Takeoff Tools™ Crosswind Calculator Instructions

Suppose you're arriving at, or about to depart from, an airport. You realize you'll need to deal with a crosswind, simply because the wind is not blowing straight down the runway. You'd like to know the strength of the crosswind component. You know which runway you're going to use and the wind direction and speed, so how do you calculate the crosswind?

There are several ways to calculate a crosswind component. If you have an electronic aviation calculator on board, you can use that. You can also purchase a circular, manually operated crosswind calculator. These devices look somewhat like standard (i.e. non-electronic) E-6B flight computers. Many Airplane Flight Manuals (also known as "POHs") also contain crosswind tables or graphs.

The main advantage of the Takeoff Tools Crosswind Calculator is its simplicity. It's a sheet of paper with a grid of numbers printed on it! It's designed to be a permanent resident of your kneeboard. I put mine underneath all the other papers I clip to my kneeboard.

How to Use

You need two pieces of information in order to use the Takeoff Tools Crosswind Calculator:

1. The wind angle (a value you must determine).
2. The wind speed (a value obtained directly from an airport wind report).

A lot of you will be able to figure out how to use the Crosswind Calculator without reading any further. Even so, you should still read the "Calculating Headwind" and "Usage Notes" sections.

Example 1: "Ridgely"

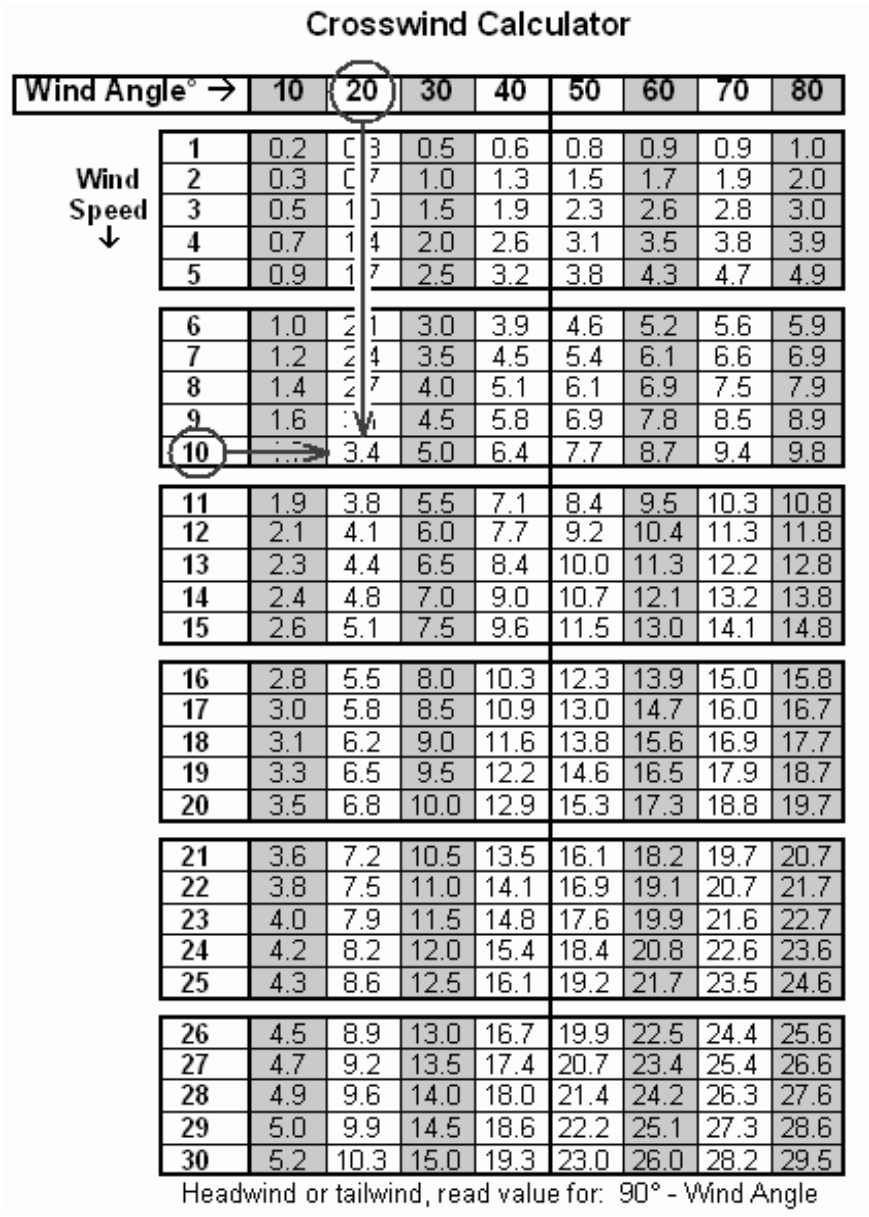
The Ridgely airport has a single runway: 12 - 30. This means it's oriented (mostly) to a magnetic heading of 120 degrees and 300 degrees. Suppose you hear this AWOS transmission:

Ridgely airport. Automated weather observation. One eight three six Zulu.
Weather, ***wind, three two zero at one zero****.*
Visibility one zero.
Sky condition, clear below one two thousand.
Temperature two one Celsius.
Dew point eight.
Altimeter two niner niner seven.

You write this information down (on a Takeoff Tools Airport ATIS form, of course), and decide to use runway 30 since the wind is most closely aligned with it.

Here comes the hard part. Runway 30 is aligned to 300 degrees, and the wind is out of 320 degrees. You must determine the wind angle, which is the difference between the two, or **20 degrees**. Congratulations! You now have the two pieces of information you need to use the crosswind calculator.

First, locate the wind angle value (20) in the top row of the calculator (refer to Figure 1). Next, use your finger to trace straight down that column until you arrive at the row corresponding to the wind speed (10). The number in the box at the intersection is the answer. In this example, the crosswind component is **3.4 knots**. That's all there is to it!



Crosswind Calculator

Wind Angle° →	10	20	30	40	50	60	70	80
1	0.2	0.3	0.5	0.6	0.8	0.9	0.9	1.0
2	0.3	0.7	1.0	1.3	1.5	1.7	1.9	2.0
3	0.5	1.0	1.5	1.9	2.3	2.6	2.8	3.0
4	0.7	1.4	2.0	2.6	3.1	3.5	3.8	3.9
5	0.9	1.7	2.5	3.2	3.8	4.3	4.7	4.9
6	1.0	2.1	3.0	3.9	4.6	5.2	5.6	5.9
7	1.2	2.4	3.5	4.5	5.4	6.1	6.6	6.9
8	1.4	2.7	4.0	5.1	6.1	6.9	7.5	7.9
9	1.6	3.1	4.5	5.8	6.9	7.8	8.5	8.9
10	1.7	3.4	5.0	6.4	7.7	8.7	9.4	9.8
11	1.9	3.8	5.5	7.1	8.4	9.5	10.3	10.8
12	2.1	4.1	6.0	7.7	9.2	10.4	11.3	11.8
13	2.3	4.4	6.5	8.4	10.0	11.3	12.2	12.8
14	2.4	4.8	7.0	9.0	10.7	12.1	13.2	13.8
15	2.6	5.1	7.5	9.6	11.5	13.0	14.1	14.8
16	2.8	5.5	8.0	10.3	12.3	13.9	15.0	15.8
17	3.0	5.8	8.5	10.9	13.0	14.7	16.0	16.7
18	3.1	6.2	9.0	11.6	13.8	15.6	16.9	17.7
19	3.3	6.5	9.5	12.2	14.6	16.5	17.9	18.7
20	3.5	6.8	10.0	12.9	15.3	17.3	18.8	19.7
21	3.6	7.2	10.5	13.5	16.1	18.2	19.7	20.7
22	3.8	7.5	11.0	14.1	16.9	19.1	20.7	21.7
23	4.0	7.9	11.5	14.8	17.6	19.9	21.6	22.7
24	4.2	8.2	12.0	15.4	18.4	20.8	22.6	23.6
25	4.3	8.6	12.5	16.1	19.2	21.7	23.5	24.6
26	4.5	8.9	13.0	16.7	19.9	22.5	24.4	25.6
27	4.7	9.2	13.5	17.4	20.7	23.4	25.4	26.6
28	4.9	9.6	14.0	18.0	21.4	24.2	26.3	27.6
29	5.0	9.9	14.5	18.6	22.2	25.1	27.3	28.6
30	5.2	10.3	15.0	19.3	23.0	26.0	28.2	29.5

Wind Speed ↓

Headwind or tailwind, read value for: 90° - Wind Angle

Figure 1 - Ridgely

Example 2: "Denver Gusts"

Suppose you hear this Denver ATIS transmission:

Denver International Airport arrival information bravo. One seven five three Zulu.
Wind two eight zero at one seven, gust two two. *Visibility one zero.*
Few clouds at eight thousand, one five thousand scattered, ceiling two zero thousand broken.
Temperature two three, dew point minus one. Altimeter two niner eight six.
Expect visual approach runway three four right, runway three five right.
Advise on initial contact you have information bravo.

This problem is a bit more complex, since you might be landing on either of two runways, and the wind is gusting.

First determine the wind angle for each potential runway.

Next, use the calculator to calculate the crosswind component for the worst-case runway (the runway with the largest wind angle). If the crosswind is within your capabilities, it's probably not necessary to calculate the crosswind for the second runway, since it will be less severe.

If the crosswind for the worst-case runway is beyond your capabilities, use the calculator to calculate the crosswind component for the second ("better") runway - it might be acceptable.

The wind angle for runway 34R (the difference between 280 degrees and 340 degrees) is **60 degrees**.
The wind angle for runway 35R (the difference between 280 degrees and 350 degrees) is **70 degrees**.
Runway 35R is the worst-case runway.

Locate the wind angle value (70) in the top row of the calculator (refer to Figure2).
Use your finger to trace straight down that column until you arrive at the row corresponding to the wind speed (17). In this example, the crosswind component is **16 knots**.

Don't forget the wind gust value - it has a crosswind component too! Use your finger to continue tracing down the same column until you arrive at the row corresponding to the wind gust speed (22). In this example, the gust crosswind component is **20.7 knots**.

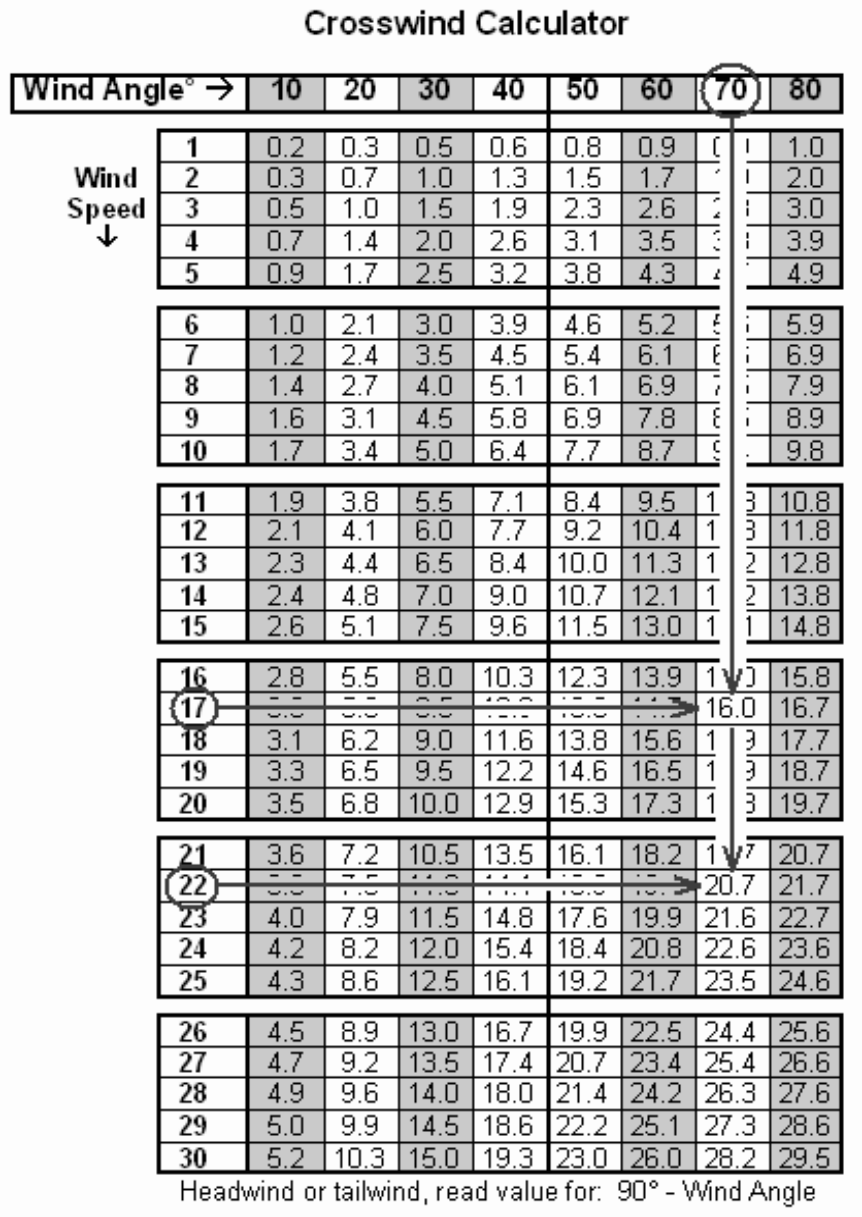


Figure 2 - Denver Gusts

Calculating Headwind

At the very bottom of the Crosswind Calculator is this note:

"Headwind or tailwind, read value for: 90^{O} - Wind Angle"

What exactly does that mean, you ask? It means that with the Takeoff Tools Crosswind Calculator you can calculate the crosswind component, and can also calculate the headwind component!

Let's take another look at Example 1, above. In that example the wind angle was 20 degrees and the wind speed was 10 knots. Those values resulted in a crosswind component of 3.4 knots.

Since the wind is only 20 degrees off of the runway heading, we're dealing with a headwind. To calculate how much of a headwind, subtract the wind angle (20 degrees) from 90 degrees:

$$90^{O} - 20^{O} = 70^{O}$$

Using 70 degrees as the wind angle, trace down until you arrive at the same row (for the same wind speed of 10 knots). The answer? 9.4 knots (refer to Figure 3).

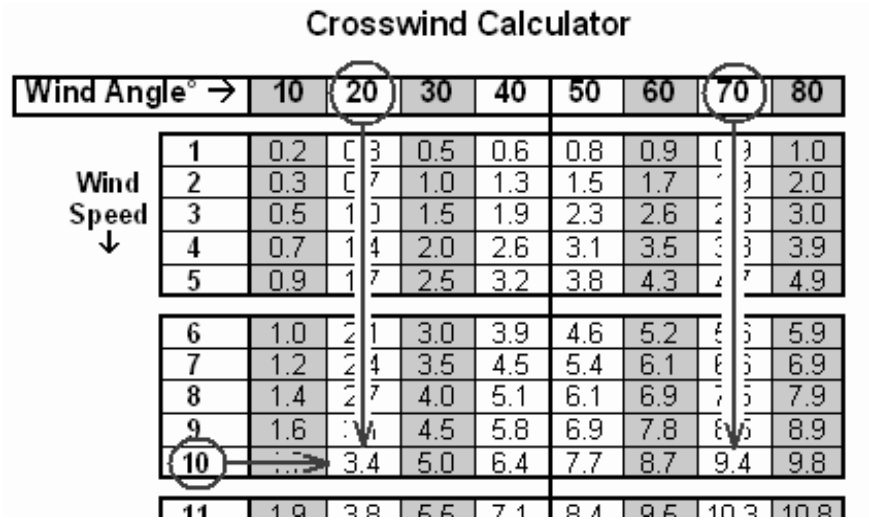


Figure 3 - Calculating Headwind

But wait! There's a much easier way!

Do you see the dark line running from the top to the bottom of the calculator? It's the line between the 40 and 50 degree wind angle columns. It divides the wind angle columns evenly - four on the left, and four on the right.

Also, notice how the 40 and 50 degree columns are not shaded, whereas the 30 and 60 degree columns are shaded. The 20 and 70 degree columns are not shaded, and the 10 and 80 degree columns are shaded.

You guessed it! The column to use to calculate a headwind is on the opposite side of the dark line, and the same distance from the dark line. For example, if you use a wind angle of 10 to calculate the crosswind, use the 80 column to calculate the headwind. Angle of 80 for crosswind? Use the 10 column for the headwind. 20 for crosswind? Use 70 for headwind, and etc.

The opposite columns (10-80, 20-70, 30-60, and 40-50) are also shaded the same way.

What About Wind Angles of 0 Degrees? 90 Degrees?

Why doesn't the Crosswind Calculator have a column for 0 or 90 degrees, you ask? Simple. It doesn't need them.

A wind angle of **0 degrees** means there is **no crosswind** - the wind is blowing straight down the runway. The headwind component is therefore equal to the wind speed.

A wind angle of **90 degrees** means it's **all crosswind** - the wind is blowing directly across the runway. The crosswind component is therefore equal to the wind speed, and there is no headwind.

Calculating Tailwind (gasp!)

Every pilot knows the general rule that if given a choice, always takeoff and land with a headwind. That means using a runway with a wind angle less than or equal to 90 degrees.

But what if that's not possible? There are a few single runway airports with insurmountable obstructions blocking one end, which means you can only takeoff while moving away from the obstruction, or land moving toward it. There are also a few airports with runways having large upward or downward grades (slopes). At those airports it might be better to takeoff downhill, even if it means having a light tailwind. Check the Airplane Flight Manual for your aircraft to determine its performance characteristics.

In these circumstances, you can still use the Takeoff Tools Crosswind Calculator to calculate the crosswind and tailwind components.

Whenever the wind angle is 100 degrees or larger (up to 180 degrees):

- Re-determine the wind angle using the opposite direction runway.
  For example, if you need to use runway 33 and the wind direction is **220 degrees**, the wind angle is 110 degrees. The opposite direction runway is 15. The re-determined wind angle is therefore 70 degrees.
- Use the calculator in the usual way to calculate the crosswind.
- To calculate the tailwind, use the methods described in the "Calculating Headwind" section (above), but understand that your answer is a **tailwind** (not a headwind).
- If the wind angle is **180 degrees**, there is **no crosswind** - the wind is blowing straight down the runway, but **from behind you**. The tailwind component is therefore equal to the wind speed.

What About Miles Per Hour? Meters Per Second?

You'll notice that no wind speed units, such as "knots", are shown on the Calculator. That's because the wind speed can be in the units of your choosing (usually knots). Just remember that whatever units you use for the wind speed, the crosswind and headwind (or tailwind) values you calculate will be in the same units.

For example, a wind angle of 30 degrees, and a wind speed of 15 miles per hour, results in a crosswind component of 7.5 miles per hour.

A wind angle of 30 degrees, and a wind speed of 15 meters per second, results in a crosswind component of 7.5 meters per second.

Visualizing With A Flight Computer

We've all used them at one time or another: the manually operated mechanical flight computer. They look like a circular slide rule on one side, and have a transparent, rotatable plastic disk (the "azimuth circle") on the other side. You can use the plastic disk side, also known as the "wind side", to visualize runway and wind directions, and to help determine wind angles.

In the air:

Find north on your directional gyro. Rotate the azimuth circle of the flight computer until it is 180 degrees opposite from your gyro ("S" on the computer should be oriented the same direction as north on your gyro). When oriented this way, the numbers on the azimuth circle can be thought of as runway thresholds. If you also locate the number corresponding to the wind direction, you can easily determine the wind angle.

On the ground:

Rotate the azimuth circle of the flight computer so that "S" is at the top, and then follow the same procedure.

Flip Side Bonus

On the flip side of the Crosswind Calculator you'll find basic VFR weather minimums from FAR section 91.155. Wow! What a deal!

Usage Notes

- **The values expressed by the Crosswind Calculator are approximate.** Wind speeds vary, as do wind angles. The wind report you hear will usually not exactly match what you experience. Adding to the uncertainty is the fact that runway alignments are not exact. However, the crosswind values you calculate using the Calculator should help keep you from getting "too close to the edge."
- The hardest part of using the Takeoff Tools Crosswind Calculator is determining the wind angle. Wind angles involving wind on one side of north and a runway on the other, are the most difficult to determine. For example, if the wind is 330 at 20, and runway 1 is in use, the wind angle is 40 degrees. If you examine a compass rose you'll see there are 30 degrees between 330 and 360 (or 0) degrees, and 10 degrees between 0 and 10 degrees. 30 plus 10 equals 40 degrees.
- The magnetic orientation of a runway usually dictates its assigned number. For example, Denver's runway 8 is actually oriented to 79.8 degrees. Be aware, however, that airports with several parallel runways will use the "correct" number for some, and then might be forced to use a higher or lower number for others.

  For example, Denver's runways 35L and 35R are oriented to 349.8 degrees. But the two additional parallel runways are named 34L and 34R even though they too are oriented to 349.8 degrees. In situations like this, use the closest actual runway alignment (350 degrees in this example) when making crosswind determinations.