THE WIZZ WHEEL

...SIMPLIFIED!

INTRODUCTION

The Navigation Computer, more commonly known as the Wizz Wheel, is a marvellous bit of kit which enables the pilot to perform a large number of calculations.

But that’s just the problem – there are so many things that can be done it’s very easy to become confused!

Furthermore, often there are several different methods of doing the same calculation.

This booklet concentrates on the two most important Wizz Wheel calculations which are vital to cross country flights and to passing the PPL Ground Examination.
THE NAVIGATION COMPUTER

also known as

FLIGHT COMPUTER or WIZZ WHEEL

Using the Navigation or Flight Computer accurately is vital. Errors in the calculations will make cross country flights very difficult if not impossible. Also many of the questions in the PPL Navigation Theory Exam. are based on the use of the “Wizz Wheel”.

If you can understand vectors and the Triangle of Velocities as described on pages 4-8 it will help you make sense of using the Flight Computer. But don’t despair if you find this difficult: simply follow the steps given on pages 9 onwards and summarised on page 33.

Note that there are several different methods for using the Nav. Computer and if you mix them up you are bound to get the wrong answer. So stick to the method shown in the following pages and if all is not clear, ask your instructor to explain!

Abbreviations used :-

G/S  ground speed
HDG  heading
Kt   knot
PLOG pilots log
TAS  true airspeed
TRK  track
W/V  wind velocity
VECTORS

These are often referred to in aviation.

A vector refers to both the **direction** and the **strength** of whatever is being described.

For the calculations for the Pilot’s Log (the PLOG) the vectors we use have direction and speed.

If we consider two examples of wind velocity, they would be written as **180/15Kt** or **300/45Kt** and can be represented in diagram 1 opposite where the **direction** of the wind is represented by the direction of the drawn line while the length of the line shows its **speed** (so the 45 Kt line is 3 times as long as the 15 Kt line). Note that wind vectors always have 3 Chevrons (arrows) indicating the direction it is coming FROM.

Another vector we need to consider is the aircraft’s direction through the air (this is the **Heading (HDG)**) and its speed through the air (True Airspeed (TAS)). Examples are shown in diagram 2.

The first example shows an aircraft flying on a HDG (always shown with one chevron) of **130** degrees and a TAS **50** Kt and the second one shows a HDG of **260** degrees and TAS of **70** Kts so that the second line is 40% greater than the first in proportion with the airspeed.

The third vector which concerns the PLOG is that of the direction over the ground (the **track (TRK)**) shown with two chevrons, and the speed over the ground (G/S). Once again they can be shown in a diagram where the direction of the line represents the direction of the TRK and the length of the line is in scale with the G/S. Diagram 3.
EXAMPLES OF VECTORS

1. WIND VECTOR.

\[ \begin{align*}
\text{180} & \quad 15 \text{ kt} \\
\text{360} & \quad 45 \text{ kt}
\end{align*} \]

Diag. 1

2. HDG / TAS VECTOR

\[ \begin{align*}
\text{130} & \quad 50 \text{ kt} \\
\text{260} & \quad 70 \text{ kt}
\end{align*} \]

Diag. 2

3. TRK / GS VECTOR

\[ \begin{align*}
\text{268} & \quad 70 \text{ kt}
\end{align*} \]

Diag. 3
THE TRIANGLE OF VELOCITIES

Let's imagine a pilot wishing to fly to B which is 268° from A. He forgets all about the wind and flies off at a TAS of 105 Kts. maintaining a heading of 268°. We can draw in this vector in the correct direction and will make it 10.5 cms. long using a scale of 1 cm per 10 Kt. See diagram 4.

Unfortunately there is a strong wind blowing from 315° at 40 Kts. as shown in the vector drawn using the same scale. Diagram 5.

Combining these two we see that because of this wind the aircraft would end up arriving at C and that the line from A to C represents his TRK and the length of the line would enable us to measure the G/S using the scale of 1 cm = 10 Kts. Diagram 6.

This would have been fine if the pilot had wanted to go to C but as he wished to arrive at B, his track should have been 268° so, making allowances for the wind the triangle should look more like diagram 7.

Of course the aircraft doesn't really fly to X and then back down to B but this Triangle of Velocities shows us the direction of the HDG needed to keep us on the required TRK taking into account the wind.
If we consider this triangle in more detail

Line A to X is the HDG / TAS vector*
Line X to B is the Wind direction / wind speed vector
Line A to B is the TRK / G/S vector**

Note: these pairs always go together.

*HDG is the direction travelled through the air and TAS is the speed we travel through the air.

**TRK is the direction travelled over the ground while G/S is the speed we travel over the ground

Unfortunately we cannot easily construct this triangle. We know how long to draw line A to X as we know what airspeed we shall elect to fly, but as yet we do not know its direction (the HDG). Also while we know the direction of line A to B (our TRK) by measuring it on the chart, we do not know how long to make the line as we do not know our G/S.

This is where the Navigation Computer comes in.
AN EXAMPLE OF A TRIANGLE OF VELOCITIES

Dia 8
USING THE NAVIGATION COMPUTER

This has two sides, one referred to as the Wind side and the other as the Calculator side.

For calculating HDG and G/S as described previously we use the wind side which is shown in the diagrams opposite.

Note the following features:

the central transparent disc can be rotated so that any required direction can be set against INDEX at the top. In this diagram 279 has been set.

the numbers along the central vertical line represent speeds which apply along the length of the curved line passing through that number. In the diagram the 100 kt. line has been illustrated.

the slide can be moved so that different speeds can be set.

the numbers marked across on the curved lines indicate the angle (measured in degrees) that the intersecting straight line makes to the central vertical line. The line 10 degrees to the right has been illustrated.

In the following instructions for using the Wizz Wheel the following format has been used:

All instructions for what to do are in bold type.

*Any common 'fatal' errors are in italics.*

Comments or explanation are in standard type.
For the example which will be illustrated in the following pages we have the following information:-

Wind direction / wind speed (306/40 Kts.)
True Airspeed 100 Kts..
Track 268°(T)

We wish to calculate:-

Heading and Ground speed (and later on in the PLOG we will use G/S to calculate the time taken on this leg).

Step1.........Set the wind direction at the INDEX

INDEX may be called something different on your Wizz Wheel: always use what is marked in the 12 o’clock position.
Step 2………Draw a line **down** to the centre spot .Use the speed scale to judge it’s length according to the wind speed. Mark in the arrows and put a “T” at the top end of the line.

*The wind vector must be drawn in **above** the central dot.*

If you think of the central dot as being the aircraft and the figure you have set at the INDEX the direction the wind is blowing from you won’t put the arrows in the wrong direction.(This is also a common error when marking the wind vector on the chart!)

The reason for putting the “T” on the end will become obvious.

At this stage it doesn’t matter what actual number is under the central dot as long as you make the wind line the correct length for the wind speed. In this example the wind vector line is drawn from 170 down to 130 to make it 40 kts, but if you move the slide up or down you will see it makes no difference to the length of the line. It’s a bad idea to put the figure for TAS under the central dot as it may confuse you later!
Step 3………Rotate the inner disc until the TRACK is set against the INDEX

I’ve drawn in the track as a line but once you are familiar with this method that won’t be necessary-(but I would always mark the wind as a line and include the arrows and the “T”, rather than just marking a cross or dot as some books recommend)

By drawing in the track line I hope you can see that the triangle we looked at on page 8 is starting to be formed.
Step 4 Set the TAS by adjusting the slide until the curved line corresponding to Airspeed lies at the end of the wind vector.

i.e. **PUT THE “T” ON THE TAS!**

*This is the commonest error. DO NOT set the TAS directly over the central line where the numbers are marked.*

It is now possible to read off the angle of drift.

In this example it is 14° as seen by the position of the end of the wind vector (which is marked by the “T”)

If this is not obvious to you, go on to the next page and then refer back to this one!
The line drawn and marked with a single arrow is the **heading** and it becomes possible to read off the **drift angle** by reference to the numbers marked across the slide. It is 14° in this example.

This triangle is identical with the one drawn on page 8 illustrating the triangle of velocities.

It’s not necessary to draw this HDG line in or to mark the drift angle as has been done here. All you need to do is to note the position of the “T” in order to read off the drift angle.
Step 5………If the heading line is to the RIGHT of the track line then add the drift angle to the track to work out the heading. If the heading is LEFT of the track then subtract the drift angle to work out the heading.

DO NOT apply the drift in the wrong direction – the aircraft always heads into wind.

The wind always blows from the heading to the track so if you mark in the wind vector with a line and arrows an error is much less likely. If your mathematics is not good you can use the scale adjacent to the INDEX as shown opposite. As shown here, the heading is 14° to the RIGHT of track. If we look at 14 degrees to the right on the outer scale and read off opposite on the inner scale we see that the heading is 282°.

Ignore any words labelled on you Flight Computer near this scale as they often refer to a different way of using the Wizz Wheel.

Remember that all the directions (wind, heading and track) used so far are referenced to True North. You will need to apply variation at this stage (Add West \ Subtract East) to arrive at the magnetic heading [HDG(M)] which you will use in flight.

(Calculation of Compass heading, HDG(C), using Deviation is not included here but you need to understand this for the PPL theory exam.)
Step 6………Read the number under the central dot. This is the Ground Speed. It measures 67Kt here.

Be sure you’ve not set the TAS under this central dot.

This may not be exactly over one of the numbers so use the small squares to arrive at the correct figure.
THE CALCULATOR SIDE OF THE WIZZ WHEEL

When you begin your cross country flying you may be surprised at the emphasis your instructor will place on TIME and the use of your watch!

For this reason, having calculated your Ground Speed and having measured the distance between waypoints using a rule of appropriate scale, you need to work out the length of time each leg will take.

If the calculator side of your Flight Computer is not clearly marked, for this type of calculation (the most common) you might care to mark in “MILES” over the outer fixed part and “MINUTES” on the inner movable disc: it will help you to ignore the numerous other labels which are not relevant at this stage.

N.B. there is an amazing number of calculations you can perform with this side of the Wizz Wheel. Until you are confident with calculating time taken from ground speed and distance it may be advisable to limit yourself this sort of calculation as it is very easy to get confused!!

Step A……… Rotate the inner disc till 60 minutes is opposite the Ground Speed on the outer scale (Miles)

We have calculated G/S to be 67Kt.

By setting Ground Speed against 60 minutes we are saying that this is the number of miles travelled (over the ground) in 60 minutes.
Step B……….Look on the outer scale for the number of miles you have to travel on that leg of the PLOG.

Let’s assume that this distance measures 45 nautical miles on your chart.

*Remember - Miles are on the Outer Scale. Don’t look for this figure on the inner scale which is for Minutes.*

The illustration shows a Nav Computer with a transparent arm which can be rotated till its centre line overlies the length of leg on the outer scale!
Step C———-Read the figure on the inner scale which is opposite the distance figure you have noted on the outer scale. This is the number of minutes taken to fly that leg.
In this example it is 40 Mins.

Remember - Miles on the Outer Scale and Minutes on the Inner Scale.

The transparent plastic arm makes it easier to read off one figure against the other but it is still quite straight-forward even if your calculator doesn’t have such an arm.

When you come to calculate the time for the next leg don’t forget to set the new Ground Speed against the 60 minute mark.
AND FINALLY………..

WHEN YOU HAVE COMPLETED YOUR PLOG:-

Draw the wind arrow on your chart remembering that the wind direction is FROM. Then check all the calculated figures in the PLOG and be sure that they make sense.

-are the headings all on the windward side of the desired tracks? The wind always blows from the Heading to the Track.

-is the Groundspeed greater or less than the Airspeed in accordance with the wind direction?

-from the Ground Speed and the length of the legs, does the time make sense? It’s even possible to make it 10x too large or too small!

Errors in the PLOG will be very difficult to spot when you are also aviating and communicating so

Get it right afore you go!
OTHER WIZZ WHEEL

CALCULATIONS

When you are confident and competent at performing these two calculations you may care to investigate some of the other possibilities of the Wizz Wheel, bearing in mind that the batteries of electronic calculators have a nasty habit of being flat at the time you most need them!

They are:

Calculation of X-wind component.

Trip Fuel Requirements.

Conversions

  - metres / feet
  - miles / kilometres
  - gallons / litres
  - kilograms / pounds

More advanced functions:

IAS / TAS

Pressure altitude / density altitude
**SUMMARY**

1. Set the wind direction against the INDEX.  
   Page 12

2. Draw the wind vector the correct length above the dot. Mark arrows and “T”.  
   Page 14

3. Set TRK against the INDEX.  
   Page 16

4. Adjust slide until TAS is under the “T”  
   Page 18

5. Read drift angle.  
   Page 20

6. Calculate HDG.  
   Page 22

7. Apply Variation to get HDG(M)  
   Page 22

8. Read G/S under central dot.  
   Page 24

**Using the other side of Wizz Wheel**

9. Set 60 minutes against G/S.  
   Page 26

10. Look for length of leg on outer scale  
    Page 28

    and read off minutes on inner scale.  
    Page 30

If you have problems with any of these steps refer back to the page whose number is shown.