OCKAM SYSTEM CALIBRATION "CRIB SHEET"

Step 1: Compass Calibration

First, check that the compass is physically aligned properly; it should be level and pointing forward parallel to centerline –a consistent discrepancy all the way around 360 degrees probably indicates your compass simply isn't pointing forward! Always keep the compass area clear of metal or electronic objects that may be moved or have changing magnetic fields - a good practical measure is to post a "compass area" warning note for the crew.

Under motor, ideally in light wind with moderate seas, you'll need to drive the boat through a couple of wide circles with the compass in "Calibrate" mode. Consult the manual for your particular brand of compass to determine how to active cal mode – some electronic compasses are supplied in (user defeatable) cal mode so whenever a couple of wide circles are made the compass will take the opportunity to cal itself. Other models require a wire in the same harness or bundle that also includes power and signal be attached to ground, then detached after the circles are steered. Generally the helmsman must steer through a couple of steady circles at modest speed (about 3 knots seems to work well), each circle taking at least a minute - picture the circle's diameter roughly equal to a football field's width. Many compasses have no built-in means to indicate when cal is underway - in an Ockam system with our newer style e/S compass interface, the interface's status LEDs can confirm cal mode is active (input and status LED's behaviour is erratic even though displayed heading appears normal).

When completed, check headings against known references to ensure the compass is supplying accurate heading information.

Step 2: Calibration of Boatspeed

Accurate display of boatspeed is important (when you're going 7 knots, you want to see 7 knots), plus boatspeed plays a major role in many calculated functions. Motoring back and forth along a known distance while logging distance (Trip Log) is the best way to calibrate boatspeed (going back and

forth and averaging the runs helps eliminate the effect of current). With the Ockam system the boatspeed master calibration is then adjusted by the percentage difference between the logged distance and the known distance. A few tips – you can speed up or slow down while logging the trip, but the course steered must be as straight as possible. Fixed geographical points are best, but Government marks are usually accurately placed and often will suffice (double check positions with DGPS), and don't confuse statute miles with nautical miles

Setup a display to control the "Trip Log" function of the Ockam system. Practice tripping the log once or twice before starting a run – there is a slight delay between pushing the button and the display responding. In relatively benign sea conditions with minimal current (avoid current running at a right angle to the trip rhumb line) approach the starting point on the rhumb line heading. Trip the log at the start and record the logged distance at the end point. Repeat the trip in the reciprocal direction and, record the logged distance. A minimum of 4 runs is recommended (twice back and forth).

Find the average of the trips. Let's say you logged an average of .88 miles, and the known distance is .92 miles. Your boatspeed is reading 4% slow (.88 is 96% of .92). To calibrate the system's boatspeed, display the "Cal Boatspeed Master" value, and raise or lower it by the corresponding percentage. In the above example, if the system's Boatspeed Master Cal is 1.03, the calibration should be raised to 1.07.

Notes: For Signet paddlewheel, interface signature switch set to "2".
Signet wiring to Ockam pigtail – red wire to pigtail's coax center, black wire and shield to pigtail's shield.
Signet default Boatspeed Master Calibration = 1.00, typical range is .95 to 1.10.

Step 3: Calibration of Wind Speed & Downwind Displayed Wind Direction

Having calibrated the compass and boatspeed, now its possible to work on wind functions. The ultimate goal is a displayed wind direction that shows wind shifts and velocity changes without "wobble" from tack to tack or gybe to gybe, with wind angle data that aid in sailtrim and coordination amongst the trimmers and the helm. At this stage, don't fixate on on wind angle symmetry (a few degrees difference in true or apparent wind angle from tack

to tack has surprisingly little effect on calculated wind direction). And do not set windspeed cal based on a guess about how hard the wind is blowing (there's often a big difference between what is felt on deck or seen on the water and the breeze 40 feet or more up at the masthead).

Start by doing a few gybes under main and jib (settling onto a heading with apparent wind just aft of the beam), while watching displayed wind direction. In an Ockam system, if wind direction is consistent within 5 degrees gybe to gybe, the Apparent Windspeed cal is at least pretty close. If "numerically" headed after each gybe, windspeed cal needs to be lowered (from say, 1.14 to 1.13), if lifted then windspeed cal should be increased.

How to tell if you're "headed after each gybe" – picture the boat on a starboard tack with Wind Direction reading 220. After gybing to port tack, the Wind Direction display shifts to 226, a shift that on port tack means the wind has swung forward toward the bow, which is a header. Gybe back to starboard and the Wind Direction swings back to 220, a shift on starboard from 226 to 220 would indicate wind direction swinging forward toward the bow, again a header. Try a few more gybes and if the pattern is repeated, the system is indeed showing "header after each gybe".

When sailing downwind the calibration that is adjusted to eliminate Wind Direction wobble from gybe to gybe is "Cal Apparent Windspeed". If headed after each gybe, Windspeed Cal needs to be lowered. If lifted after each gybe, Windspeed Cal should be raised. The system manual indicates a change of 1.25% per degree of shift. It is in fact very difficult to nail things down to that level of precision after a few gybes. You might want to think in less specific terms – if the wobble is a few degrees, try adjusting the Cal by a small amount. If the "header" is 2 or 3 degrees, try lowering the system's Windspeed cal from 1.14 to 1.13, and then check the result with a couple of gybes. A bigger header warrants a bigger adjustment.

Notes: IF HEADED AFTER EACH GYBE, WINDSPEED CAL NEEDS TO BE LOWERED.
- B&G 213 type masthead unit, Wind Interface Signature switch setting is "B", with default Cal Windspeed of 1.13.
- Signet MHU signature switch setting is 5, with default Cal Windspeed of 1.07.
- Wind Interface's "Heel Sign" switch should be pushed toward starboard side of boat. Correct Heel Sign is indicated by

positive displayed Heel values when heeling on Starboard tack (port side down) and negative (-) Heel on Port Tack (starboard side down).

Step 4, Calibration of Upwash & Upwind Wind Direction

What "upwash" isn't – vertical movement of the wind where air flows up toward the masthead spilling off the upper leeches of the sails and messing up the wind sensor (we do have a name for non horizontal wind flow – axial wind, but that's a discussion for another day). So what is upwash? Picture a rock in a river. The water begins bending around the rock well before it reaches the rock itself, and that is exactly what wind does as your sailplan forces its way through the flow - upstream, ahead of the sails, the "true wind" shifts direction, aka upwash. How much upwash effect is there? That's the rub – a lot when beating, not so much on a reach, hardly any on a run, more when sails are set with full rounded shapes, less when flatter, a huge relative amount in light air, less in fresh breeze. Ockam systems have always offered upwash calibration and in the more recent "Unisyn" CPU software, upwash calibration may be sloped so more cal is applied in light breeze when sails are set fuller, with less upwash cal effect as breeze strengthens.

If your CPU has Unisyn firmware (Unisyn is version 16 or higher) check that Upwash Slope is set to 0. Begin by monitoring displayed Wind Direction while tacking the boat, ideally in 10 to 14 knots true windspeed. If headed after each tack, Cal Upwash needs to be raised. The phrase "HEADS UP" is worth remenbering – if HEADed sailing UPwind, adjust UPwash Upward (and as with most things in sailing, downwind represents the opposite – when headed, the windspeed cal needs to be lowered). Obviously if lifted after each tack, the Cal Upwash should be lowered. The system manual recommends an adjustment of .3 for each degree of shift, but as noted above this kind of precision is difficult to reach in the real world. If the wobble is 5 or 6 degrees, try making a change of 1.0 or 2.0. If the Wind Direction swings back and forth with each tack more than 10 degrees, try adjusting the cal by 3.0 or 4.0. After a few more tacks you'll have a better idea of whether you're narrowing in on the ideal value, and can make adjustments in smaller increments (.5 steps).

Remember that Cal Upwash can be (and often is) a negative value; -2.0 for example. Increasing a cal setting of –2 .0 by a factor of 1.5 will result in a Cal Upwash setting of -0.5.

Step 5 – Upwash Slope

Having determined a good Cal Upwash value in 14 knots True Windspeed, you'll likely find this setting doesn't work as well in significantly lower or higher windspeeds. Typically, lighter winds require a lower cal, and stronger breeze indicates a higher Cal Upwash value. The best way to learn this is to calibrate in these varying windspeeds and assemble a matrix of appropriate, boat specific, Cal Upwash values for a range of Windspeeds. Having done this, you might then wish that the system would set the correct cal depending on Windspeed - a capability previously available to those with onboard computers running OckamSoft's "Autocal" function. With a Unisyn equipped CPU, a reasonably good approximation is enabled without a computer – Upwash Slope.

Ockam's "Release Notice for Unisyn 16.1 Software" (included in current system manuals) does describe Upwash Slope in mathematical formula terms. I applaud those able to decipher the formula and hope someday that I might be able to. In the meantime, here's an explanation that works for me.

If Upwash Slope is set to 0, the Cal Upwash value used by the system (let's say it is currently set at –2.0) remains the same whether the windspeed is 2 knots or 20. But, by setting a slope value, the Cal Upwash used by the system will change as Windspeed changes. The "hinge" point is 12 knots True Windspeed. If an Upwash Slope is set of .20, then at 12 knots TWS, the effective Cal Upwash is –2.0. But if the Windspeed increases 1 knot, from 12 to 13 knots TWS, the Cal Upwash rises from –2.0 to –1.8. Another knot of True Windspeed from 13 to 14 knots will raise the Cal Upwash another .20, from –1.8 to –1.6 and so on. Below our "fulcrum" of 12 knots TWS, the same .20 slope will reduce Cal Upwash .20 per knot of True Windspeed so at 11 knots TWS, the Cal Upwash used by the system is –2.2, at 10 knots TWS, Cal Upwash is –2.4 and so on.

A slope value of .1 for example will result in a less radical adjustment of Cal Upwash as WindSpeed changes, and a slope value set as a negative number (-.1 for example) will cause Cal Upwash to fall in windspeeds above 12 knots, and move higher below 12 knots TWS (this would be a fairly unusual choice). Keep in mind that every boat is different and the sailplan, mast and

rigging setup alters a particular boat's Cal Upwash requirement. Bendy Fractional rigs often twist horizontally with the masthead "torqueing" to weather as running backstays, checkstays and mainsail leech tension are adjusted. Boats of this type are notoriously difficult to calibrate and often require an elaborate, non-linear Autocal table to get excellent results.

That said, for the majority of masthead boats, and the relatively simple stiff carbon fiber rigs found on current offshore one design classes, a Cal Upwash set at –2.0 with a slope of .20 seems to be a reasonable default setting.

Notes: Eliminate "wobble" in Wind Direction from gybe to gybe (downwind Wind Direction) by adjusting "Cal Apparent Windspeed". Decrease cal if headed, increase if lifted.
For B&G 213 type masthead unit, Wind Interface signature setting is "B" with default Cal Windspeed of 1.13.
For Signet masthead sensor, Wind Interface signature setting is "5", default Cal Windspeed of 1.07.
Heel Sign switch on Interface pushed toward starboard side of boat.
Eliminate Wind Direction wobble upwind by adjusting "Cal Upwash". Increase cal if headed, decrease cal if lifted – HEADS UP.

Step 6 – Calibrating Boatspeed Differences from Tack to Tack

Boatspeed may not read symmetrically from tack to tack for a number of reasons. If the paddlewheel sensor is not located on centerline, is on centerline but installed in a thruhull that is turned to one side, or in a dual sensor setup with each paddlewheel needing a different calibration. Be careful that boatspeed discrepancies from tack to tack or gybe to gybe are not a result of wind that is twisted verttically (sheared), a difference in wave angles, or sailtrimmers setting up their sides differently – all these things will and should provide asymmetric readings.

If you are convinced of a real error, adjust the Cal Boatspeed Offset by half the percentage error. The cal should be increased if Starboard tack is faster, decreased if Port tack is faster.

Example – If starboard tack boatspeed is 6.4 knots and port tack is 6.8, the percentage difference is (rounded off) 6%. The Cal Boatpseed Offset should be adjusted 3%, and because port is faster the cal should be lowered. Assuming a default setting of 0.00, the new cal would be -.03.

Step 7: Calibration of Wind Angle

Earlier in these notes, you're advised not to fixate too much on wind angle discrepancies - for the purpose of calibrating Wind Direction, wind angle asymmetry is not major issue. However, ultimately you will want wind angles, True and Apparent, to be displayed accurately from tack to tack. It is important to rcognize that wind direction often does "twist" vertically (wind shear), particularly in the spring when water is cold with warm air above it, and that asymmetry in wind angle display may be correct and not indicating a need to calibrate.

Consistent observation may confirm an error in wind angle (generally a result of the masthead unit not pointing straight forward, parallel to centerline). Determine the difference in degrees, divide by two (the calibration takes away from one side and adds to the other, so the cal is half the error) and adjust "Cal Wind Angle Offset" accordingly. If starboard tack reads wider, the calibration should decrease, port tack wider indicates an increase.

A good check of the wind angle is possible in calm conditions – motor at full speed while displaying Apparent or True Wind Angle and the value should equal zero!

Final Notes

On most boats, Cal Leeway should be set to 8.0.

Calibration takes time, so when you have determined a good set of cals for your boat – write them down.

Cals entered by keyboard or Matryx display will be "remembered" by the CPU if the backup battery is good. But, when the system is Master Reset or if the backup battery is dead, the calibrations will be determined by "polling" the Apparent Wind and Boatspeed interfaces. The cal pots settings will determine the calibration values used by the CPU. To perform a Master

Reset, start with the CPU power switch off/lights switch on, then switch the CPU on and immediately turn the light switch to the off position.

After writing down your calibration values, you should manually set the interface cal pots to these desired numbers. Perform a Master Reset, display the calibration values, and (carefully) turn the cal pots until the displayed calibrations match up. The cal pot on the Wind Interface that is unamed (a white blank label) acts as “Cal Upwash Slope” when Unisyn CPU software is in place. Having set the interface cal pots, an accidental Master Reset won’t negatively effect the system, and should you need to swap in a replacement CPU, a quick Master Reset will encode your boat’s calibrations!

Thanks,

Tom Davis, September 2001