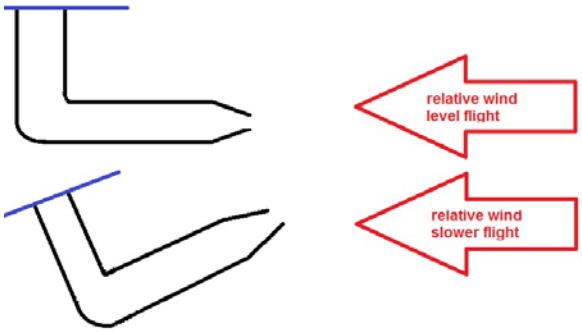
Airspeeds, and airspeed indicators Part II

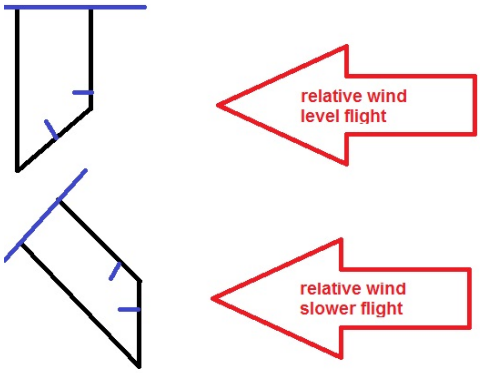
When we talk about airspeeds, there are three different airspeeds that we care about. Actually, that is the first lie. If you fly airplanes at speeds in excess of about .85 Mach and altitudes above about 30,000 ft., there is a fourth airspeed. And if you are flying down in the lower levels at the more sedate airspeeds, you really don't need to know about the third airspeed except for your Private Pilot Exam.

In the first part of this discussion, I spent a good deal of time talking about the difference between indicated airspeed and true airspeed. The other two airspeeds are **calibrated airspeed** and **equivalent airspeed**.

To understand calibrated airspeed, we need to know how airspeed is measured. In a car, this is easy. Just measure how fast the wheels turn, figure out the radius of the tire, and do a bit of math. In airplanes, we don't really know how fast we are moving through the air. But we can measure the pressure at the front of the airplane, and we can deduce that as the pressure increases, airspeed is increasing.



Standard pitot tube



Piper-style pitot mast

So, we compress the air in the pitot tube and its associated plumbing, compare it to the pressure of the non-moving air, hook it to a needle, and spend some time associating air pressure readings to airspeeds. This works great if we are measuring the pressure of the air coming into the tube in a straight line. If the air pressure is acting at an angle, this results in some inaccuracy. And the greater the angle, the greater the discrepancy. Aircraft manufacturers know this, so somewhere in the Pilot's Operating Handbook, they have given us a chart that

shows us the difference between the speed we would be reading if we had a straight pitot tube (calibrated), and what we will actually be reading on the indicator (indicated). Here is an example from a Cessna 172 POH as well as one from a Piper Archer POH

Cessna 172 (flaps up)						
Indicated	40	60	80	100	120	140
Calibrated	49	64	82	99	120	141
Piper Archer (flaps up)						
Indicated	50	70	90	110	130	150
calibrated	53	72	90	108	125	143

Two things worth noting in these two charts. First, at normal cruise speeds, 90 to 110, there is not much difference between calibrated and indicated airspeeds. This is because the manufacturer has positioned the pitot tube in such a way that it is parallel to the airstream at these speeds. However, in the case of the Cessna, as we fly slower, and the angle of attack increases, the discrepancy increases as well. However, this is not so dramatic in Piper aircraft. The Piper folks essentially gave us two sources of pitot pressure, one that works in normal cruise flight, and one that works in slow flight.

Now that we have spent all this time on this subject, why will I tell you that we don't really care in our day-to-day flying? In normal flying, there are three times when we really care about our airspeed – takeoff/climb; cruise; approach/landing.

Starting with cruise flight – at this point, we are most concerned with how fast we can move to spot to spot, so we care about ground speed, which is a factor of the wind and our true airspeed.

In the takeoff and climbout phase, we are concerned with our speed relative to the stall speed, or our best angle of climb, or our best rate of climb. For this phase, the manufacturer has figured out what the calibrated airspeed is, but has furnished us with converted information, and tells us what indicated airspeed to fly to give us the performance we need.

Likewise, in the approach and landing phase, the manufacturer has already made all of the adjustments necessary to allow us to see our performance at the correct indicated airspeed.

So, go fly with the correct indicated airspeed and know that even though the indicator is not really telling the truth, your aeronautical engineer has your back.

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