OCKAM INSTRUMENTS, INC.

The Ockam Polar

Basic polars

A 'polar' is a database relating a boat's speed to the true wind conditions it is sailing in. If graphed in normal fashion (with a line for each true wind speed), it would look something like this. →

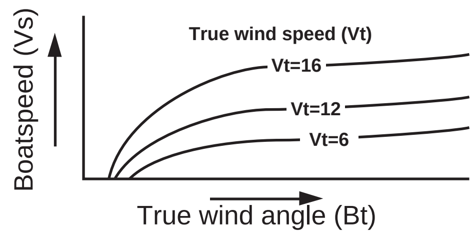


Figure 1

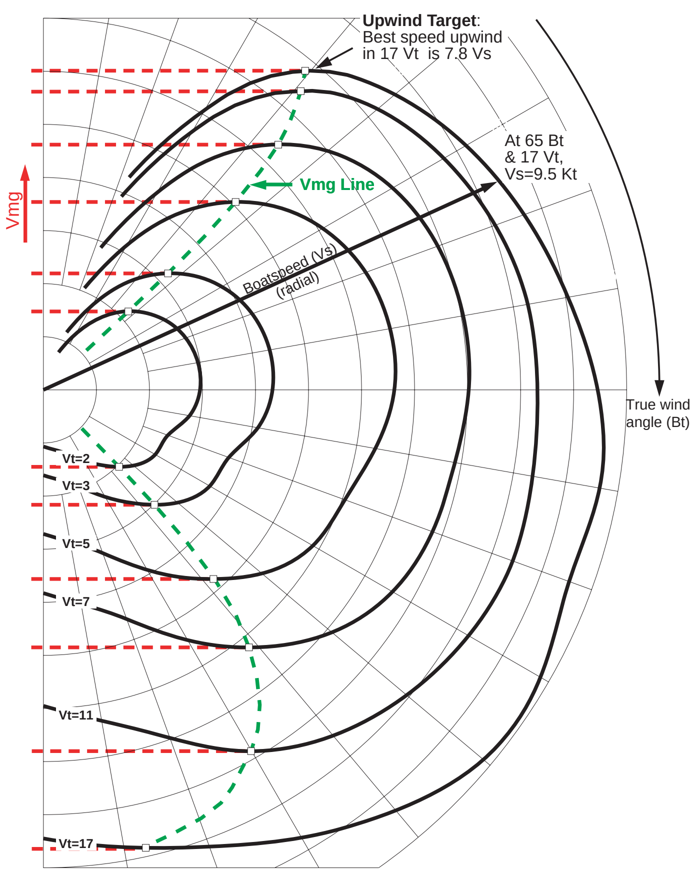


Figure 2

← When graphed in polar coordinates (where boatspeed is the radial distance from the origin and true wind angle is measured from the top), the format provides a graphical solution for Vmg ('Velocity' Made Good [to weather or leeward]). Boatspeed and angle for optimum sailing into (or away from) the wind can be determined by inspection. The term 'polar' derives from this type of graph.

Ockam polars include additional data that is used to calculate optimum sailing on any point of sail.

Vmc Sailing

What about non-upwind/downwind sailing, such as found in distance races? In figure 2, the polar says that at 65º and 17 Kt true, boatspeed should be 9.5 knots. If the next mark bears 65º true, then we should be able to go there at 9.5 knots.

But just as in the upwind case, there is a faster way – Velocity Made Good on Course (Vmc).

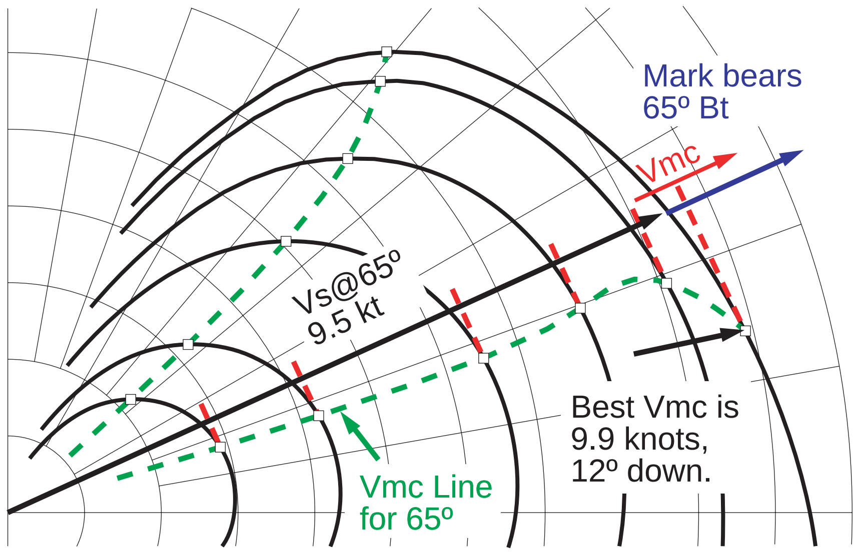


Figure 3

In the conditions shown in figure 3, bearing off 12º speeds the boat up about 0.4 knots, and the speed toward the mark increases 0.38 knots, or 4%, equivalent to **<u>15 seconds per mile</u>** of rating.

Of course, the disadvantage of Vmc sailing is that you go off rhumbline, and will eventually have to get back. In the upwind case, you tack. But in the offwind case, you cannot. If the mark is days away, the wind will likely change and allow you to consolidate back to the rhumbline. If the mark is minutes away, maybe no Vmc sailing. If the mark is in between, it depends on circumstances. Read the Ockam U manual to find out more. Order yours at http://www.ockam.com/OUorderForm.pdf for $35 plus shipping.

<u>Also notice that the up and downwind Vmg lines are just special cases of Vmc sailing at 0º and 180º true</u>.

Doing the Wally

Vmc sailing also works in the upwind-downwind case. In an oscillating wind (one which will shift back and forth during the leg), rather than using Vmg up the present wind direction, you should sail Vmg up the average wind direction.

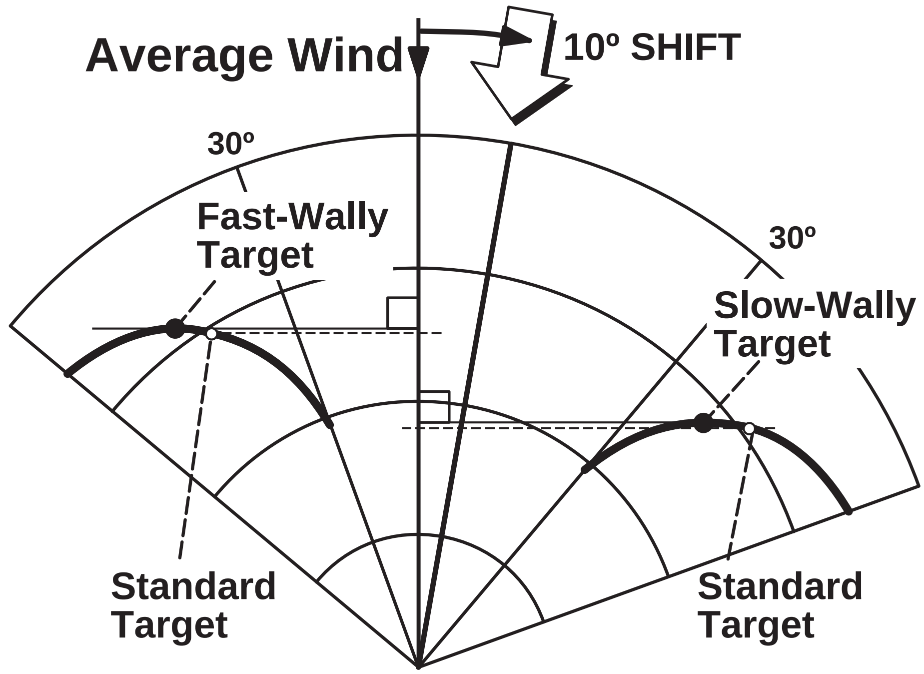


Figure 4

The Vmg gain isn't much, but every bit helps, and you can do the Wally on both tacks. There is a corresponding "Slow-Wally" for those situations when you are headed and can't tack, e.g. for tactical reasons.

Another advantage of the Wally is that it automatically adjusts your lateral position so that when the shift happens, you will gain more against those on the wrong side and lose less against those on the right side. Again, this is all covered in the Ockam U manual.

Notice that having a polar which extends to narrower angles than upwind target angle is important for calculating the slow-wally.

An easy to understand example is a windward leg in a northwest offshore wind. Say the wind is from 315º and shifting ±10º every couple of minutes. Standard practice is to sail your targets on both tacks, adjusting course as the wind shifts.

To use Wally in this scenario:

1. When the wind is 315º, sail target speed.
2. As you start getting lifted, start to foot (wider true wind angle). The more the lift, the more the foot. The amount of change in speed and

angle is given by the Vmc angle data. If you don't have hard numbers, the true wind angle should be increased about half the amount of the shift. By the time the wind is 10º lifted, your true wind angle should be 5º wider than target.

3. As the wind returns to 315º, your true wind angle returns to target. When the wind reaches the average, tack onto the new lifted tack as the wind continues to veer.
4. On the new tack, repeat steps 2 and 3.

On <u>both</u> tacks, Vmg is higher than not Wallying, you are tacking on the shifts, and there's no off-rhumbline penalty to pay.

The Ockam Polar

In addition to polar speed, Ockam polars include a table of 'Vmc angle' information that tells you how much to sail off the rhumbline to maximize Vmc.

In the example of figure 5, upwind (Bt=0) Vmc angle is 39º (which means your upwind tacking angle is 78º). Downwind (Bt=180), the Vmc angle is -25º (which means you sail 180-25=155º true).

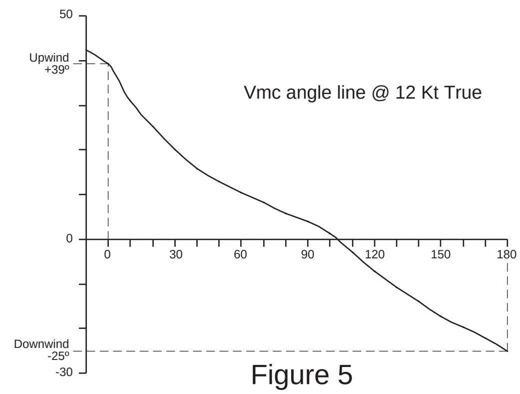


Figure 5

There are some things to note about the Vmc angle line:

- You can assume Vmc lines are straight lines. In figure 5, the change from upwind to downwind is 64º over 180º, or about 3.5º every 10 degrees. More accurately, Vmc angles should be taken from the Ockam polar.
- The Bt where Vmc angle is zero is the mark Bt where there is no Vmc adjustment.
- In order to calculate Wally, the polar must go narrower than upwind targets by at least 10º (i.e., pinching information is important). It would be nice to get by-the-lee data, but sailing there is not a long-term option.

Because Vmg is the special case of Vmc at 0º & 180º, Ockam determines:

UpwindTarget = PolarSpeed(VmcAngle(0,Vt),Vt)

DownwindTarget = PolarSpeed(180+VmcAngle(180,Vt),Vt)

Thus VmcAngle is an indispensable part of the Ockam polar.

The canonical Ockam polar is normally supplied as a spreadsheet. There are two or three areas in the spreadsheet, designated by "range names".

- Range name “POLAR” (required) is a table giving boatspeed as a function of true wind speed and angle.
- Range name “VMCANGLE” (required) is a table giving VMC angle as a function of true wind speed and angle. This table can be created by the “FITVMC” application by differentiating the POLAR range.
- Range name “TARGETS” (optional) is a table giving upwind and downwind target boatspeed as a function of true wind speed. If this table is supplied, FITVMC will force the VmcAngles for up and downwind to return the value as defined in the TARGETS table.

Polars on the Ockam System

Polar data can be realized two ways on an Ockam system.

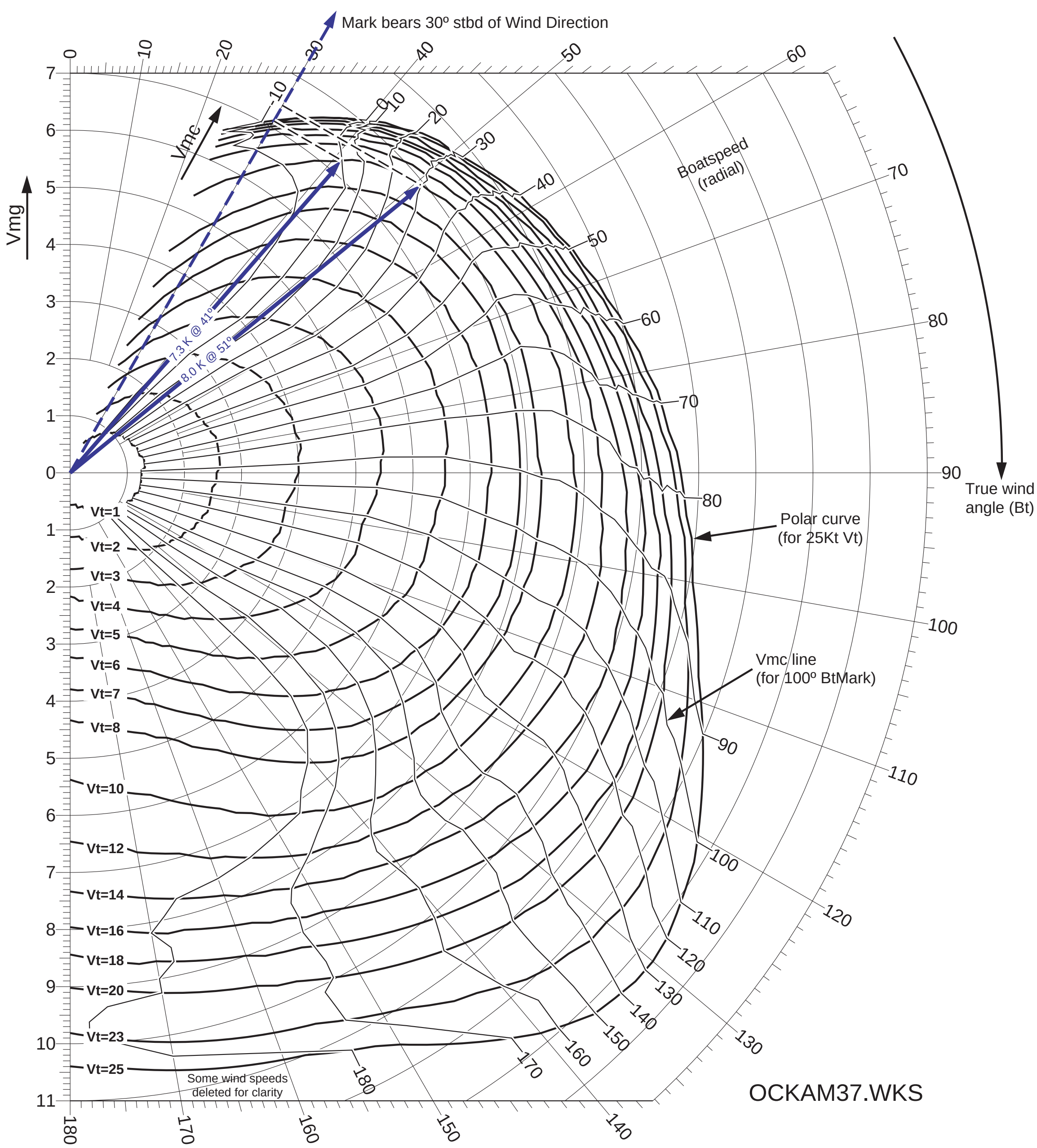
1. They can be stored in the system itself, which then outputs them.
2. They can live on a PC and be output to the system with user commands.

These two methods are not mutually exclusive unless both are trying to output on the same tag.

If you run onboard software, you probably have a polar file already. Using the second method is pretty simple; tell the software to output the numbers. However, if your laptop crashes, you lose your polars and targets.

If this is an issue, then the added reliability of instrument-resident polars should be considered. To convert your polars to an Ockam compatible format, download http://www.ockam.com/docs/FitVmc.zip for a tool to do a FitVmc on your data.

Typical Ockam Polar
with Vmc Angle Lines



If you want to get further into this, download the Ockam 37 polar spreadsheet at http://www.ockam.com/ockam37.wks.