Mental arithmetic goes out of the window for most pilots when flying. Here’s a really simple way.

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**PHOTOS** www.airteamimages.com

I PRESUME you are reading this in a comfortable armchair, or on a train, or maybe even in a flying school with the rain pounding on the windows. Possibly there’s a favourite tipple in one hand and some gentle music in the air. Under these conditions, if I asked you to do some mental arithmetic (and you were aged over 29), it would probably take you less than five seconds to work out “two-thirds of 50”. Now imagine the situation when you are at the holding point for runway 24. You call “ready for departure” and the tower replies with “cleared to land; wind 030, 25 knots”. What’s the crosswind component? What’s the headwind component if the performance is a bit tight? Is it the same as you used in your performance calculations? Not as easy as when you were on the train, is it?

Maybe you are at the end of a long flight, typically slightly longer than the comfortable endurance of your bladder. You are flying an approach which is a bit more turbulent than part of your anatomy would prefer when, at 500 feet, you call “final” for runway 35 and the tower replies “cleared to land; wind 090, 30 knots”. What is the crosswind component? Would you agree that it would not be as easy now as in your armchair?

Let’s be honest with each other. Do you actually calculate the crosswind component every time you are told the wind strength and direction after a call of “ready for departure” or “final”? Do you always think about the wind direction and make an appropriate aileron input? Honestly?

During my time as an instructor and examiner it has been very rare that a pilot has volunteered the crosswind or headwind components on an approach or before take-off. If I ask them, the answer is usually (with some honourable exceptions) “errr” followed by a pause and a shrug. Frequently they don’t even know whether the wind will be from the left or right without looking at the windows! It’s an unfortunate aspect of aviation that we all lose a significant proportion of our intellectual capacity when we have an aircraft strapped to our back. I cannot tell you how it happens but I can show you a way around the problem when it comes to crosswinds and headwinds. The purpose of this article is to present a simple method which will allow you to assess the crosswind and headwind components with as much accuracy as you like, without any sums, without any gadgets, in less than five seconds, and whilst flying an aeroplane.

**BASIC GEOMETRY**

We will start by going back to basic geometry – but even sitting in your armchair, I doubt most people would be able to work it out in less than five seconds, and whilst flying an aeroplane.

The “rule of sixths” makes use of the happy coincidence that the sine of an angle between the nose of the aircraft and the wind direction (called the relative wind angle) can also be calculated, either as the wind speed multiplied by the sine of the angle between the beam of the aircraft and the wind direction.

To use this “rule” you first determine the relative wind angle, and then multiply the reported wind strength by the appropriate fraction. So, if the reported wind is 350/25 and you are using runway 09, the relative wind angle is 210 degrees and use 0.6 rather than 6/6. This method is a fairly accurate approximation for most wind directions but we can see that there is a significant error at 60 degrees. Because of this some pilots modify the rule for 60 degrees and use 0.5 rather than 0.6, in order to get the error down from 13% to 3%

Let’s look at that more slowly.

All we have to do, at 500 feet on a bumpy day, is to take a quick glance at the wind indicator, and you are going to mentally draw the vector triangle on the face of the DI. The distance from the centre of the DI to the edge represents the wind speed and the centre line is the proportion of the wind speed that is at right angles to your direction; in other words, the crosswind.

To make calculating crosswind components easier, use the aircraft’s Direction Indicator (DI).

**DIRECTION INDICATOR**

To virtually every aircraft there is a Direction Indicator (DI) that looks vaguely like the one shown in Figure 1 and we can use this as a form of analogue computer (those of you who have an older-style ribbon display need despair, I’ll discuss how you can use the same techniques a little later). At first, reading this may sound complicated but believe me, with practice it is very easy.

What we need is a simple technique for accurately estimating the crosswind component, a technique that requires virtually NO brain power for those days when the remaining brain cells have had enough. Something visual and easy that doesn’t require sums or a gadget. And here it is.

**WHAT TO DO AT TAKE-OFF**

When you are at the end of the runway you call “ready for departure” and the tower replies “cleared to land; wind 090, 30 knots”.

Firstly, find the wind strength on your DI. You do this by drawing a circle that represents the wind speed and lines drawn from the centre of the DI to the edge represents the wind speed in units of knots. Then use the centre line to your (for example) 30 knot wind to represent an imaginary 10 knots.

Similarly, the centre line to your 6 knot wind speed strength represents an imaginary 1 knot.

On your 30 knot wind speed strength, draw a line between the centre of your DI and your 6 knot wind speed strength. This line represents the relative wind angle.

Now, if you have a hand calculator, multiply 30 (the wind speed) by 0.5 (the relative wind angle) to get the crosswind component. If you have a hand calculator, multiply 30 by 5/6ths (the relative wind angle) to get the headwind component.

**WHAT TO DO ON FINAL APPROACH**

When you are on the final approach to R27 and the reported wind is 310/25... what is the crosswind component?

Firstly, find the wind strength on your DI. You do this by drawing a circle that represents the wind speed and lines drawn from the centre of the DI to the edge represents the wind speed in units of knots. Then use the centre line to your (for example) 25 knot wind speed strength to represent an imaginary 5 knots.

This time use the centre line to your 5 knot wind speed strength to represent an imaginary 1 knot.

On your 25 knot wind speed strength, draw a line between the centre of your DI and your 5 knot wind speed strength. This line represents the relative wind angle.

Now, if you have a hand calculator, multiply 25 (the wind speed) by 0.5 (the relative wind angle) to get the crosswind component. If you have a hand calculator, multiply 25 by 0.67 (the relative wind angle) to get the headwind component.

**WHAT IS THE CROSSWIND COMPONENT?**

Let’s look at this more slowly.

All we have to do, at 500 feet on a bumpy day, is to take a quick glance at the wind indicator, and you are going to mentally draw the vector triangle on the face of the DI. The distance from the centre of the DI to the edge represents the wind speed and the centre line is the proportion of the wind speed that is at right angles to your direction; in other words, the crosswind.

To make calculating crosswind components easier, use the aircraft’s Direction Indicator (DI).

**REFERENCES**

Dave Sawdon has recently joined the Pilot Coaching Scheme as a Full Coach. He is a freelance Instructor and Examiner for all aspects, including aerobatics, IMC, multi-engine, tailwheel and night training. Most weekends he can be found working at Old Sarum, but he travels or instructing at airfields within the South West region.

He has held a CAA CPL since 1997 and an MEPL in 1996 and has flown about 700 hours as a freelance Instructor or instructing at various airfields within the South West region. Recently joined the Civil Aviation Authority as a CAA Examiner for aerobatics, IMC, multi-engine and a Pilot Examiner for the Civil Aviation Authority and also as a Director Examiner for the Civil Aviation Authority.

**TABLE 1: RULE OF SIXTHS**

<table>
<thead>
<tr>
<th>RELATIVE WIND</th>
<th>RULE OF SIXTHS</th>
<th>SINE OF WIND ANGLE</th>
<th>ERROR</th>
</tr>
</thead>
<tbody>
<tr>
<td>10°</td>
<td>1/6</td>
<td>0.17</td>
<td>1%</td>
</tr>
<tr>
<td>20°</td>
<td>2/6</td>
<td>0.34</td>
<td>1%</td>
</tr>
<tr>
<td>30°</td>
<td>3/6</td>
<td>0.50</td>
<td>0%</td>
</tr>
<tr>
<td>40°</td>
<td>4/6</td>
<td>0.64</td>
<td>2%</td>
</tr>
<tr>
<td>50°</td>
<td>5/6</td>
<td>0.77</td>
<td>7%</td>
</tr>
<tr>
<td>60°</td>
<td>6/6</td>
<td>0.87</td>
<td>13%</td>
</tr>
<tr>
<td>70°</td>
<td>7/6</td>
<td>0.94</td>
<td>6%</td>
</tr>
<tr>
<td>80°</td>
<td>8/6</td>
<td>0.98</td>
<td>2%</td>
</tr>
<tr>
<td>90°</td>
<td>9/6</td>
<td>1.00</td>
<td>0%</td>
</tr>
</tbody>
</table>

**FIGURE 1**

This table shows that the crosswind component is very much underestimated at 60 degrees. This method is a fairly accurate approximation for most wind directions but we can see that there is a significant error at 60 degrees. Because of this some pilots modify the rule for 60 degrees and use 0.5 rather than 0.6, in order to get the error down from 13% to 3%.

To use this “rule” you first determine the relative wind angle, and then multiply the reported wind strength by the appropriate fraction. So, if the reported wind is 300/25 and you are using runway 09, the relative wind angle is 240 degrees and use 0.6 rather than 0.6/6.

**FIGURE 2**

To virtually every aircraft there is a Direction Indicator (DI) that looks vaguely like the one shown in Figure 1 and we can use this as a form of analogue computer (those of you who have an older-style ribbon display need despair, I’ll discuss how you can use the same techniques a little later). At first, reading this may sound complicated but believe me, with practice it is very easy.

What to do at take-off:

1. Find the wind speed on your DI.
2. Draw a line between the centre of your DI and your wind speed strength.
3. Multiply the wind speed by the appropriate fraction (0.5 for 60 degrees).

What to do on final approach:

1. Find the wind speed on your DI.
2. Draw a line between the centre of your DI and your wind speed strength.
3. Multiply the wind speed by the appropriate fraction (0.67 for 60 degrees).
if the wind is 25 knots the radius of the DI represents 25 knots.

Step 1: Find the reported wind direction on the outside of the DI (shown as a large blue arrow). You now have the first piece of information; the wind is from the right.

Step 2: Mentally drop a vertical line down from the wind direction on the outside of the DI to the horizontal centreline.

Step 3: The horizontal centre line represents the crosswind axis so visually scale-off the crosswind component as a proportion of the length of the crosswind axis, i.e. the wind speed. In Figure 3 it looks like the crosswind component is just less than 80% of the total length, say just less 20 knots. Mathematically, the answer is 19kt. With a little bit of practice this is fast, and as accurate as you choose to make it. It also inherently wakes you up to whether the wind is from your left or your right – it’s written on the face of the DI.

HEAD OR TAIL WIND COMPONENT

Once you are comfortable with the technique it can be used to estimate the head or tail wind component in addition to the crosswind.

Look at Figure 4. You are lined up for departure, or on final approach, or simply want to know the wind components on heading 135.

The wind is reported as 180/30. What are the headwind and crosswind components?

You already know how to assess the crosswind component and can estimate that it’s close to 20 knots. We can use the same technique to assess the headwind component.

Just project a horizontal line from the wind direction on the outside of the DI to the vertical centre line (which represents the head or tailwind axis) and visually scale-off the headwind component as a proportion of the length of the headwind axis, i.e. the wind speed. In Figure 4 it looks like the headwind component is about 22 knots (mathematically the answer is 21 knots).

What could be easier?

But what, you might say, if you aren’t lined-up with the runway and want to know the crosswind and head/tailwind components? Maybe you are at the holding point, at dispersal or approaching the airfield. There are two solutions; one is simply to rotate the DI so that the runway heading is at the top, but a better answer is to use the ADF or VOR indicators in exactly the same way as described for the DI. This is also the answer for those with a ribbon DI: use one of the other compass roses.

Possibly you’re flying a very basic aircraft with no compass rose type instruments at all? If you stick or draw a compass rose on your kneeboard you can still use the method. In fact, with a compass rose of any type you are now able to accurately estimate wind components without doing sums. Isn’t that a relief?

PRACTICE IN THE BATH

Use the compass rose in Figure 2 to practice on while you’re in the bath. Turn the DI to represent a turbulent approach into a shortish airstrip with a runway orientation of 345°. The wind is 090/25.

Estimate the crosswind component. Is it inside the demonstrated crosswind capability of your aircraft? Will the headwind component have been reduced sufficiently to give you concerns over the landing distance available? Mind the bubbles!

Even airliners have to consider the crosswind and be able to correct the crab angle for landing.