark it. With the rudder vertical and laying on its port side, mark the center of the hole 1 mm towards the 2:30 position [14]. Drill only about 1/4" into the rudder and test the fit, both in the locked down and parked positions. Make sure that there's a definite *snap* when the rudder locks down and there's no fore-aft play in the rudder tip. Finish up the hole on the drill press.

Final Checks

Install both rudders on the boat. The tiller arms should be level with each other both in the parked and locked down positions. Go sailing in a variety of conditions. The helm should be neutral / slight weather on all points of sail. If you've got too much helm or slop – try again. It may take several attempts before you get it just right, but the payoff is a much improved sailing experience.

Thanks go to John Bauldry (the "Hand Model"), Mike Hammond and Matt Miller for their help with this article.

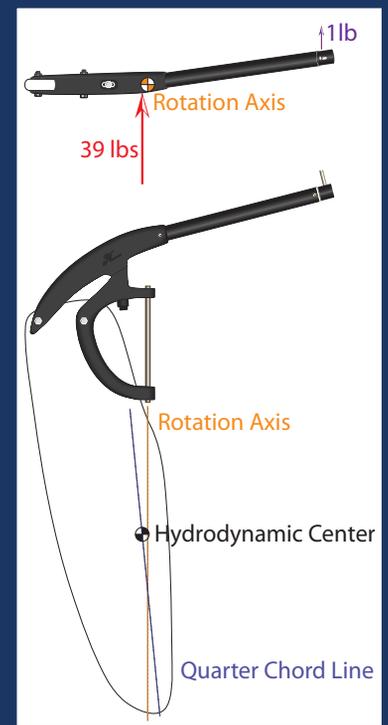
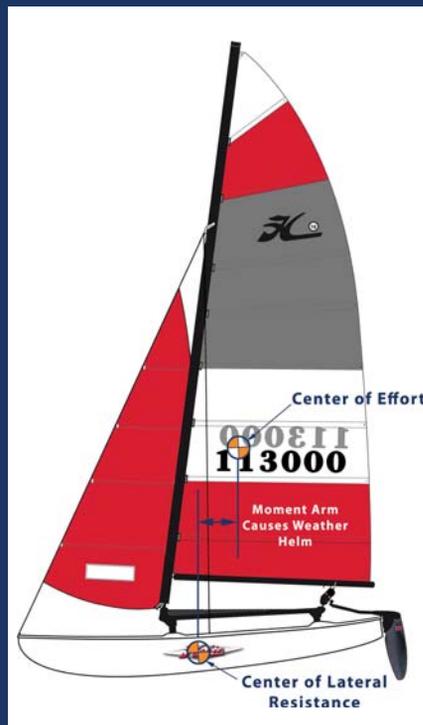


Weather Helm Problems

A boat has weather helm when the sail plan's Center of Effort is aft of the hulls' Center of Lateral Resistance. This moment arm makes the boat want to turn into the wind. As a consequence, you must pull on the tiller to keep the boat going in a straight line. How much tiller force it takes depends on your rudder rake relative to the rudder's axis of rotation.

Whenever a foil (like a rudder) creates lift (turning force), the force acts through a point (the Hydrodynamic Center - HC) located approximately on the foil's quarter chord line. How much force you feel on the tiller depends on how far the HC is from the rudder's rotation axis and the length of the tiller arm. On a balanced Hobie 17, the HC is about 0.4" aft of the rotation axis; the tiller arm is 17" long; therefore a 1 lb pull on the tiller is caused by a 39 lb force on the rudder. On a Hobie 16, changes are even more pronounced since the tiller arm is 26" long.

To increase the rudder rake to reduce weather helm, move the lower casting hole forward and slightly upward - the 2 o'clock direction.



On the 16 / 14 castings, a 1/8" change in hole position results in a 1/4" change in the rake measurement. On the 17/18/Wave

castings, a 1/8" change in hole position results in a 3/16" change in the rake measurement.