Airspeeds, and airspeed indicators Part I

When I fly with other pilots, I am often a bit surprised by their responses when we talk about airspeeds. Generally, the topic arises when we compare the number on the airspeed indicator with the readout on the GPS groundspeed indicator. Many pilots tell me that the difference between the two is the headwind / tailwind component. Then we start into a discussion about the difference between true airspeed and indicted airspeed, and somewhere in there we talk about calibrated airspeed. So perhaps a review is in order.

Knots
(nautical miles per hour)

Mph
(statute miles per hour)

combo,
with true airspeed calculator

Here are three different airspeed indicators, any of which you might see in your airplane. The first is a basic indicator, reading in knots or nautical miles per hour. The second is nearly the same, but it indicates in mph or statute miles per hour. Remember that the difference is that a statute mile is 5,280 feet long, and a nautical mile is 6,008 long. So if you travel one nautical mile, you have also travelled about 1.14 statute miles. More about why that is significant later.

The third indictor above adds two features to the first two. (Sometimes, you will have an indictor that shows one feature or the other, and sometimes as in this case, you will see both.) The first addition is that the manufacturer has printed two scales on the face. The outer scale is marked in miles per hour, and the inner scale is marked in knots. So, when the needle falls across the 100 knots indicator, it also falls upon the 115 mph scale. (In this case, mph is on the outer ring, knots on the inner ring. Sometimes you will see that reversed.)

To understand the second feature, we need to go back and review the difference between the airspeed which is “indicated” on the dial, and the speed which we are “truly” travelling through the air. Unlike the conversion between knots and mph, there is no easy multiplier. Rather, we need understand that the difference depends on the density and temperature of the air pressing on the opening of the pitot tube. For pilots who attained a license in the last century, the device used to make that conversion was the E-6B computer. For the modern pilot, the device is either the internet or the aux feature on the GPS. Or for the pilot who uses the third indicator shown above, the readout is right there.

Using the outer rotating ring, match the outside air temperature with the altitude. (The purist here is going to tell me to use 29.92 momentarily as an altimeter setting. True, but I contend that it won’t make any difference in the result.) In the case above, an altitude of 8,500’ aligns with 0° C. Moving the black ring around to make that comparison will also move the scale shown in white in the lower left part of the dial. And the needle now points to three airspeed indications – 152 knots indicated, 170 mph indicated, and 202 mph true.

And is the difference between the 202 mph true airspeed and the GPS groundspeed readout the headwind / tail wind component? Well, no.

Let’s digress for a minute and talk about why some manufacturers show their airspeed in knots and some in mph. Early aviators borrowed a lot of practices from their ocean-sailing friends. And the international standard of distance was the nautical mile, which is defined as one minute (or $1/60^{th}$ of a degree) of latitude. This became the international standard even though some countries otherwise measured distances in kilometers or statute miles. And likewise, its velocity component, knots, became the standard of speed. I find that most aircraft manufactured prior to the early 1970 have indicators shown in knots.

Indicators shifted to mph around the early 1970s, and I contend that that is when the marketing department became more involved than the engineering department in selling aircraft. Remember, that for any given speed, the speed will show a higher number in mph than in knots. And nothing shows this better than the Moony 201, which debuted in 1977. Mooney wanted to call attention to its top speed of 201 using a 200 hp engine. And they could not do that if they

were measuring in knots. So, this airplane boasts a top speed of 201MPH. The "Mooney 147" just doesn't have the same zing. Speed Sells!

Going back to the wind question, we need to get everything back into a common measurement. So, convert that 202 mph to knots (approximately 148) and compare that number to the GPS readout to calculate a headwind / tailwind.

What about that calibrated airspeed thing? And how can I compute a true airspeed using my GPS? Good question. For another day.

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