OCKAM INSTRUMENTS, INC.

The Ockam Minute

Calibration

Calibration of instrument systems is necessary to make displayed information correct and useful. Instrument systems use sensors to measure primary environmental factors (boatspeed, wind, heading, position, heel and others), possibly combine them, and display the results.

Input calibrations correct sensor inputs to make their readings accurate. They adjust for things like boundary layer (paddlewheels), upwash (masthead units), and installation variables such as compass deviation or sensor misalignment. Output adjustments scale or warp outputs to correct for unmeasured or unknown effects (such as wind shear and gradient), or when input calibrations do not completely correct the sensor inputs.

The calibration of Ockam systems is covered here. This is a general discussion applicable for other instrument systems.

Preliminary checks

- Check that heel angle is zero with the boat upright. Confirm you are getting a reasonable reading of apparent wind speed.
- Go in a slow circle and confirm
    - That the compass readout agrees with the binnacle.
    - The apparent wind angle (not true wind angle) readout agrees with the masthead vane.
- Do these checks all the way around the clock. If you turn up any problems, you should fix them before proceeding.

A word about your compass

Wind direction is built upon the instrument's compass. Any error in it reflects 1 to 1 in wind direction solution. There is no manual way to confirm its accuracy. Traditionally, compass adjusters would be called in for this. But nowadays, there are way too few of them. One thing you can do is to sniff around the area where the compass is mounted with a hand-bearing compass to see if there is any iron in the vicinity.

Most people assume that modern compass auto-calibration guarantees a good heading. Nothing could be further from the truth. If the compass is mounted in the wrong place (e.g. near iron), no autocal will correct for it.

Calibrate boatspeed and wind angle offsets

Do these calibrations only if no significant wind shear is present. **Here's how to tell**.

For all the sailing calibration time, you should look for a developed breeze of around 12-14 knots, generally later in the day. Choosing this type of condition helps to reduce the possibility of wind shear (changes in wind speed with altitude) and wind gradient (changes in Wind Direction with altitude) which are often present early in the day, when the breeze is light or the sea breeze is developing. Cold water and warm air (especially in the spring) can also cause wind shear and gradient.

For offsets, you will want to sail upwind to gather sufficient data to calculate the necessary changes in the calibrations. The purpose of these two calibrations is to develop symmetry in boatspeed and apparent wind angle readings from one tack to the other.

1. Sail the boat close hauled with careful attention to the details of trim on one tack. You will want to duplicate the same trim settings on the other tack. You should sail by the telltales or the angle of heel or a method in which you can easily and consistently keep the boat in the groove. The idea here is to maintain symmetry in the way you are sailing the boat, and to keep the boatspeed and apparent wind angle as stable as possible.
2. Record the boatspeed and apparent wind angle on each tack as often as you can while the boat is in good stable trim. Allow the boatspeed to accelerate and then level off after coming out of a tack.

Print out the **Offsets Worksheet**

Calibrate boatspeed

Boatspeed transducers measure water flow close to the hull, but have to be adjusted to read the boatspeed thru the water. The reason that flow near the hull does not equal boatspeed, is that the hull distorts the flow near itself. Calibrations for boatspeed are therefore required to compensate for hull shape and the position of the transducer.

Boatspeed can be calibrated in many ways: timed runs over a measured distance, comparison with a good standard (i.e. another boat known to be well calibrated, or a towing calibrator), dead-reckoning, or a combination of these. You should use the best standards available and should continue to further improve the calibration as you gain more experience.

If you use calibration by time between marks, make timed runs over an ACCURATELY MEASURED distance of at least 1/2 mile, going over the course in both directions to negate current effects. Remember to keep as straight a course as possible, because sinuous courses always make the actual distance traveled longer than measured. Also, if you are powering or being towed over the course, prop wash will make the indicated boatspeed higher than actual.

Both of these effects tend to make your calculated boatspeed lower than it actually is. Take the log readings over the course in each direction, trying to interpolate to 1/1000 mile.
Repeat the procedure several times until the applied corrections are less than 2%, which is about as good as running a measured course can do.

Print out the **Boatspeed Worksheet**