

Explanation of Drift Simulation

Load the simulation called "Drift"

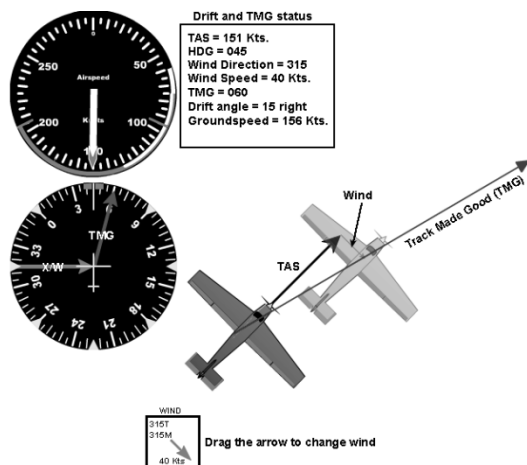
Click the next button to start the simulation.

In frame 1 there is NO wind. The ghost airplane (on the right) shows where the airplane will be in one hour.

Use the Z-key and Q-key on your keyboard to speed up and slow down, or drag the airspeed bug. Not surprisingly the airplane will be farther away after an hour if it flies faster, etc.

Use the left-arrow-key on your keyboard to turn left, or the right-arrow-key to turn right. Alternatively use the heading bug knob, or drag the heading bug directly.

Tip: Drag the airplane around to position it for easier viewing.



Click the "next" button, or number "2."

The picture above shows frame 2 as it appears when you first arrive there.

Try speeding up and slowing down with the Z-key and Q-key. Notice that the wind vector, see picture above, does NOT change when TAS changes.

Make a turn using the left-arrow-key, or right-arrow-key. It is VITAL that you notice that the wind vector does NOT turn when the airplane, turns. However, the TAS vector, see picture, always points in the direction the airplane is pointed (i.e. the heading.)

The green arrow is called the Track Made Good (TMG.) It is the most important concept to grasp. You must realize that the airplane does NOT move in the direction it is pointed (not exactly.) The wind drifts it so that it moves along the TMG.

The simulation also creates a green TMG vector on the HI. Try making some turns. You will notice that if you turn directly into the wind, or with a direct tailwind, the airplane does fly in the direction of the heading. But if the wind is at an angle to the airplane it drifts, such that the TMG arrow points slightly away from the nose.

Notice that the greater the angle between the wind and the aircraft axis the more it drifts. Of course it also drifts more, as the wind gets stronger.

The blue vector on the HI shows the wind relative to the airplane. Such a vector would be tremendously helpful in a real airplane. In fact modern EFIS equipped airplanes, with flight data computers do have such a vector. Sadly the airplane you are likely to use for your initial IFR training won't have such a vector, so you must learn to visualize it on your own.



Drag the tip of the wind arrow (the one in the wind box, see picture above) to change the wind. Notice the blue wind vector on the map change. You can totally change where the airplane winds up after one hour of flying by changing the wind. If you make a wind vector opposite to the direction of flight, and drag it out far enough you can stop all forward motion. Or, you can create a tailwind greatly increasing how far the airplane goes in one hour.

Click the "next" button, or number "3."

This frame defines drift angle (DA.) Drift angle is the angle between the heading (TAS) and the track made good (TMG.)

We will return to these definitions in the next simulation.

Click the "next" button, or number "4."

This frame is a challenge. There is a beacon that we wish to fly to that is exactly 300 degrees from our present position. Your task is to find the heading that takes you to that beacon.

Note: you cannot move the airplane in this frame.

The required heading will NOT be 300 degrees.

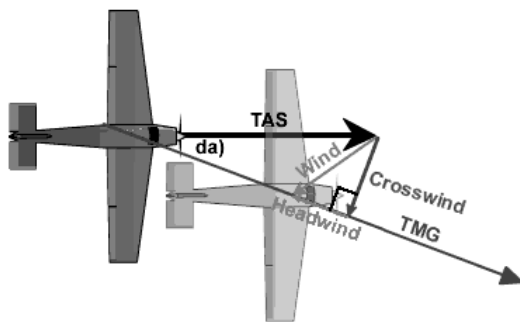
Once you have found the required heading try changing the wind to a northeast wind and do the challenge again.

Take note of the Drift and TMG status box beside the airspeed indicator. In this box the simulation displays all the data you need to figure out the required heading. (Specifically required heading = desired course (300) +/- drift angle.) The point being made is that if you know the wind and TAS you can calculate drift angle. Once you know the drift angle you can calculate the heading required to maintain your desired course (dTMG.)

Keep in mind, as we work through the next two simulations that our objective is always to find a heading that keeps us on course.

Load the simulation called Crosswind, headwind, tailwind, drift angle – definitions.

Click the next button to start the simulation.



The first frame provides some crucial definitions.

TAS is the vector that represents the airplanes motion through the air. We will assume it always acts in the same direction as the heading – of course if the airplane was slipping that wouldn't be true, so we are assuming that when doing IFR procedures you won't be slipping.

The TMG, as we have already seen, is the vector that represents where the airplane is actually going, over the ground. It is equal to the SUM of the TAS and WIND vectors.

The wind vector, in blue, shows the direction and strength of the wind.

The new definitions in this simulation are crosswind and tailwind (headwind.) Crosswind is the component of the wind at right angles to the track made good. Tailwind, or headwind, is the component of wind parallel to the TMG.

Click the "next" button, or number "2."

A common MISTAKE is to think that crosswind is the wind at right angles to the airplane's axis – in fact pilots often talk about the “wind on the wingtip.” This is WRONG. Crosswind is always measured at right angles to the TMG. Similarly tailwind and headwind are along the TMG, and NOT exactly on the nose or tail of the airplane.

In this frame grab the wind arrow and change the wind at will. Notice the magenta tailwind and brown crosswind vectors change as the wind changes.

There are crosswind (brown) and headwind/tailwind (magenta) vectors on the heading indicator (HI.) There is also a wind vector (blue) and a TMG vector (green.)



Grab the wind arrow and drag slowly through 360 degrees (keep the wind speed fairly high.) On the HI watch the blue vector move around 360 degrees under your command. Now notice that the crosswind and headwind vectors (blue and magenta) stay close to, but not on the wingtip and nose/tail. The green vector (TMG) shows the direction the airplane will travel under the influence of the wind you have created.

In the Drift and TMG status box (beside the airspeed indicator.) notice the digital readout of crosswind and headwind as well as TMG, drift angle, and groundspeed.

Click the “next” button, or number “3.”

In this frame you will learn that the drift angle depends ONLY on the crosswind. I.E. the headwind or tailwind makes no difference to the drift.

Try dragging a HUGE wind, but adjust the direction so there is only a 10-knot crosswind. Note the drift angle.

Now make a much lighter wind, but once again adjust the direction so there is a 10-knot crosswind. Notice that there is the SAME drift angle, and TMG.

Of course the groundspeed was very different in the above two cases.

Now change the airspeed to a significantly different value (lower or higher, it doesn't matter.) Next set the wind so you once again have a 10-knot crosswind. Notice that there is a different drift angle this time.

We have learned that drift angle depends ONLY on TAS and crosswind.

Click the "next" button, or number "4."

This frame shows the mathematical formulas for drift and groundspeed. If you have a flight computer these are programmed into your computer. If you are using a regular calculator you can use these formulae for flight planning.

The first formula is for drift angle. As we expected, it has only two variables, TAS and Crosswind.

$$\text{Sin}(DA) = \text{crosswind}/\text{TAS}$$

Groundspeed is more difficult to calculate. A common mistake is to think that you just add or subtract tailwind to the TAS. But, you can see in the diagram that this is incorrect. If you have a strong crosswind it reduces groundspeed, even if there is NO headwind or tailwind. So, to calculate groundspeed you need to know BOTH the crosswind and the tailwind. Therefore to determine groundspeed first use the formula above then:

$$GS = \text{Cos}(DA) \times \text{TAS} + \text{TW}$$

$$GS = \text{Cos}(DA) \times \text{TAS} - \text{HW}$$

GS stands for groundspeed, TW stands for tailwind, HW for headwind.