

Wind Instruments

Wind Velocity

Wind can be defined in terms of its **SPEED**, its **DIRECTION** or its **ANGLE** relative to the boat.

SPEED – Usually in knots

DIRECTION – measured in degrees of the compass. DIRECTION is where the wind is coming from, not where it is going to.

ANGLE – measured in degrees from the bow of the boat. Zero degrees is equal to HEADING (for apparent wind) and COURSE for true wind (Course = Heading + Leeway) Values therefore range between zero and 180 degrees to port or to starboard.

Types of Wind

Wind can also be defined in terms of whether it is a **GROUND** wind, an **APPARENT** wind or a **TRUE** wind

GROUND Wind – Is the wind as it would be perceived if one were standing on land. For those on the water, an analogy might be the wind that is perceived when anchored and not swinging. GROUND wind readings assume that there is no movement of the boat in relation to the earth.

APPARENT Wind – Is the wind as it would be perceived if one were standing on the deck of a boat that was subject to movement by; **a)** The movement of the boat within a body of water. (caused by some form of propulsion; sails, engine etc) and **b)** The movement of the body of water itself. (caused by currents, tides etc.). APPARENT wind readings assume that there is movement of the boat in relation to the earth.

TRUE Wind - Is the wind that would be perceived if there was no movement of the boat through the water by a propulsion system. It therefore represents the wind perceived by an object stationary in the water, but moving with the tide or current. The wind felt by a stick floating down a river for example. The true wind is the wind that is available to use to power our sails.

On the better instrument systems, true wind also includes an allowance for Leeway. This is because the inclusion of Leeway gives a more accurate indication of the wind available to sail in. Which is the whole point of a true wind readout.

The term “TRUE Wind” causes all kinds of misunderstandings because it is logical that TRUE wind should be defined as the wind as it would be perceived if one were standing on land. Unfortunately, this is what boat instruments call GROUND wind. TRUE wind (as displayed by boat instruments) is therefore an unfortunate term which might cause less confusion if it were called something along the lines of ‘available wind’ or ‘water surface wind’ or ‘motionless boat wind’. But it isn’t. So:-

Measurement and Calculation of Wind

GROUND wind can only be measured when the boat is fixed in some way to the earth (e.g. anchored). Ground wind is what is given in weather forecasts.

TRUE wind can only be measured if there is no movement through the water but APPARENT wind can be measured at any time. Therefore, when the boat is sailing (when we need wind information) APPARENT wind is the only wind that can be measured and as such, it is used as the basis for calculating (not measuring) GROUND wind and TRUE wind.

Calculating True Wind - TRUE wind is a calculation that adds or subtracts the BOATSPEED/COURSE vector from the APPARENT WIND SPEED/APPARENT WIND DIRECTION vector.

Calculating Ground Wind - GROUND wind calculation requires GPS data, since it is established by adding or subtracting the SPEED OVER GROUND/COURSE OVER GROUND vector from the APPARENT WIND SPEED/APPARENT WIND DIRECTION vector.

Accuracy of the Calculation - The data calculated can quite often be inaccurate and give misleading values for TRUE wind. This is due to a number of factors.

First and foremost is the inaccurate measurement of BOATSPEED. Paddle wheels are the major culprit here. Often they are not calibrated correctly, or the calibration has been lost due to a build up of slime, slight wear or damage to the paddle wheels or a different level of friction in the paddlewheel. Also, paddle wheels can only be calibrated accurately at one boat speed. So if it was calibrated at 5kts, it will be inaccurate at 10kts. It does not take much for a paddle wheel to display inaccurate BOATSPEED. The ultrasonic boat speed transducers that are now available provide a much greater level of accuracy.

Another inaccuracy that creeps in is LEEWAY. The rule of thumb is that $Leeway = -1 * k * Heel / BSP^2$. The formula itself is often called into question, especially with modern surfing and planning hulls. Also, there are very few who accurately assess the k value for their own boat. The k value itself will vary according to crew numbers and boat loading.

As GROUND wind data is derived from GPS data and given the advances in GPS technology and the number of satellites available, the calculation for GROUND wind is usually accurate.

As an aside, the SET and DRIFT of the tide or current is calculated as the difference between the GROUND wind vector and the TRUE wind vector. Therefore, the most significant implication of inaccurate BOATSPEED and LEEWAY is the inability to determine the tide or current that is present. The quantum of the inaccuracy can be checked easily if the instruments can display tide set and drift (for which you will need GPS information in the system). Follow this procedure; Motor at a fixed BOATSPEED and HEADING and record the SET and DRIFT. Slow the boat down, but maintain the HEADING. If the SET and DRIFT readout changes, you need to recalibrate your BOATSPEED.

Using the Numbers

What is described below is a very broad explanation of how the various numbers may be used. It should be noted that wind data can be used on its own, or in combination with other data, in many different ways to achieve a particular goal. This is just a very broad-brush overview.

GROUND Wind – Weather forecasts, wind forecasts, synoptic charts, depictions of currents and tidal flows are referenced to the surface of the earth. As such, real time GROUND wind, as presented by the boat instruments, is used predominantly for weather tracking and for future route planning. It contributes nothing to sail selection or performance prediction (from polars), nor can it be used to determine how well the boat is being sailed.

TRUE Wind –TRUE wind will never be felt on a moving boat, but it is the basis for sail selection and performance prediction and measurement. This is because TRUE wind represents the wind that is available to the sailor for propulsion.

APPARENT Wind – APPARENT wind results from how the boat is being sailed in the TRUE wind available. The APPARENT wind is what the sails are actually experiencing and therefore sail trim, boat trim and helm control directly affect and are affected by, the APPARENT wind.